PROJECT MANUAL

ADVANCED PROTEIN CRYSTALLIZATION FACILITY (APCF)

9700 S. Cass Avenue
Lemont, IL 60439

CONSTRUCTION DOCUMENTS

PROJECT NO.: **22378.000**

ISSUE DATE: **JULY 3, 2012**

ISSUED FOR: **CONSTRUCTION**

VOLUME 1 – DIVISIONS 00 - 08

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SECTION 00 01 07

SEALS PAGE

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GEOTECHNICAL DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications, apply to this Section.

1.2 DESCRIPTION

A. A. Geotechnical investigations were conducted for the Owner in the area where work is to be performed under the Contract and a report of the results prepared. The report is included in the Project Manual.

1.3 USE OF DATA

A. The report of geotechnical investigations was obtained for use in study and design. The report is made available for Bidder's information only and is neither a part of the Contract Documents nor a warranty of subsurface conditions.

B. Bidder shall visit the site and become acquainted with existing conditions. Prior to bidding, Bidder may make its own subsurface investigations to satisfy itself as to site and subsurface conditions, subject to the following stipulations:
   1. Such investigations shall be performed only under time schedules and arrangements approved in advance by the Owner in writing.
   2. The sites of such investigations shall be restored to the respective conditions that existed before such investigations were undertaken.
   3. Bidder shall indemnify and hold harmless the Owner and Architect from and against claims, damages, losses, and expenses attributable to bodily injury or death and to injury to or destruction of tangible property arising out of or resulting from such investigations.

C. Bidder shall assume full responsibility for interpreting the information furnished in the report, for the conclusions drawn from the information furnished, and from its inspection of the site.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

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May 18, 2011

Sent via email (Carolina.lopez@smithgroup.com)

Ms. Carolina Lopez
Smith Group, Inc.
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Subject: Subsurface Exploration and Geotechnical Engineering Report for the Proposed Argonne National Laboratory (ANL) Advanced Protein Crystallization Facility (APCF), DuPage County, Illinois – AECOM Project No. 60215145

Dear Ms. Lopez:

In accordance with your authorization of our proposal dated March 4, 2011, AECOM has completed the subsurface exploration, laboratory testing and geotechnical analysis for the above-referenced project.

Project Description

Based on information that we have been provided in the RFP dated March 1, 2011 and subsequent conversations, we understand that the new APCF located at the ANL will be a state of the art bioscience laboratory with office and support space. APCF is located adjacent to the Advanced Photon Source (APS) at LOM 435. The building will be a 1 to 2-story structure, with an anticipated maximum column load of 63 kips for 1-story and 152 kips for 2-story. The laboratory and office areas are divided by an open corridor with clerestory lighting above. The target gross square footage is 52,700. No basement space is planned. The building is connected to the APS (or Main Ring) by an enclosed pedestrian link. The approximate footprint is 70 feet long and 8 feet wide. The link will be isolated from the APS by an expansion joint.

The structural system for the building will be structural steel with composite steel deck slabs for floor slabs and/or green roofs, and metal deck for non-green roofs. The exterior façade will include metal panel, architectural precast concrete, architectural cast in place concrete, and curtain wall. The ground floor is anticipated to be a slab on grade at elevation 744, similar to that of APS.

In addition to the new structure, there are site improvements planned including a new surface parking, detention basin, and drainage swale. No depths were provided for the detention basin or drainage swale.

The purposes of this report are to describe the soil and groundwater conditions at the project site, analyze and evaluate the geotechnical data obtained from the previous and current subsurface explorations, and provide recommendations regarding the design and construction of foundations and appurtenant structures as they pertain to the proposed structure.

Scope of Services

The subsurface exploration program included advancing seventeen (17) boreholes, B-1 through B-15, B-18, and B-19 at the site. Two initially planned Borings B-16 and B-17 were cancelled due to the inaccessibility of the drilling rig at the boring locations. Boring depths typically ranged between 10 to 25 feet below the ground surface (bgs). However, Boring B-18 located north of proposed building extended to a depth of 41.5 feet below grade. Boreholes were advanced with continuous flight power augers and a tri-cone roller bit. Boreholes were performed with a D-50 drill rig by Strata Earth Services, LLC (Strata) under subcontract to AECOM.

Representative soil samples were obtained by means of a split-barrel sampling device in general accordance with ASTM Specification D 1586. In general, samples were collected at 2.5 foot intervals in the upper 15 feet of the borings and at 5 foot intervals thereafter. All samples were immediately sealed in the field and brought to our Vernon Hills laboratory for further examination and testing. Boreholes were grouted with a cement-bentonite mixture and patched with asphalt upon completion.
Elevations and Northing and Easting coordinates of soil boring locations used on boring logs and the report were provided to AECOM by Terra Engineering.

Laboratory Testing

Laboratory testing was completed to further classify and confirm field sample descriptions. The laboratory testing program included visual and textural observations, determining natural water content and estimating unconfined compression strength from representative samples. Unconfined compression strength estimates were obtained using a calibrated hand penetrometer on cohesive samples. Laboratory testing results are included on the soil boring logs in the attachments.

Samples were visually classified on the basis of texture and plasticity in accordance with the AECOM soil classification system, a derivative of the Unified Soil Classification System (USCS). The estimated appropriate group symbol according to the USCS system is included on the soil boring logs. A description of the Field and Laboratory Procedures, Standard Boring Log Procedures and AECOM Soil Classification System is provided in the attachments.

Subsurface Exploration Results

Subsurface Conditions

Building Borings (B-1 through B-9)

The subsurface conditions encountered in the borings varied slightly between each borehole. The subsurface conditions encountered in the borings were consistent with our previous borings performed for APS project. In general, approximately 12 to 18 inches of topsoil was encountered at the ground surface in 5 of the Borings B-1 through B-5. In Borings B-8 and B-9, approximately 8 to 10 inches of crushed stone/gravel mixed with little clay was encountered at the ground surface. Below the topsoil/crushed stone in Borings B-1 through B-5 and B-8 and at the ground surface in Borings B-6 and B-7, fill mostly consisting of brown and/or black silty clay was encountered to depths ranging between 2 and 6.5 feet below the ground surface (elevation between about 744 and 737 feet). In two of the Borings B-6 and B-9, buried topsoil was encountered below the fill material and extended to a depth of about 2 to 4 feet below grade. Below the fill/buried topsoil in borings, natural medium to hard, typically very stiff to hard brown to gray silty clay was encountered extending to the maximum explored depth of about 25 feet below grade, with a few intermediate layers of granular soils. The medium consistency brown silty clay was encountered in Boring B-2 at depths between 5 and 6.5 feet below grade. In Boring B-2, brown silty sand was encountered at depths between 6.5 and 9.5 feet below grade; in Boring B-5, sand and gravel was encountered at depths between 20 and 22 feet below grade; and in Boring B-6, clayey sand was encountered at depths between 22 and 25 feet below grade.

Pavement/Detention Pond Borings (B-10 through B-15)

The subsurface conditions encountered in the borings varied slightly between each borehole. In Borings, B-11, 14 to 18 inches of gravel/sand and gravel was encountered at the ground surface. In Boring B-15, approximately 6 inches of topsoil was encountered at the ground surface. In Borings B-10 through B-14, fill material mainly consisting of brown and black silty clay was encountered to depths ranging between 1.5 and 4 feet below the ground surface (elevation between about 742 and 739 feet). No fill was observed in Boring B-15 below the topsoil. Below the fill/topsoil in borings, natural very stiff to hard brown to gray silty clay was encountered extending to the explored depth of about 10 feet below grade.

The above-described soil conditions represent typical descriptions of conditions encountered during the exploration. Slight variations in the soil conditions may exist at the site depending on location. The specific soil conditions encountered at each boring location are indicated on the individual boring logs. It should be noted that the stratification lines on the soil boring logs were based on drilling notes, visual observations and laboratory testing. Therefore stratification lines on the boring logs are in some cases estimated; in situ, transitions between soil types may be gradual and may vary.

Other Site Borings (B-18 and B-19)

As requested by Smith Group, Inc., we have included boring logs for these borings in the report. We understand no structure is currently planned in the vicinity of these borings; therefore, no discussions and analysis are provided based on these borings.

Groundwater Conditions

Groundwater level readings were made in the soil borings during and upon completion of the drilling operations. The readings obtained are indicated on their respective boring logs. Groundwater was first encountered in Borings B-2, B-6 through B-9, and B-11 at depths between 1.5 and 16.5 feet. The groundwater encountered in Boring B-11 at a depth of about 1.5 feet may be a perched water condition.

Groundwater levels are likely to vary over the course of the year and seasonal fluctuations in the groundwater level should be expected depending upon variations in precipitation, evaporation and surface run-off. Due to this and based on depth of color change from brown to gray, we recommend a design groundwater level of 8 to 10 feet bgs, or elevation about 737 to 735 feet.

Analysis and Recommendations

Shallow Foundations

Based on the anticipated loading described above and the soil encountered in the soil borings performed at the project site, we recommend that a shallow footing foundation system be utilized to support the proposed building and the pedestrian bridge. These footings may be situated on the natural brown, very stiff to hard silty clay encountered below the fill, topsoil, soft natural clay soils, and any otherwise unsuitable soils. This layer was first encountered at depths ranging from 2 to 6.5 feet below the ground surface (elevations 736 to 742 feet).

If new fill is used to replace unsuitable soils or to raise footing elevations, we recommend that a well-graded granular material such as IDOT Grade CA-6 be used to refill undercuts. All fill used to achieve the final foundation grades should be an approved material which is free of organic matter and debris. The fill should extend beyond each edge of the footings horizontally one foot for each foot of new fill required below the footing. The fill should be placed in 9 inch maximum loose lifts and compacted to a minimum of 95% of the modified Proctor (ASTM D-1557) maximum dry density. Lean concrete could also be used for fill below foundations for which no lateral fill extension would be required.

Shallow footings bearing in the very stiff to hard, native brown and gray silty clay material or properly compacted granular material such as IDOT Grade CA-6 can be designed for a net allowable soil bearing pressure of 4,000 pounds per square foot (psf). This allowable pressure may be increased by 1/3 for load combinations including intermittent wind loads where allowed by code. The allowable net soil bearing pressure refers to that pressure which can be transmitted to the ground in excess of the minimum final surrounding overburden pressure. A representative from AECOM should be onsite to observe the bearing stratum is similar to material encountered at that depth during the subsurface exploration.

The shallowest depths of natural soils suitable for a net allowable soil bearing pressure of 4,000 psf encountered in the building borings are as shown below.

Boring No.	Shallowest Depth of Soils with 4,000 psf Bearing Capacity (Ft.)
B-1	4
B-2	6.5
B-3	5
B-4	6.5
B-5	5
B-6	4
B-7	2.5
B-8	2.5
B-9	2

Settlement of the shallow footings bearing on the native stiff to very stiff silty clay is anticipated to be less than 1 inch, and differential settlement due to varying column loads and subsurface conditions can be estimated as being up to ¾ of the total settlement.

To provide adequate frost protection, we recommend that all footing foundations in non-heated areas be situated at a minimum depth of 4 feet below final outside grade while the perimeter footings in heated areas should be situated at a minimum depth of 3.5 feet below final outside grade. Also, in order to avoid disproportionately small footing sizes, we recommend that continuous footings have a minimum width of 1.5 feet and that isolated column footings have a minimum lateral dimension of 2.5 feet.

If higher lateral resistance is required due to the anticipated wind load, the footings with a grade beam system can be designed and footings can be placed at lower depths on suitable soils. We recommend that the passive pressure should be neglected within the frost depth. Below the frost depth, a passive pressure coefficient, Kp of 3.0 can be used. Assuming granular fill will be used on the exterior with a unit weight of 125 pcf, an equivalent passive fluid pressure of 375 psf/ft can be used. We recommend a factor of safety of 3 should be applied to this passive pressure calculated as shown above.

For the design of the wall footings the estimated coefficient of friction provided at the base of footings is estimated at 0.35 and 0.4against the hard to very stiff brown and gray natural silty clay and granular fill material, respectively. These values incorporate a factor of safety approximately equal to 1.5.

A modulus of vertical subgrade reaction, k_V of 150 pounds per cubic inch (pci) can be used to design the spread footings supported on suitable natural soils or granular fill material as discussed herein.

A modulus of horizontal subgrade reaction, k_H of 50 pounds per cubic inch (pci) can be used for the lateral design of the foundation wall with granular backfill.

We recommend that a well graded granular material such as IDOT Grade CA-6 be used to backfill around walls and foundations. The backfill should be placed in maximum 6-inch lifts since hand operated compaction equipment will be used. The fill should be compacted to 90% of the ASTM D-1557 maximum dry density.

Subgrade Preparation

For pavements or floor slabs, all existing topsoil, vegetation, buried topsoil, should be removed before site grading commences. As mentioned earlier, fill material was encountered in borings to a depth of 1.5 to 6.5 feet below grade. After stripping the topsoil/buried topsoil, at least 1 foot of fill material should be disked and recompacted. Upon reaching the proposed subgrade elevation or prior to the placement of fill, we recommend that the stripped surface be observed and proofrolled in the presence of an AECOM representative. For those areas where visibly objectionable materials are present or proofrolling indicates significant deflections and instability of the soil exposed at the stripped surface, we recommend the area be removed and replaced with granular fill and recompacted. Proofrolling of the subgrade may be accomplished with a fully loaded tandem axle dump truck with at least 25 tons gross weight driven over

the area under the observation of an experienced soil engineer. Two passes of the proofrolling vehicle in perpendicular directions across the slab-on-grade or pavement subgrade are recommended. Areas of excessive rutting or deflection observed during the proofrolling operation should then be removed and replaced with a properly compacted backfill. We recommend that overexcavation of soft areas be limited to a depth of three (3) feet below the proposed slab subgrade.

On-site fill should be visually observed during excavation. Imported fill should consist of Illinois Department of Transportation (IDOT) Grade CA-6, crushed stone or crushed concrete which is free of organic matter, topsoil and debris. Fill should be placed in maximum 9 inch loose lifts and compacted to a minimum of 90% its maximum dry density obtained in accordance with ASTM Standard D-1557, modified Proctor method. Where slab areas will support loads in excess of 500 psf, heavy concentrated loads or masonry partition walls, the fill should be compacted to a minimum of 95% of the dry density referenced above. Moisture contents should be maintained within ±2 percent of optimum.

Slab on Grade

Beneath slab-on-grade areas, a minimum of 6 inches of free draining, granular base course material with less than 3 percent passing the No. 200 sieve is recommended to facilitate fine grading and provide a capillary cutoff. A moisture vapor barrier may also be needed depending on floor coverings and use of the interior space.

Floor slabs should be isolated from foundations to permit relative displacement without cracking. Slabs should also be provided with adequate reinforcing and jointing to control minor slab cracking. American Concrete Institute (ACI) recommendations should be followed for specifics regarding the placement of joints in slabs on grade and for the use and construction of moisture vapor barriers. A modulus of subgrade reaction, k of 100 pounds per cubic inch (pci) can be used to design the slab on grade for the subgrade prepared as discussed herein.

Pavement

We recommend that the project pavements be designed on the basis of an Illinois Bearing Ratio (IBR) of 2.0, for a properly compacted and prepared clayey subgrade. We would be pleased to be of further assistance in the design of project pavements if furnished with information regarding loading, usage, frequency of load application and desired design period.

We recommend that suitable drainage of the pavement and base course be provided. Around storm inlets or catch basins, it may be appropriate to utilize subsurface finger drains to allow any water to drain out of the base course which may otherwise collect in low areas.

Retaining Walls

Permanent below grade retaining walls should be designed for all appropriate lateral earth pressures, hydrostatic and surcharge loads (see below). In addition to the surcharge loads, the retaining wall system should be designed for a linearly increasing equivalent fluid pressure of 50 psf/ft above the drainage tile located at the base of the wall.

Rigid retaining walls can be designed for the 50 psf/ft pressure provided an adequate drainage system is in place to direct groundwater flow towards the base drainage tile and not against the wall.

The recommended drainage system behind the permanent retaining wall should consist of a perforated, open-joint or porous drain tile running parallel to the wall for the entire length. The drain line should be located at an elevation near the bearing level and be surrounded with a minimum of 6 inches of free-draining backfill material (less than 2 percent by weight passing the No. 200 sieve) which will act as filter against the surrounding native soils. The drain tile should outlet to the sewer to remove the collected water. The zone behind the permanent retaining wall should be backfilled with pervious well graded granular material such as clean sand or IDOT Grade CA-7 crushed concrete or stone to facilitate movement of water to the drain line. The pervious well graded granular material should extend laterally

behind the wall a minimum distance equal to the width of the wall foundation. The top of the wall backfill should be capped with a minimum of 2 feet of clay or a surface pavement to minimize surface water infiltration and be sloped away from the wall.

For the design of the retaining wall footings the estimated coefficient of friction provided at the base of footings is estimated at 0.35 and 0.4 against the hard to very stiff brown and gray natural silty clay material and granular fill material, respectively. This value incorporates a factor of safety approximately equal to 1.5.

Any surcharge loads or pressures, applied to the area that projects upward from the base of the permanent retaining wall on a 45 degree angle (using a lateral earth pressure coefficient of 0.4), should be included as additional lateral pressures on the retention systems. A licensed Structural Engineer, registered in the State of Illinois, should be retained to design the lateral earth support systems.

Seismic Site Classification

Based on International Building Code (IBC) 2009, Table 1613.5.2, the average undrained shear strength of cohesive soil layers encountered in our previous deep APS borings indicates that the site meets the definition of Site Class C.

Detention Pond

We understand that two detention ponds are planned to be located near the south end of the property. Borings in this area include B-12 and B-15. The bottom of the pond is planned to be approximately 5 feet below existing ground surface. The construction of the detention ponds will entail excavating primarily silty clay soils. This soil tends to be relatively susceptible to moisture and disturbance.

Based on the color change of natural soils observed in the borings, the long-term groundwater depth appears to be approximately 8 feet below the ground surface (Elev. 733). No long term ground water measurements were obtained.

If moisture infiltration is encountered during pond excavations, after heavy equipment traffic the soils exposed in the base of excavation may begin to show signs of instability. Heavy equipment traffic should be limited in these areas and any standing water removed from the area.

We recommend that long-term slopes of the ponds for this site be a minimum of 3 Horizontal to 1 Vertical. To maintain the design water level, we recommend that a clay liner be placed in the area of the pond. For the pond we recommend that a minimum 2 foot thick clay liner be installed. It should be compacted in loose lifts not exceeding 9 inches in thickness and be benched into the excavated bank. The material should be compacted to 90 percent of the maximum dry density determined by the standard Proctor method (ASTM D-698). This material should be placed on the wet side of optimum moisture content.

Construction Considerations

Some minor problems including accumulation of seepage or runoff water at the base of the foundation excavations may occur during construction. All such accumulations should be promptly removed utilizing typical sump pit and pump procedures. In addition, all soils which become softened or loosened at the base of the foundation excavations, or excavations which are to receive compacted structural fill or base course materials should be carefully removed down to an approved, undisturbed soil surface prior to the placement of these fills or foundation concrete.

No structural fill or foundation concrete should be placed into excavations which contain water, ice or frozen soil. If winter construction is anticipated, exposed soils at the base of the excavation should be protected from freezing.

We anticipate that excavation sideslopes above the water table will likely remain stable at slopes of 1.5H:1V for short periods of time. Excavation sideslopes remaining open for extended periods, or those extending below the water table, may require flatter sideslopes. Regardless, all excavations should be performed in accordance with pertinent local, state, federal, and OSHA regulations. Excavation safety is the responsibility of the contractor.

Care should be exercised where new excavations encroach upon existing foundations or other structural elements to prevent loss of support or undermining. In situations where this occurs, underpinning and/or earth retention structures may be required.

Excavated fill and soil should be environmentally tested to determine its physical and chemical characteristics if the material is to be disposed off site.

General Qualifications

General Qualifications applicable to subsurface exploration are attached and are an integral part of this report. This report has been prepared in accordance with generally accepted soil and foundation engineering practices to aid in the evaluation of this property and to assist the owner and the architect and/or engineer in the design of this project. No other warranty, expressed or implied, is made. The scope of this report is limited to the specific project and location described, and our description of the project represents our understanding of the significant aspects relevant to soil and foundation characteristics.

If this report is submitted as the Geotechnical Engineering Report of Record for permitting the project, AECOM should be retained to observe and verify that the foundation bearing strata are consistent with the findings of this report. Without this oversight and special testing, we cannot be responsible for misinterpretations of our data, our analyses, and/or our recommendations, or how these items are incorporated into the final design.

We appreciate this opportunity to be of service to you. If there are any questions with regard to the information contained in this report, or if we may be of further assistance, please contact us.

Respectfully,

AECOM Technical Services, Inc.

Kiran Adhikary /RCK

Kiran Adhikary, P.E., LEED AP
Senior Project Engineer

Ted D. Bushell

Ted D. Bushell, P.E.
Principal Engineer

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Attachments:

- General Qualifications
- Soil Boring Location Diagram
- Soil Boring Logs
- General Notes
- AECOM Soil Classification System
- Field and Laboratory Procedures
- Standard Boring Log Procedures

AECOM

AECOM General Qualifications

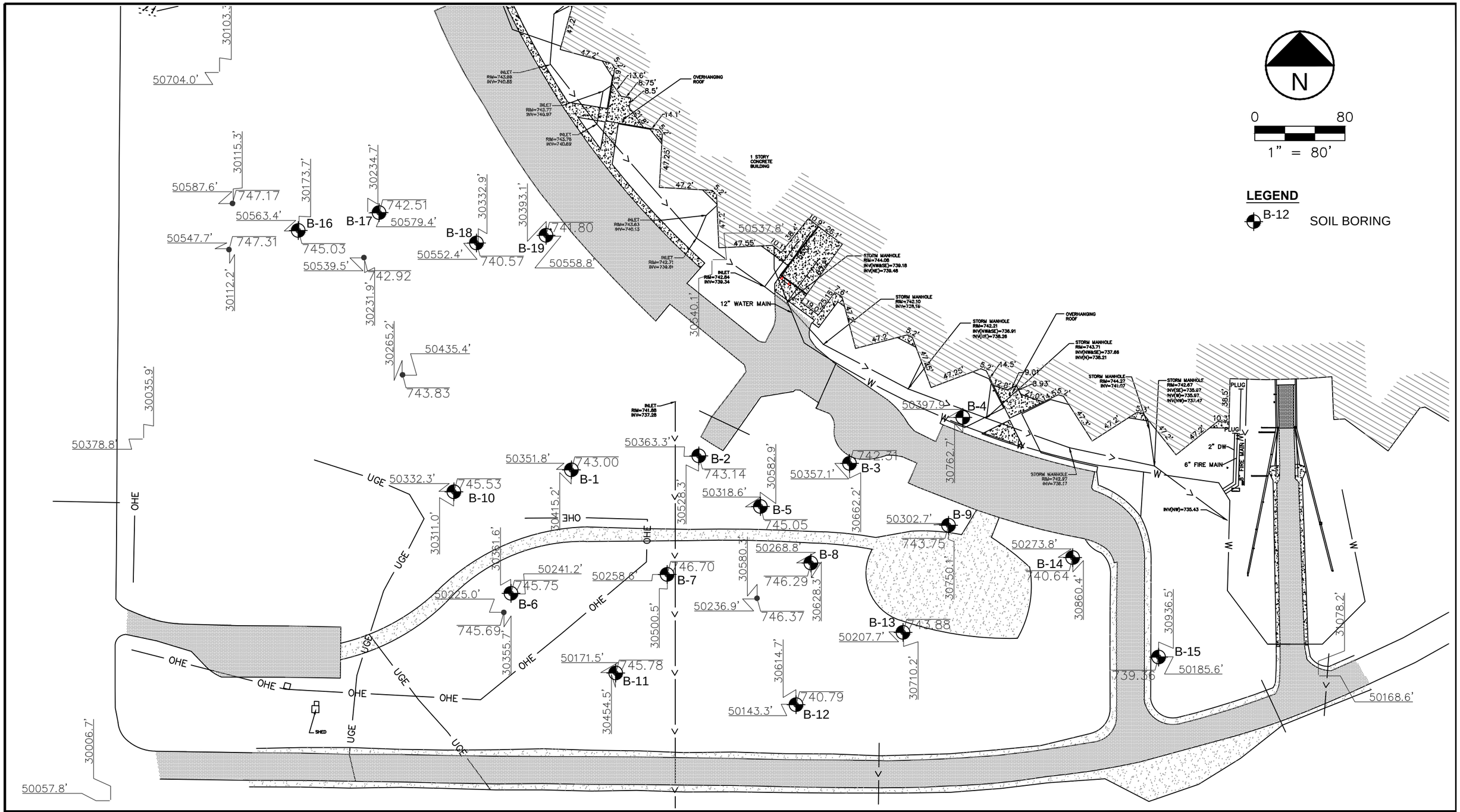
Underground Engineering

This report has been prepared in general accordance with normally accepted geotechnical engineering practices to aid in the evaluation of this site and to assist our Client in the design of this project. We have prepared this report for the purpose intended by our Client, and reliance on its contents by anyone other than our Client is done at the sole risk of the user. No other warranty, either expressed or implied, is made. The scope is limited to the specific project and location described herein, and our description of the project represents our understanding of the significant aspects relevant to the geotechnical characteristics. In the event that any changes in the design or location of the facilities as outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified as necessary in writing by the geotechnical engineer. As a check, we recommend that we be authorized to review the project plans and specifications to confirm that the recommendations contained in this report have been interpreted in accordance with our intent. Without this review, we will not be responsible for the misinterpretation of our data, our analysis, and/or our recommendations, nor how these are incorporated into the final design.

The analysis and recommendations submitted in this report are based on the data obtained from the soil borings performed at the locations indicated on the location diagram and from the information discussed in this report. This report does not reflect any variations which may occur between the borings. In the performance of subsurface explorations, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil and rock conditions exist on most sites between boring locations and that seasonal and annual fluctuations in groundwater levels will likely occur. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations contained in this report after performing on-site observations during the construction period and noting the characteristics of the variations.

The geotechnical engineer of record is the professional engineer who authored the geotechnical report. It is recommended that all construction operations dealing with earthwork and foundations be observed by the geotechnical engineer of record or the geotechnical engineer's appointed representative to confirm that the design requirements are fulfilled in the actual construction. For some projects, this may be required by the governing building code.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria, viruses, and the byproducts of such organisms) assessment of the site, or identification of or prevention of pollutants, hazardous materials or conditions. Other studies beyond the scope of this project would be required to evaluate the potential of such contamination or pollution.



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SOIL BORING LOCATION DIAGRAM
ARGONNE NATIONAL LABORATORY - APCF
SMITH GROUP, INC.
35 E. WACKER DRIVE, SUITE 2200
CHICAGO, ILLINOIS

Drawn :	KLC	05/03/2011
Checked:	KA	05/03/2011
Approved:	KA	05/03/2011
PROJECT NUMBER	60215145	
FIGURE NUMBER	FIG. 1	

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-1**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

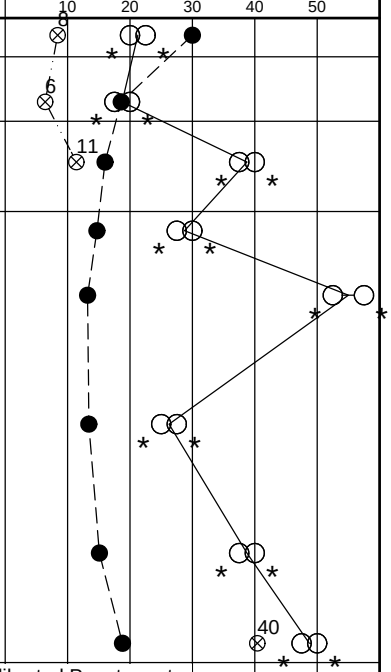
SURFACE ELEVATION +743.0 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			Topsoil	
			PA				
		2	SS			FILL: Silty clay - little topsoil - trace gravel and sand - brown and black - stiff to very stiff (FILL)	
5.0			PA			Silty clay - trace gravel and sand - very stiff to hard (CL)	
		3	SS				
			PA				
		4	ST			Silty clay - trace gravel and sand - gray - very stiff to hard (CL)	
10.0			PA				
		5	ST				
			PA				
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
25.0		8	SS				

1.5 — 4.0 — 7.5 — 25.0

End of Boring
Backfilled
Automatic Hammer

* Calibrated Penetrometer



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

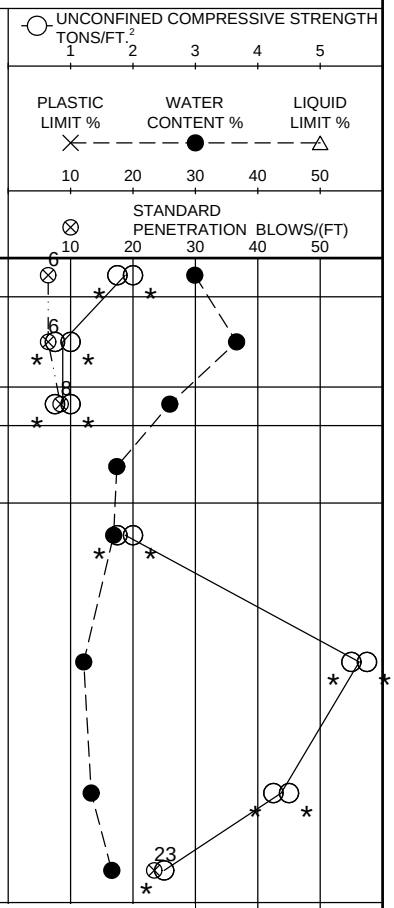
NORTHING **30415.2**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50351.7**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-2**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

SURFACE ELEVATION +743.1 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			Topsoil (1.5)	
			PA			FILL: Silty clay - trace gravel sand and topsoil - brown and black - stiff (FILL)	
		2	SS				
5.0			PA			(5.0)	
		3	SS			Silty clay - trace gravel and sand - brown - medium to stiff (CL) (6.5)	
			PA			Silty sand - trace gravel - gray (SM)	
		4	ST			(9.5)	
10.0			PA			Silty clay - trace sand and gravel - gray - very stiff to hard (CL)	
		5	ST				
			PA				
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
25.0		8	SS			(25.0)	



End of Boring
Backfilled
Automatic Hammer

* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30528.4**	BORING STARTED **4/19/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50363.3**	BORING COMPLETED **4/19/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **7.5 WD**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-3**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

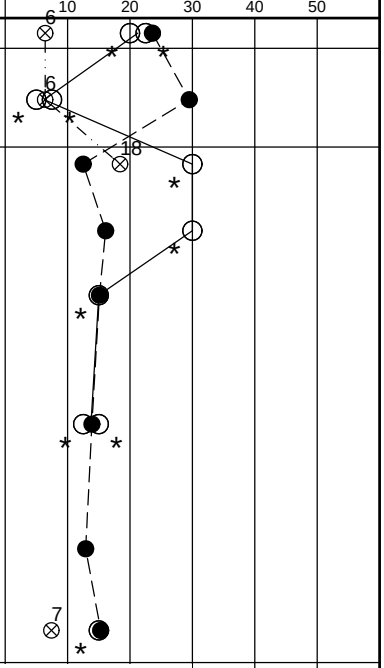
SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +742.3 Feet	
		1	SS			1.2 Topsoil	
			PA			FILL: Silty clay - trace gravel and sand - brown and black - medium (FILL)	
		2	SS				
5.0			PA			5.0	
		3	SS			Silty clay - trace gravel and sand - gray - stiff to very stiff (CL)	
			PA				
		4	ST				
10.0			PA				
		5	ST				
			PA				
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
25.0		8	SS			25.0	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30662.3**	BORING STARTED **4/19/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50357.1**	BORING COMPLETED **4/19/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-4**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

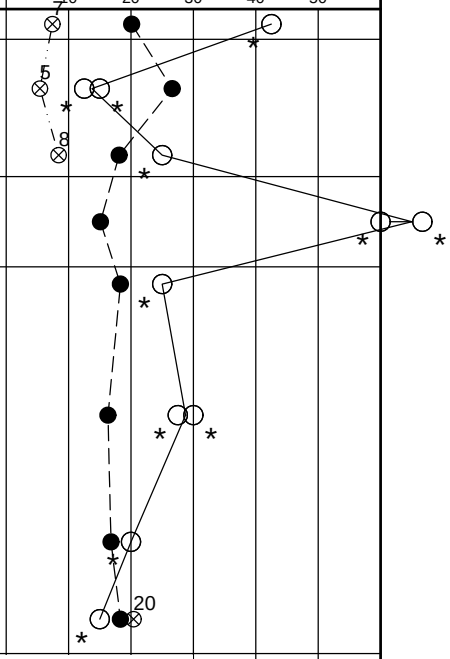
SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +743.6 Feet	
		1	SS			1.2 Topsoil	
			PA			FILL: Silty clay - trace gravel and sand - brown - stiff to very stiff (FILL)	
		2	SS				
5.0			PA				
		3	SS			6.5	
			PA			Silty clay - trace gravel and sand - brown - hard (CL)	
		4	ST				
10.0			PA			10.0	
		5	ST			Silty clay - little gravel and sand - gray - very stiff to stiff (CL)	
			PA				
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
		8	SS				
25.0						25.0	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

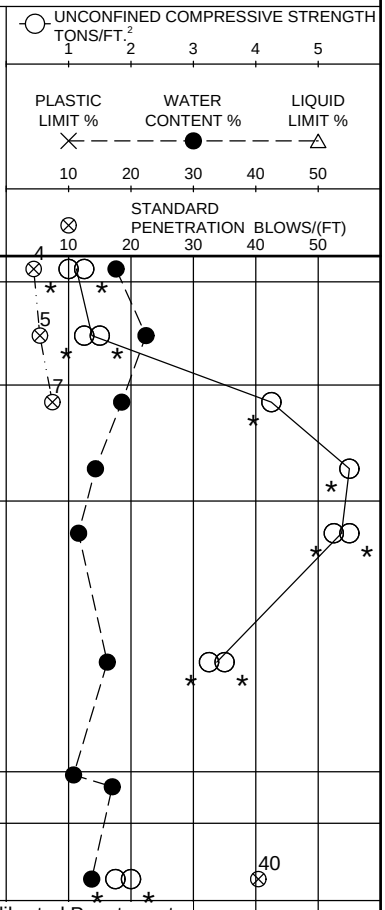
NORTHING **30762.7**	BORING STARTED **4/19/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50397.9**	BORING COMPLETED **4/19/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-5**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

SURFACE ELEVATION +745.1 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			1.0 Topsoil	
			PA			FILL: Silty clay - trace gravel and sand - brown and black - stiff to very stiff (FILL)	
		2	SS				
5.0			PA			5.0	
		3	SS			Silty clay - trace gravel and sand - brown - hard (CL)	
			PA				
		4	ST			9.5	
10.0			PA			Silty clay - trace gravel and sand - gray - hard to very stiff (CL)	
		5	ST				
			PA				
15.0							
		6	ST				
			PA				
20.0		7	ST			20.0	
		7A	ST			Sand and gravel - gray (SP-GP) 22.0	
			PA			Silty clay - trace gravel and sand - gray - very stiff (CL)	
25.0		8	SS			25.0	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30583**	BORING STARTED **4/20/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50318.6**	BORING COMPLETED **4/20/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-6**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

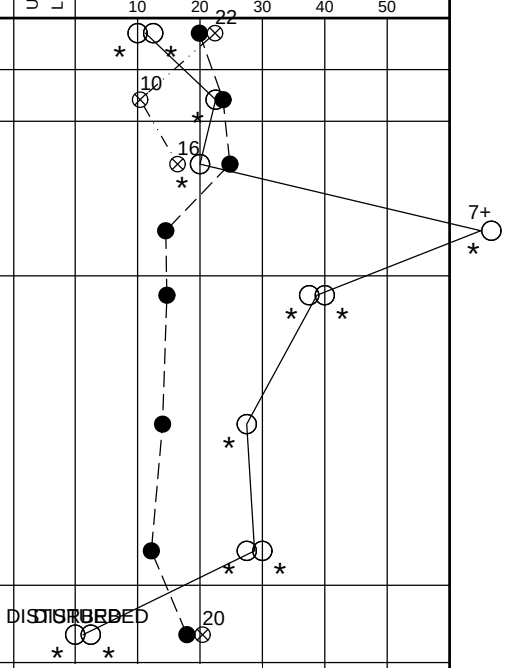
UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

SURFACE ELEVATION +745.8 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			FILL: Silty clay - trace gravel and sand - brown - stiff (FILL)	
			PA				
		2	SS			Buried topsoil - black (OL)	
5.0			PA			Silty clay - trace gravel and sand - brown - very stiff to hard (CL)	
		3	SS				
			PA				
		4	ST				
10.0			PA				
		5	ST			Silty clay - trace gravel and sand - gray - very stiff (CL)	
			PA				
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA			Clayey sand - little gravel - gray - medium dense (SC)	
25.0		8	SS				

2.0 — 4.0 — 10.0 — 22.0 — 25.0

End of Boring
Backfilled
Automatic Hammer



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30361.6**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50241.2**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **18.0 WD**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-7**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

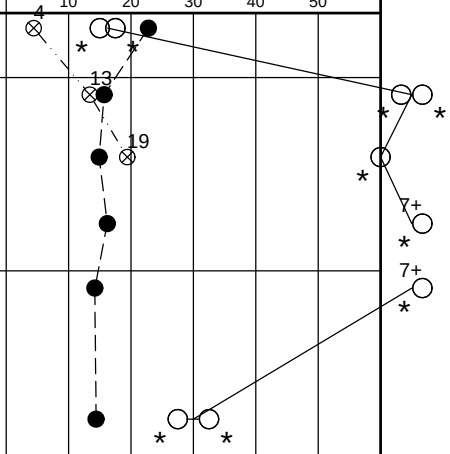
UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

SURFACE ELEVATION +746.7 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			FILL: Silty clay - trace gravel and sand - brown - stiff (FILL)	
			PA				
	2.5	2	SS			Silty clay - trace gravel and sand - brown - hard (CL)	
5.0			PA				
		3	SS				
			PA				
		4	ST				
10.0			PA				
	10.0	5	ST			Silty clay - trace gravel and sand - gray - hard to very stiff (CL)	
			PA				
15.0		6	ST				
			PA				
19.1	19.1	7	SS			Auger refusal at 19.1' (Possible boulder) End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

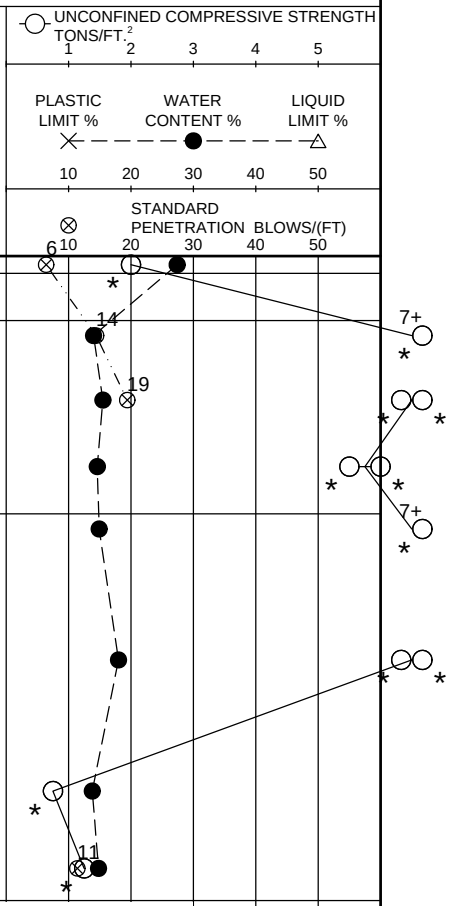
NORTHING **30500.5**	BORING STARTED **4/20/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50258.5**	BORING COMPLETED **4/20/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **16.0 WD**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-8**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

SURFACE ELEVATION +746.3 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			0.7 Crushed stone	
			PA			FILL: Silty clay - trace gravel and sand - brown - very stiff (FILL) 2.5	
		2	SS			Silty clay - trace gravel and sand - brown - hard (CL)	
5.0			PA				
		3	SS				
			PA				
		4	ST				
10.0			PA			10.0	
		5	ST			Silty clay - trace gravel and sand - gray - hard to stiff (CL)	
			PA			Sand seam @ 12'	
15.0							
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
		8	SS				
25.0						25.0	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

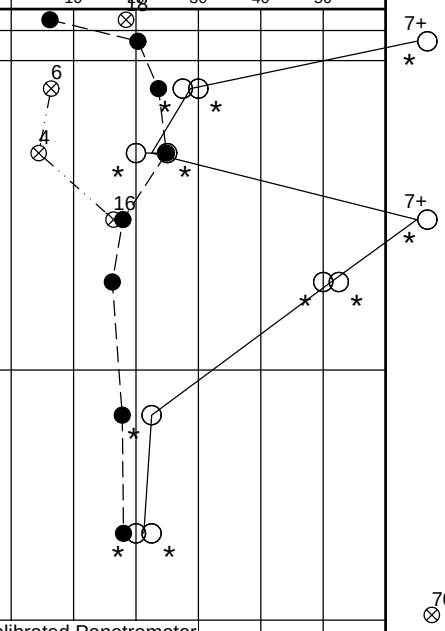
NORTHING **30628.3**	BORING STARTED **4/20/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50268.8**	BORING COMPLETED **4/20/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **16.5 WS**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-9**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +743.2 Feet	
		1	SS			0.8 Gravel	
		1A	SS			2.0 Buried topsoil - black (OL)	
			PA			Silty clay - trace gravel and sand - brown - very stiff to hard (CL)	
		2	SS				
5.0			PA				
		3	SS				
			PA				
		4	ST				
10.0			PA				
		5	ST				
			PA			14.0	
15.0						Silty clay - trace gravel and sand - gray - very stiff (CL)	
		6	ST				
			PA				
20.0							
		7	ST				
			PA				
23.7		8	SS			23.7	
						Auger refusal at 23.7' (Possible boulder) End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30750.1**	BORING STARTED **4/20/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50302.8**	BORING COMPLETED **4/20/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **10.0 WS**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-10**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

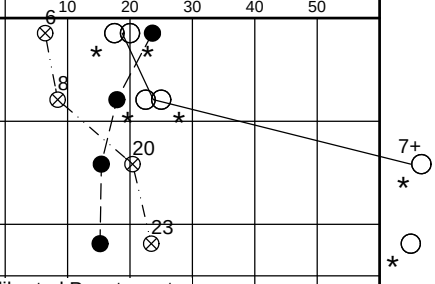
UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

SURFACE ELEVATION +745.5 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			FILL: Silty clay - trace gravel and sand - brown and black - very stiff (FILL)	
			PA				
		2	SS				
	4.0						
5.0			PA			Silty clay - trace gravel and sand - brown - hard (CL)	
		3	SS				
			PA				
	8.0						
		4	SS			Silty clay - trace gravel and sand - gray - hard (CL)	
10.0	10.0						
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30311**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50332.4**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-11**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

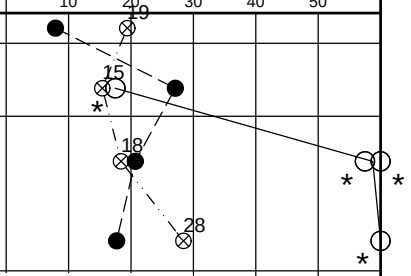
SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +745.8 Feet	
		1	SS			1.2 Gravel	
			PA			FILL: Silty clay - trace gravel and sand - brown and black - stiff (FILL)	
		2	SS			4.0	
5.0			PA			Silty clay - trace gravel and sand - brown - hard (CL)	
		3	SS				
			PA				
10.0		4	SS			10.0	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30454.5**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50171.5**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **1.5 WD**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-12**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

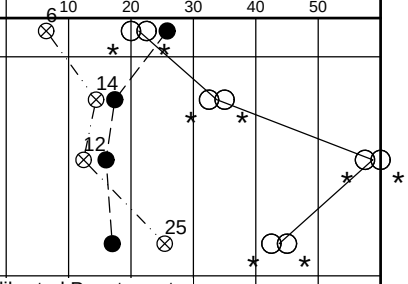
SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

SURFACE ELEVATION +740.8 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			FILL: Silty clay - trace gravel and sand - brown - hard (FILL)	
			PA				
		2	SS			Silty clay - trace gravel and sand - brown - very stiff to hard (CL)	
5.0			PA				
		3	SS				
			PA				
		4	SS				
10.0						End of Boring Backfilled Automatic Hammer	

1.5 — 10.0



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30614.8**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50143.3**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-13**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

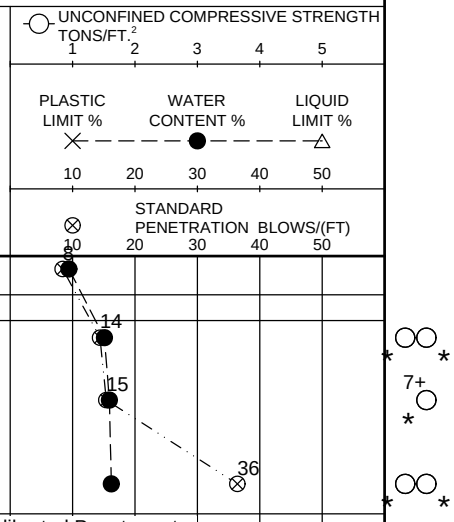
UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

SURFACE ELEVATION +743.9 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			Sand and gravel (1.5)	
			PA			FILL: Silty clay - trace gravel and sand - brown - hard (FILL) (2.5)	
		2	SS			Silty clay - trace gravel and sand - brown - hard (CL)	
5.0			PA				
		3	SS				
			PA				
10.0		4	SS			(10.0)	
						End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30710.2**	BORING STARTED **4/18/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50207.7**	BORING COMPLETED **4/18/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-14**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

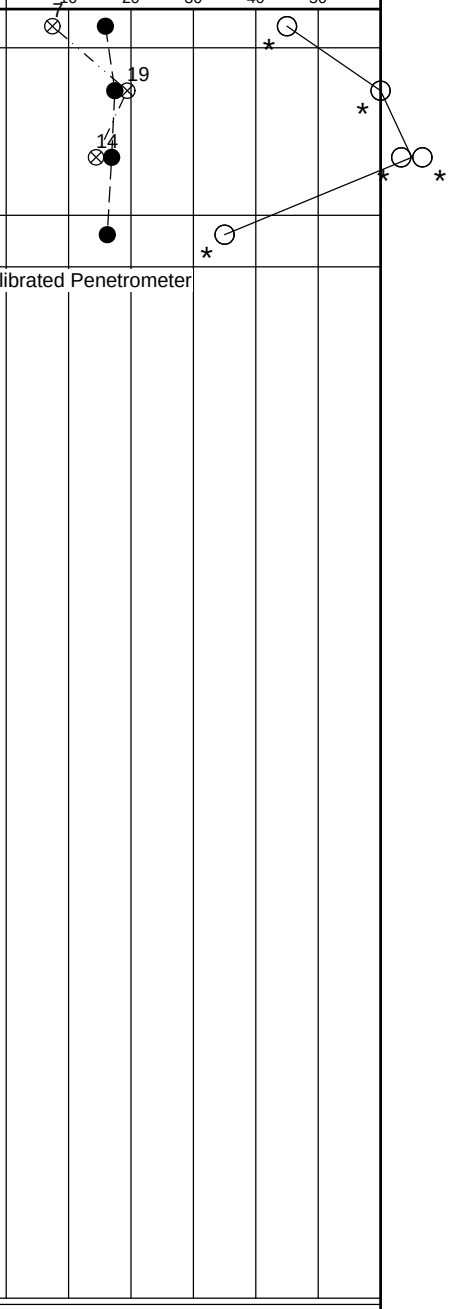
SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)

STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +740.6 Feet	
		1	SS			FILL: Silty clay - trace gravel and sand - brown - hard (FILL)	
			PA			1.5 Silty clay - trace gravel and sand - brown - hard (CL)	
		2	SS				
5.0			PA				
		3	SS				
			PA			8.0	
		4	SS			Silty clay - trace gravel and sand - gray - very stiff (CL)	
10.0						10.0 End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

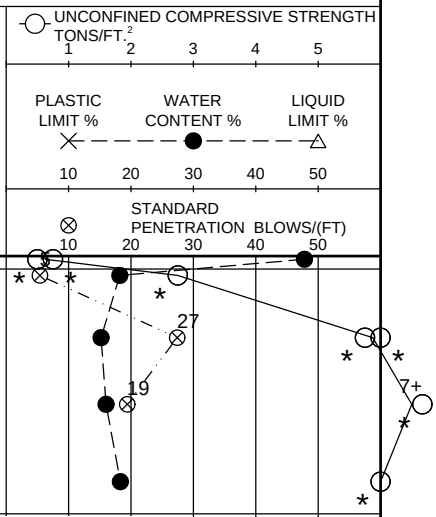
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30860.4**	BORING STARTED **4/19/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50273.8**	BORING COMPLETED **4/19/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-15**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
						SURFACE ELEVATION +739.4 Feet	
		1	SS				
		1A	SS			0.5 Topsoil	
			PA			Silty clay - trace gravel and sand - brown - very stiff to hard (CL)	
		2	SS				
5.0			PA				
		3	SS				
			PA				
		4	SS				
10.0						10.0 End of Boring Backfilled Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

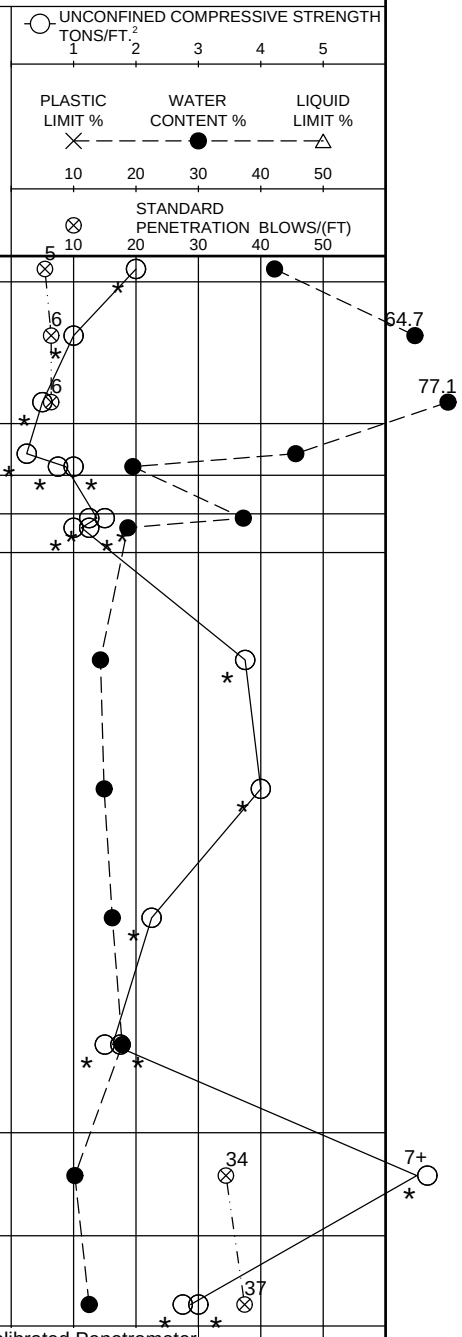
NORTHING **30936.5**	BORING STARTED **4/19/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50185.6**	BORING COMPLETED **4/19/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

CLIENT	LOG OF BORING NUMBER
Argonne National Laboratory	**B-18**
PROJECT NAME	ARCHITECT-ENGINEER
APCF	**Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

SURFACE ELEVATION +740.6 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			1.0 Topsoil	
			PA			FILL: Silty clay and topsoil - trace organics - brown and black - stiff (FILL)	
		2	SS				
5.0			PA				
		3	SS			6.5	
			PA			Buried topsoil - black (OL)	
		4	ST			8.5	
		4A	ST			Silty clay - trace gravel and sand - gray - stiff (CL)	
10.0			PA			10.0	
		5	ST			Organic clay - black - stiff (OL)	
		5A	ST			11.5	
			RB			Silty clay - trace gravel and sand - gray - very stiff to stiff (CL)	
15.0							
		6	ST				
			RB				
20.0							
		7	ST				
			RB				
25.0							
		8	ST				
			RB				
30.0							
		9	ST				
			RB			34.0	
35.0						Silty clay to clayey silt - trace gravel and sand - gray - hard (CL-ML)	
		10	SS				
			RB			38.0	
						Silty clay - trace gravel and sand - gray - very stiff (CL)	
40.0							
41.5		11	SS			41.5	
						End of Boring Grouted Automatic Hammer	



* Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING	BORING STARTED	AECOM OFFICE	
30345.9	**4/20/11**	**Chicago Area - 01**	
EASTING	BORING COMPLETED	ENTERED BY	SHEET NO. OF
50564.7	**4/20/11**	**SJH**	**1 1**
WL	RIG/FOREMAN	APP'D BY	AECOM JOB NO.
5.0 WS	**D-50/MALOUF**	**RCR**	**60215145**

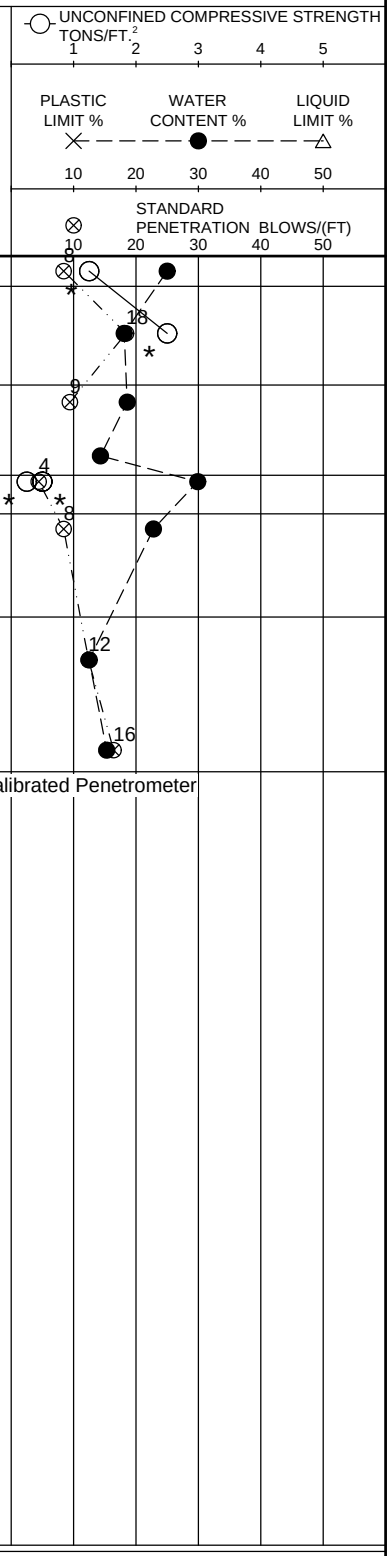
AECOM LOG 60215145.GPJ FS_DATATEMPLATE.GDT 5/4/11

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B-19**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

SURFACE ELEVATION +741.8 Feet

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS./FT.^{3}
		1	SS			1.2 Topsoil	
			PA			FILL: Silty clay - trace gravel, sand and topsoil - brown and black - stiff to very stiff (FILL)	
		2	SS				
5.0			PA			5.0	
		3	SS			FILL: Medium to coarse sand - trace gravel - brown - loose (SP)	
			PA				
		4	SS			8.5	
		4A	SS			Organic clay - trace gravel and sand - gray - soft (OL)	
10.0			PA			10.0	
		5	SS			Clayey silt - trace gravel and sand - gray - loose (ML)	
			PA			14.0	
15.0						Fine to medium sand - trace gravel - gray - medium dense (SP)	
		6	SS				
			PA				
20.0		7	SS			20.0	
						End of Boring Backfilled Automatic Hammer	



*Calibrated Penetrometer

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING **30393.1**	BORING STARTED **4/20/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING **50558.7**	BORING COMPLETED **4/20/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL ▼ **5.0 WS**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM

AECOM General Notes

Drilling and Sampling Symbols:

SS : Split Spoon - 1-3/8" I.D. 2" O.D. (Unless otherwise noted)	HS : Hollow Stem Auger
ST : Shelby Tube-2" O.D. (Unless otherwise noted)	WS : Wash Sample
PA : Power Auger	FT : Fish Tail
DB : Diamond Bit-NX, BX, AX	RB : Rock Bit
AS : Auger Sample	BS : Bulk Sample
JS : Jar Sample	PM : Pressuremeter Test
VS : Vane Shear	GS : Giddings Sampler
OS : Osterberg Sampler	

Standard "N" Penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split spoon sampler, except where otherwise noted.

Water Level Measurement Symbols:

WL : Water Level	WCI : Wet Cave In
WS : While Sampling	DCI : Dry Cave In
WD : While Drilling	BCR : Before Casing Removal
AB : After Boring	ACR : After Casing Removal

Water levels indicated on the boring logs are the levels measured in the boring at the time indicated. In pervious soils, the indicated elevations are considered reliable groundwater levels. In impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations; additional evidence of groundwater elevations must be sought.

Gradation Description and Terminology:

Coarse grained or granular soils have more than 50% of their dry weight retained on a #200 sieve; they are described as boulders, cobbles, gravel or sand. Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as clay or clayey silt if they are cohesive and silt if they are non-cohesive. In addition to gradation, granular soils are defined on the basis of their relative in-place density and fine grained soils on the basis of their strength or consistency and their plasticity.

Major Component of Sample	Size Range	Description of Other Components Present in Sample	Percent Dry Weight
Boulders	Over 8 in. (200 mm)	Trace	1-9
Cobbles	8 inches to 3 inches (200 mm to 75 mm)	Little	10-19
Gravel	3 inches to #4 sieve (75 mm to 4.76 mm)	Some	20-34
Sand	#4 to #200 sieve (4.76 mm to 0.074 mm)	And	35-50
Silt	Passing #200 sieve (0.074 mm to 0.005 mm)		
Clay	Smaller than 0.005 mm		

Consistency of Cohesive Soils:

Unconfined Compressive Strength, Qu, tsf	Consistency
<0.25	Very Soft
0.25 - 0.49	Soft
0.50 - 0.99	Medium (firm)
1.00 - 1.99	Stiff
2.00 - 3.99	Very Stiff
4.00 - 8.00	Hard
>8.00	Very Hard

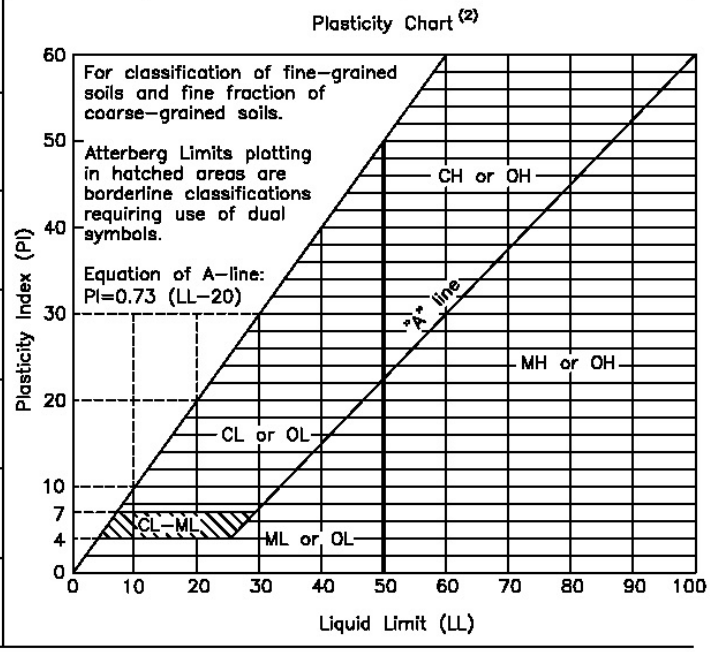
Relative Density of Granular Soils:

N-Blows per foot	Relative Density
0 - 3	Very Loose
4 - 9	Loose
10 - 29	Medium Dense
30 - 49	Dense
50 - 80	Very Dense
>80	Extremely Dense

AECOM

AECOM Soil Classification System [1]

	Major Divisions		Group Symbols	Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is *larger* than No. 200 sieve size)	Gravel (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravel (Little or no fines)	GW	Well-graded, gravel, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent . . . . . GW, GP, SW, SP; More than 12 percent . . . . . GM, GC, SM, SC; 5 to 12 percent . . . . . Borderline cases *requiring* dual symbols[3]	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
			GP	Poorly graded gravel, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravel with fines (Appreciable amount of fines)	GM	Silty gravel, gravel-sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Above "A" line with PI between 4 and 7 are *borderline* cases requiring use of dual symbols
			GC	Clayey gravel, gravel-sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
	Sand (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sand (Little or no fines)	SW	Well-graded sand, gravelly sand, little or no fines		$C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 & 3	
			SP	Poorly graded sand, gravelly sand, little or no fines		Not meeting all gradation requirements for SW	
		Sand with fines (Appreciable amount of fines)	SM	Silty sand, sand-silt mixtures		Atterberg limits below "A" line or PI less than 4	Limits plotting in hatched zone with PI between 4 and 7 are *borderline* cases requiring use of dual symbols
			SC	Clayey sand, sand-clay mixtures		Atterberg limits above "A" line or PI greater than 7	
Fine-grained soils (More than half of material is *smaller* than No. 200 sieve size)	Silt and clay (Liquid limit less than 50)		ML	Inorganic silt and very fine sand, rock flour, silty or clayey fine sand or clayey silt with slight plasticity	Plasticity Chart [2]		
			CL	Inorganic clay of low to medium plasticity, gravelly clay, sandy clay, silty clay, lean clay			
			OL	Organic silt and organic silty clay of low plasticity			
	Silt and clay (Liquid limit greater than 50)		MH	Inorganic silt, micaceous or diatomaceous fine sandy or silty soils, elastic silt			
			CH	Inorganic clay of high plasticity, fat clay			
			OH	Organic clay of medium to high plasticity, organic silt			
	Highly organic soils		PT	Peat and other highly organic soil			



1. See AECOM General Notes for component gradation terminology, consistency of cohesive soils and relative density of granular soils.
2. Reference: Unified Soil Classification Systems
3. Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

AECOM

AECOM Field and Laboratory Procedures

Field Sampling Procedures

Auger Sampling (AS)

In this procedure, soil samples are collected from cuttings off of the auger flights as they are removed from the ground. Such samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from discrete depths.

Split-Barrel Sampling (SS) - (ASTM Standard D-1586-99)

In the split-barrel sampling procedure, a 2-inch O.D. split barrel sampler is driven into the soil a distance of 18 inches by means of a 140-pound hammer falling 30 inches. The value of the Standard Penetration Resistance is obtained by counting the number of blows of the hammer over the final 12 inches of driving. This value provides a qualitative indication of the in-place relative density of cohesionless soils. The indication is qualitative only, however, since many factors can significantly affect the Standard Penetration Resistance Value, and direct correlation of results obtained by drill crews using different rigs, drilling procedures, and hammer-rod-spoon assemblies should not be made. A portion of the recovered sample is placed in a sample jar and returned to the laboratory for further analysis and testing.

Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-94

In the Shelby tube sampling procedure, a thin-walled steel seamless tube with a sharp cutting edge is pushed hydraulically into the soil and a relatively undisturbed sample is obtained. This procedure is generally employed in cohesive soils. The tubes are identified, sealed and carefully handled in the field to avoid excessive disturbance and are returned to the laboratory for extrusion and further analysis and testing.

Giddings Sampler (GS)

This type of sampling device consists of 5-foot sections of thin-wall tubing which are capable of retrieving continuous columns of soil in 5-foot maximum increments. Because of a continuous slot in the sampling tubes, the sampler allows field determination of stratification boundaries and containerization of soil samples from any sampling depth within the 5-foot interval.

AECOM

AECOM Field and Laboratory Procedures

Subsurface Exploration Procedures

Hand-Auger Drilling (HA)

In this procedure, a sampling device is driven into the soil by repeated blows of a sledge hammer or a drop hammer. When the sampler is driven to the desired sample depth, the soil sample is retrieved. The hole is then advanced by manually turning the hand auger until the next sampling depth increment is reached. The hand auger drilling between sampling intervals also helps to clean and enlarge the borehole in preparation for obtaining the next sample.

Power Auger Drilling (PA)

In this type of drilling procedure, continuous flight augers are used to advance the boreholes. They are turned and hydraulically advanced by a truck, trailer or track-mounted unit as site accessibility dictates. In auger drilling, casing and drilling mud are not required to maintain open boreholes.

Hollow Stem Auger Drilling (HS)

In this drilling procedure, continuous flight augers having open stems are used to advance the boreholes. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow stem augers thus provide support to the sides of the borehole during the sampling operations.

Rotary Drilling (RB)

In employing rotary drilling methods, various cutting bits are used to advance the boreholes. In this process, surface casing and/or drilling fluids are used to maintain open boreholes.

Diamond Core Drilling (DB)

Diamond core drilling is used to sample cemented formations. In this procedure, a double tube (or triple tube) core barrel with a diamond bit cuts an annular space around a cylindrical prism of the material sampled. The sample is retrieved by a catcher just above the bit. Samples recovered by this procedure are placed in sturdy containers in sequential order.

AECOM

AECOM Laboratory Procedures

Water Content (Wc)

The water content of a soil is the ratio of the weight of water in a given soil mass to the weight of the dry soil. Water content is generally expressed as a percentage.

Hand Penetrometer (Qp)

In the hand penetrometer test, the unconfined compressive strength of a soil is determined, to a maximum value of 4.5 tons per square foot (tsf) or 7.0 tsf depending on the testing device utilized, by measuring the resistance of the soil sample to penetration by a small, spring-calibrated cylinder. The hand penetrometer test has been carefully correlated with unconfined compressive strength tests, and thereby provides a useful and a relatively simple testing procedure in which soil strength can be quickly and easily estimated.

Unconfined Compression Tests (Qu)

In the unconfined compression strength test, an undisturbed prism of soil is loaded axially until failure or until 20% strain has been reached, whichever occurs first.

Dry Density (γd)

The dry density is a measure of the amount of solids in a unit volume of soil. Use of this value is often made when measuring the degree of compaction of a soil.

Classification of Samples

In conjunction with the sample testing program, all soil samples are examined in our laboratory and visually classified on the basis of their texture and plasticity in accordance with the AECOM Soil Classification System which is described on a separate sheet. The soil descriptions on the boring logs are derived from this system as well as the component gradation terminology, consistency of cohesive soils and relative density of granular soils as described on a separate sheet entitled "AECOM General Notes". The estimated group symbols included in parentheses following the soil descriptions on the boring logs are in general conformance with the Unified Soil Classification System (USCS) which serves as the basis of the AECOM Soil Classification System.

AECOM

AECOM Standard Boring Log Procedures

In the process of obtaining and testing samples and preparing this report, standard procedures are followed regarding field logs, laboratory data sheets and samples.

Field logs are prepared during performance of the drilling and sampling operations and are intended to essentially portray field occurrences, sampling locations and procedures.

Samples obtained in the field are frequently subjected to additional testing and reclassification in the laboratory by experienced geotechnical engineers, and as such, differences between the field logs and the final logs may exist. The engineer preparing the report reviews the field logs, laboratory test data and classifications, and using judgment and experience in interpreting this data, may make further changes. It is common practice in the geotechnical engineering profession not to include field logs and laboratory data sheets in engineering reports, because they do not represent the engineer's final opinions as to appropriate descriptions for conditions encountered in the exploration and testing work. Results of laboratory tests are generally shown on the boring logs or are described in the text of the report, as appropriate.

Samples taken in the field, some of which are later subjected to laboratory tests, are retained in our laboratory for sixty days and are then discarded unless special disposition is requested by our client. Samples retained over a long period of time, even in sealed jars, are subject to moisture loss which changes the apparent strength of cohesive soil, generally increasing the strength from what was originally encountered in the field. Since they are then no longer representative of the moisture conditions initially encountered, observers of these samples should recognize this factor.

AECOM

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June 7, 2011

Sent via email (laura.holman@smithgroup.com) and U.S. Mail

Ms. Laura Holman
Smith Group
35 East Wacker Drive, Suite 2200
Chicago, IL 60601

Subject: Addendum to AECOM Report Dated May 18, 2011, Argonne APCF Project, DuPage County, IL – AECOM Project No. 60215145

Dear Ms. Holman:

As requested by Thornton-Tomasetti, AECOM is pleased to provide additional recommendations for the foundation design. This letter should be considered as an addendum to our geotechnical report for the project.

We have recommended that for the design of the wall footings the coefficient of friction provided at the base of footings is estimated at 0.35 against the natural cohesive soils (natural silty clay which is brown and gray) and 0.4 against granular fill material (IDOT CA-6). These values incorporate a factor of safety approximately equal to 1.5. The coefficients of friction and the modulus of horizontal subgrade reaction, K_H, values recommended in our report can also be used for the design of isolated spread footings.

As you are aware if the foundation wall moves into the soil, then the shear strength of soil will be mobilized and passive pressure will be developed. The passive pressure that develops along the buried face of the foundation may be utilized as additional restraint to lateral movement. In order to develop the full passive pressure along the wall/footing, a relatively large degree of movement is required. A factor of safety is applied to the passive pressure to limit the amount of movement. This is similar to the design of foundations for vertical loads. A factor of safety of 2 to 3 is typically used for passive pressures. The factor of safety applied to the passive pressure will limit movements to be compatible with the relatively small movement required to mobilize sliding friction.

Assuming a minimum 3 foot wide zone of compacted IDOT CA-6 is used for backfill along the foundation wall/footing, a coefficient of passive pressure, Kp of 3 may be utilized for design. This passive coefficient includes a factor of safety of 2.5. Since the wall will need to be backfilled anyway, this requirement should not require an unusual amount of additional effort. The IDOT CA-6 material should be placed in maximum 6 inch loose lifts and compacted to at least 95% of the maximum dry density per ASTM D 1557.

Passive pressure should be neglected within the frost depth at the perimeter footings as shown in the attached Figure 2.

We look forward to continue working with you on this project. If you have any questions, please contact us.

Respectfully,

AECOM Technical Services, Inc.

Kiran Adhikary, P.E., LEED AP
Senior Project Engineer

Ted D. Bushell, P.E.
Principal Engineer

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Attachment: Figure 2

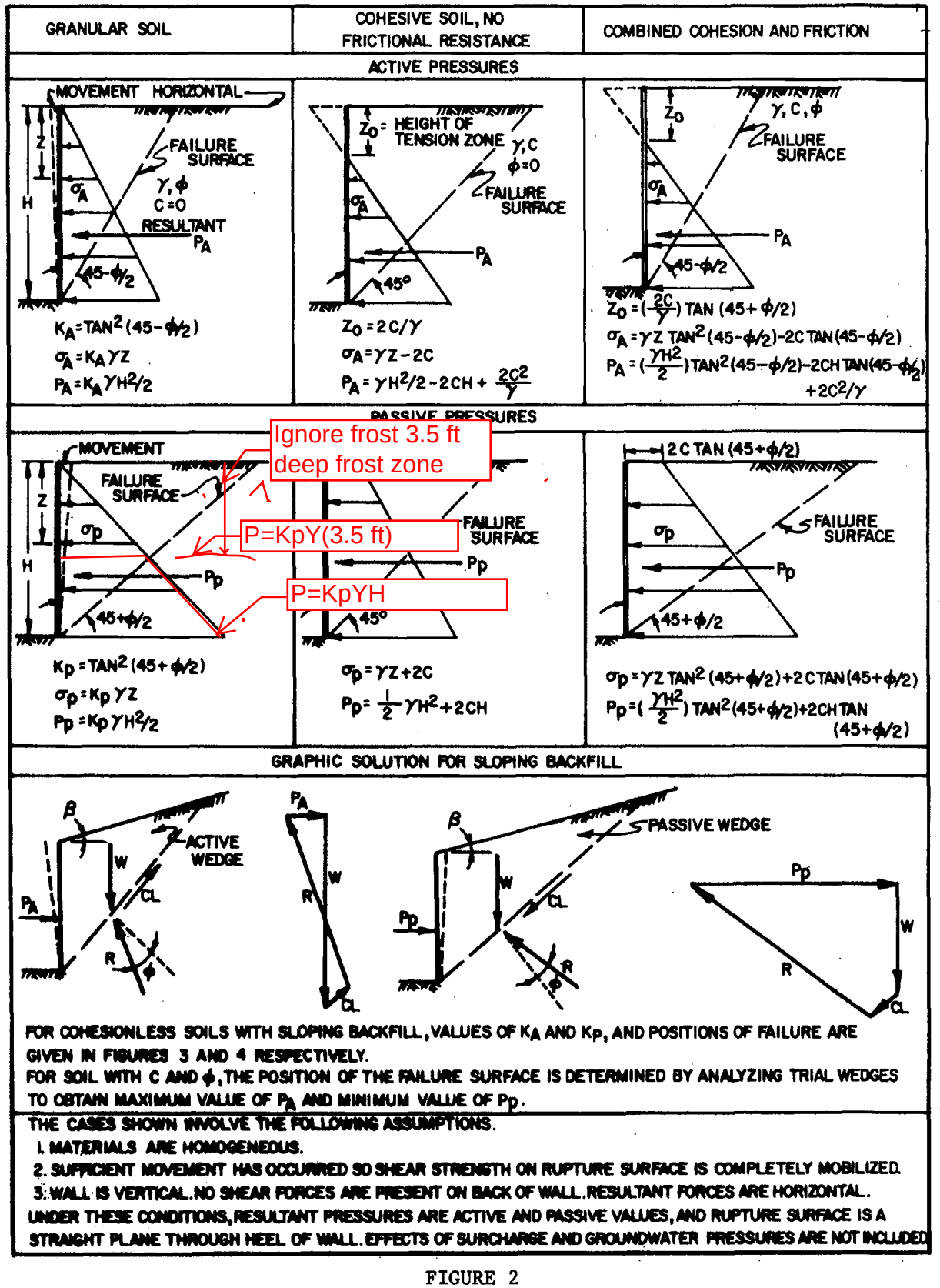

FIGURE 2
Computation of Simple Active and Passive Pressures

AECOM

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July 20, 2011

sent via email (laura.holman@smithgroup.com) and U.S. Mail

Ms. Laura Holman
Smith Group
35 East Wacker Drive, Suite 2200
Chicago, IL 60601

Subject: Additional Foundation Recommendations, Argonne APCF Project, DuPage County, IL – AECOM Project No. 60215145

Dear Ms. Holman:

As requested by Thornton Tomasetti, AECOM is pleased to provide additional recommendations for the foundation design. This letter should be considered as an addendum to our geotechnical report for the project.

We recommended in our original report that shallow footings bearing in the very stiff to hard, native brown and gray silty clay material or properly compacted granular material such as IDOT Grade CA-6 can be designed for a net allowable soil bearing pressure of 4,000 pounds per square foot (psf).

This allowable pressure may be increased by 1/3 for load combinations including intermittent wind loads and seismic loads where allowed by code.

We look forward to continue working with you on this project. If you have any questions, please contact us.

Respectfully,

AECOM Technical Services, Inc.

Kiran Adhikary, P.E., LEED AP
Senior Project Engineer

Tony A. Kiefer, P.E.
Principal Engineer

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cc: Sarah Vaughan, Thornton Tomasetti (SVaughan@ThorntonTomasetti.com)

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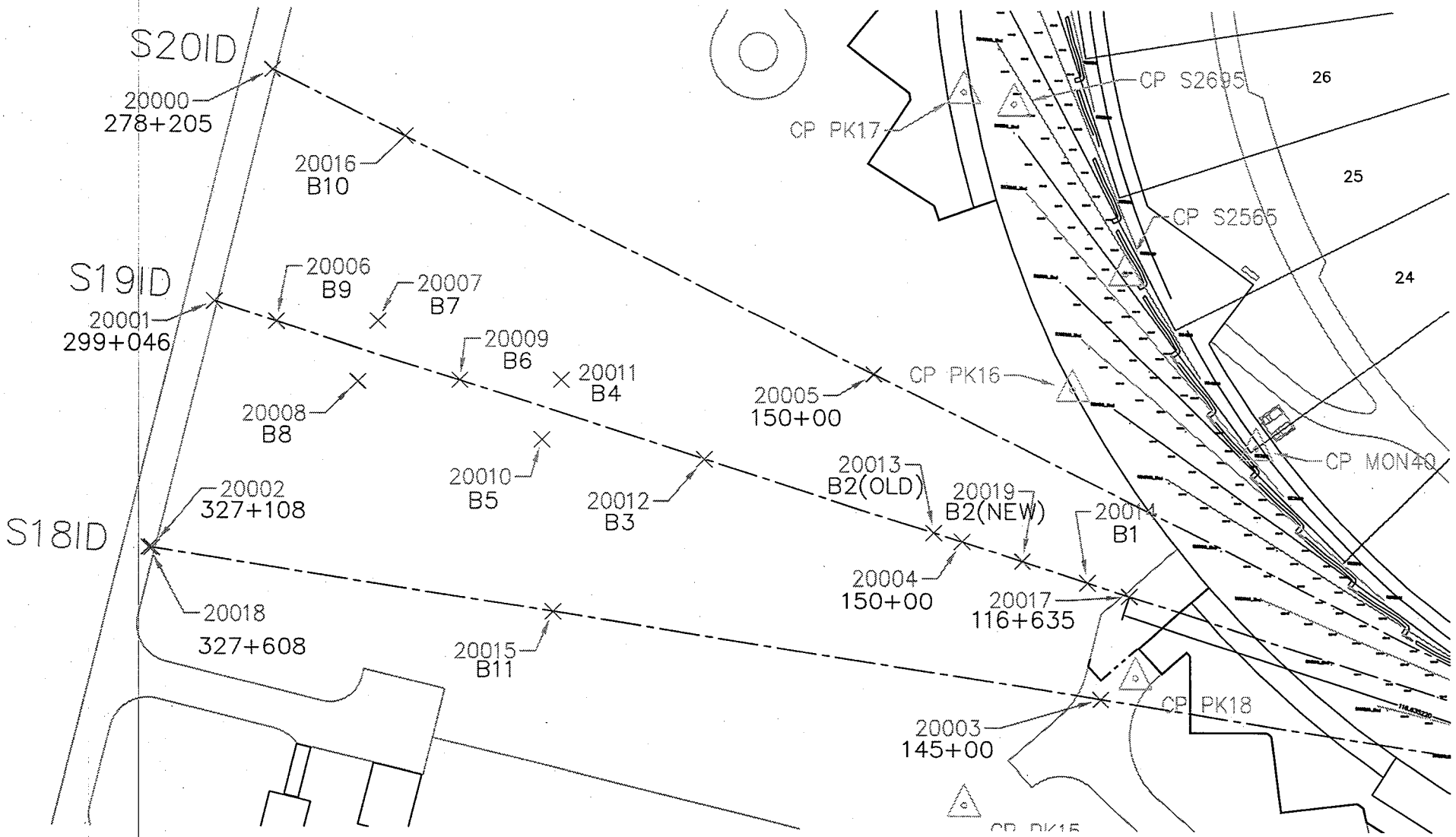
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20008
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B5
20012
B3
20005
150+00
CP PK16
CP PK17
CP S2695
CP S2565
CP MON40
26
25
24
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20002
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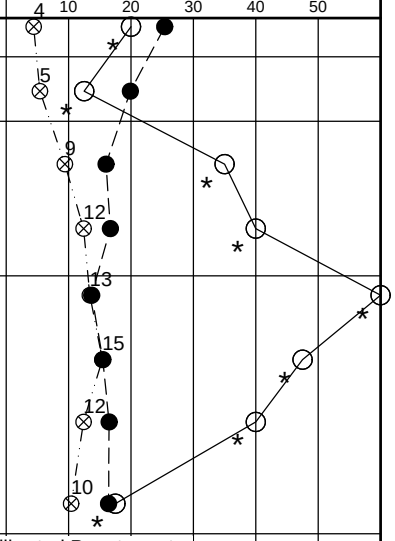
20018
327+608
20015
B11
20013
B2(OLD)
20019
B2(NEW)
20014
B1
20004
150+00
20017
116+635
20003
145+00
CP PK18

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B6**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

UNCONFINED COMPRESSIVE STRENGTH TONS/FT.^{2} (1, 2, 3, 4, 5)
PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT % (10, 20, 30, 40, 50)
STANDARD PENETRATION BLOWS/(FT) (10, 20, 30, 40, 50)

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION Feet	UNIT DRY WT. LBS./FT.^{3}
		1	SS			1.5 Clayey topsoil, little silt and fine to coarse sand - black - very stiff (OL)	
			PA			Possible Fill: Silty clay, trace fine to coarse sand and fine gravel - brownish gray and black - stiff (CL)	
		2	SS			4.0	
5.0			PA			Silty clay, trace fine to coarse sand, fine gravel and shale - brownish gray - very stiff to hard (CL)	
		3	SS				
			PA				
		4	SS				
10.0			PA			10.0	
		5	SS			Silty clay, trace fine to coarse sand, fine gravel and shale - gray - hard to stiff (CL)	
			PA				
		6	SS				
15.0			PA				
		7	SS				
			PA				
		8	SS				
20.0						20.0	



End of Boring
Automatic Diedrich Hammer used for Standard Penetration Tests
Borehole backfilled upon completion

* Calibrated Penetrometer

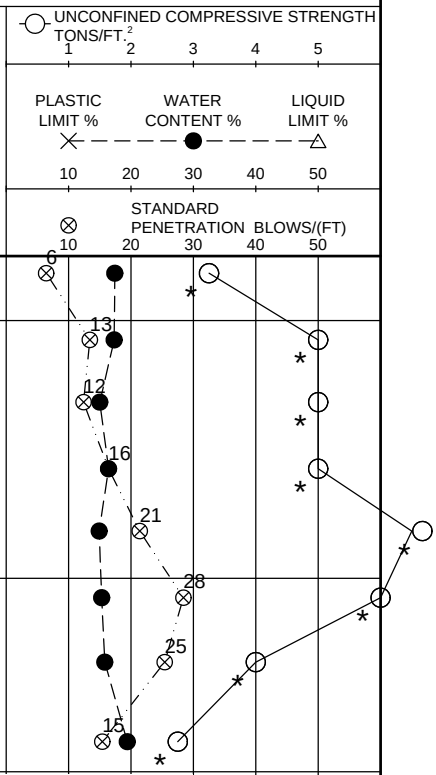
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING	BORING STARTED **7/26/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING	BORING COMPLETED **7/26/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

AECOM	CLIENT **Argonne National Laboratory**	LOG OF BORING NUMBER **B9**
	PROJECT NAME **APCF**	ARCHITECT-ENGINEER **Thornton Tomasetti**

SITE LOCATION
Argonne National Laboratory, Lemont, IL

DEPTH(FT)	ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL SURFACE ELEVATION Feet	UNIT DRY WT. LBS./FT.^{3}
		1	SS			Silty clay, trace fine gravel, fine to coarse sand and roots - brown with black - very stiff (CL)	
			PA			2.5	
		2	SS			Silty clay, trace fine gravel, fine to coarse sand and shale - brown - hard (CL)	
5.0			PA				
		3	SS				
			PA				
		4	SS				
10.0			PA				
		5	SS				
			PA			12.5	
		6	SS			Silty clay, trace fine gravel, fine to coarse sand and shale - gray - hard to very stiff (CL)	
15.0			PA				
		7	SS				
			PA				
		8	SS				
20.0						20.0	
						End of Boring Automatic Diedrich Hammer used for Standard Penetration Tests Borehole backfilled upon completion	* Calibrated Penetrometer



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

NORTHING	BORING STARTED **7/26/11**	AECOM OFFICE **Chicago Area - 01**	
EASTING	BORING COMPLETED **7/26/11**	ENTERED BY **SJH**	SHEET NO. **1** OF **1**
WL **DRY**	RIG/FOREMAN **D-50/MALOUF**	APP'D BY **RCR**	AECOM JOB NO. **60215145**

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SECTION 00 43 00
LIST OF SUBCONTRACTORS

Bidders shall submit with their bids, on forms provided for same, the name and location of the place of business of each subcontractor who will perform work or labor or render service to the Contractor in or about the construction of the work or improvement and the portion of the work which will be performed by each subcontractor.

No Bidder whose bid is accepted shall substitute any person as subcontractor in place of the subcontractor listed nor shall any subcontract be assigned or transferred except as approved by owner.

LIST OF SUBCONTRACTORS

The following is a list of the proposed subcontractors to whom I (we) propose to sublet a portion or portions of this work.

NAME/ADDRESS	CLASSIFICATION OF WORK TO BE EXECUTED
_____	
_____	_____
_____	
_____	_____
_____	
_____	_____
_____	
_____	_____
_____	
_____	_____
_____	
_____	_____

END OF SECTION

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SECTION 1A0

GENERAL CONDITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. These General Conditions apply to all Divisions of this specification.

1.2 INTENT OF DRAWINGS AND SPECIFICATIONS

A. The Contractor shall furnish all labor, material, tools, equipment, plant and services necessary to complete the work shown on the drawings, in strict accordance with the various divisions of these specifications.

B. The drawings and specifications are intended to include everything obviously requisite and necessary to the proper and entire completion of the work whether or not each item is specifically mentioned. In the event of inconsistency between the drawings and specifications, the specifications shall govern.

C. Wherever it is required in these specifications or on the drawings that the Contractor provide apparatus or equipment, it shall be understood that the Contractor shall furnish, install and connect such apparatus or equipment in a complete manner to insure satisfactory operation, except when otherwise definitely specified. All material and equipment shall be new unless otherwise specified.

1.3 DEFINITIONS

A. Wherever the word "Laboratory" appears on the drawings or specifications, it shall be construed to mean the "Argonne National Laboratory".

B. Wherever the word "Contractor" appears on the drawings or specifications, it shall be construed to mean the entity who is responsible to the Laboratory for the successful execution of the project construction and other requirements of the contract documents.

C. When the terms "approved", "satisfactory", "equal", "approved equal", "proper", or "as directed" are used, they shall be interpreted as meaning "approved", etc., by the Laboratory.

1.4 STANDARDS, CODES AND FEDERAL SPECIFICATIONS

A. The standards, codes, Federal Specifications and other recommendations and publications referred to in these specifications shall be of the latest issue (including all amendments) in effect on the date of the specifications.

B. Where requirements are in excess of the above standards, codes and Federal Specifications, the Contractor shall be bound by the information indicated in the specifications and/or on the drawings.

1.5 SITE INSPECTION

A. It is expected that the Contractor has visited the site and has become thoroughly acquainted with all conditions relative to the site, work location and all other matters which might affect the work to be performed.

1.6 VERIFICATION OF DIMENSIONS

A. Wherever existing obstructions or dimensional inaccuracies capable of verification by the Contractor in the field, or wherever minor variations of indicated arrangements or dimensions of equipment, interfere with the installation as shown on the drawings, the Contractor shall make such necessary alterations as are approved by the Laboratory and such alterations shall not constitute a basis for extra charge.

1.7 SUBSTITUTION OF EQUIPMENT AND MATERIALS

A. The naming of manufacturers in the specifications or on the drawings shall not be construed as an intention to eliminate the products of other manufacturers having approved equivalent products. The substitution of material other than that named in the specifications or on the drawings, may be made only after the approval of the Laboratory has been granted in writing. Any request for substitution must be accompanied and substantiated by written technical and operational data (Reference Section 01 25 00.)

B. Any necessary modification of equipment, building, piping, ductwork, electrical or any other work resulting from the use of equipment or materials other than that first named in the specifications, and any construction work related to such modification shall be the responsibility of the Contractor notwithstanding approval of same by the Laboratory, shall be without cost to the Laboratory and the Contractor shall not be entitled to any additional payment or extension of time by reason thereof. The Contractor shall submit with the request for use of equipment or materials, other than that first named in the specifications, the necessary modifications resulting from such use, and obtain Laboratory approval before proceeding with the procurement. The Laboratory's approval will not relieve the Contractor from sole responsibility for proper installation and functioning of such equipment or materials, nor will the necessary review by the Laboratory of the data submitted be considered as a basis for any additional payment or extension of time for performance of the contract work.

1.8 BREAKDOWN OF CONTRACT PRICE

A. Whenever progress payments are to be made, or if otherwise requested by the Laboratory, the Contractor shall, before starting work, submit a breakdown estimate of the amount of the contract. This estimate breakdown shall itemize all work items including the number of units, unit prices and total estimated cost for each work item. This estimate, which will include all overhead and profit spread over the work item costs proportionately, will constitute the basis for partial payments (if any) to the Contractor.

1.9 CONSTRUCTION SCHEDULE

A. The Contractor shall, before starting work, submit a construction schedule in a form satisfactory to the Laboratory (Reference Section 01 31 00).

1.10 APPROVAL OF SUBCONTRACTORS

A. The Contractor shall, with its proposal, submit for approval by the Laboratory a list of the proposed Subcontractors who will be performing work at the site. Included on this list shall be the type of work each Subcontractor will perform (Reference Section 00 43 00).

1.11 EQUIPMENT PURCHASE ORDERS

A. The Contractor shall immediately place purchase orders for all materials and equipment necessary to complete all work on schedule and shall be prepared to submit one (1) copy of purchase orders to the Laboratory when requested.

1.12 DIGGING PERMITS

A. Existing underground utilities shall be exposed by hand digging done during the regular Laboratory working hours, Monday through Friday, in accordance with provisions contained in the "Digging Permit". The "Digging Permit" is obtained by the Laboratory representative and approval given to the Contractor. After the existing underground utilities stated in the "Digging Permit" have been exposed by hand digging, machines may be used for the remaining excavation in accordance with the provisions in the "Digging Permit". Each specific “Digging Permit” must be requested a **minimum of three (3) business days in advance** of specified activity. A “Digging Permit” is required for any activity that will penetrate the ground (Earth) greater than 6” in depth, or as other directed by the Laboratory representative.

1.13 SHUTDOWN OF BUILDING FACILITIES

A. The installation shall be scheduled by the Contractor so as to minimize shutdown of Laboratory facilities. All necessary shutdowns must be arranged with the Laboratory at **least five (5) business days** in advance of the required shutdown time.

1.14 USE OF EXISTING UTILITIES

A. The Laboratory will make existing utilities such as water, gas and electricity available to the Contractor without cost where such utilities are conveniently located with respect to the work site. The Contractor must provide all materials, labor and equipment necessary for extending existing utilities to the point of use. The method of connection into existing utilities must be approved by the Laboratory and these connections to utilities shall be under the immediate supervision of the authorized Laboratory representative. The Contractor will be held responsible for the proper installation, operation and maintenance of temporary utilities and must adhere to all uniform codes governing such installations. Upon completion of the work, the Contractor shall remove all temporary utility lines and restore existing utilities to the original condition as directed by the Laboratory. The contractor must allow for up to 90 days following initial request for utility service.

1.15 SUPERVISION BY CONTRACTOR

A. The Contract stipulates that the Contractor shall, at all times during the progress of the work, provide a competent Project Manager and Superintendent. The Project Manager and/or Superintendent shall be vested with the necessary authority to direct and schedule the work of the Subcontractors, who may be engaged in the work and represent his/her firm in matters that may be referred to him/her by the authorized Laboratory representative.

1.16 COORDINATION

A. References which are made to the Contractor throughout these specifications under the various divisions refer to both the Contractor and/or Subcontractors who may be performing the particular work items. The necessary coordination between the work to be performed by the Contractor and that of the Subcontractors shall be the responsibility of the Contractor. Inclusion of all work items including materials, equipment and installation shall be considered as contained in the proposal to be submitted. The responsibility for determinations as to which Subcontractor shall purchase and which Subcontractor

shall install shall be vested completely in the Contractor, who shall also establish the work schedules for the various trades that may be required in the execution of the work.

1.17 CONTRACTOR'S WORK AREA

A. The work area, material and equipment storage area, location of construction office and similar installation areas will be limited as indicated on the drawings or by the authorized Laboratory representative. The Contractor shall be limited in his/her access to these areas to the most direct route from public and Laboratory roads, shall be responsible for restricting the movements of his/her employees, watchmen, subcontractors and all associated personnel to the construction limits, and shall have no privilege of access beyond the established limits except as permitted for the installation of utilities and services.

1.18 CUTTING AND PATCHING

A. In the event that during the cutting of concrete or masonry, including floors, walls, or roofs, and whether or not shown on the drawings, any reinforcing rods, bars, etc., are cut, or should any utility be damaged, the Contractor and his Subcontractors of any tier shall immediately stop all such cutting until permission to resume cutting is obtained from the authorized Laboratory representative and shall take such precautionary measures as directed thereby. The Contractor and his Subcontractors of any tier are responsible for the repair of all damage resulting from improperly proceeding with the work, at no expense to the Laboratory. In addition, the Contractor and his Subcontractors of any tier are required to prevent free silica dust exposures in excess of the American Conference of Governmental Industrial Hygenist Threshold Limit value. Refer to Section 01 49 90.

1.19 SHOP DRAWINGS

A. As used in this clause "shop drawings" means:

B. Supplemental drawings prepared for a specific installation under this contract showing accurate dimensions and all details necessary to fully define the work and assure proper execution and completion of the work.

C. Manufacturer's drawings, instructions, specifications, catalog data such as performance charts and curves, wiring diagrams and data, showing all information necessary to describe the physical and/or performance characteristics of equipment and products to be furnished by the Contractor.

D. Shop drawings shall be submitted by the Contractor to the Laboratory for approval.

E. Reference Section 01 33 00 for general submittal requirements and Section 01 04 00 for coordination shop drawing requirements.

F. The Contractor shall furnish the originals of all approved shop drawings prepared only for this contract.

G. The delivery or installation of any of the items for which shop drawings are required shall not be started until such drawings have been approved. Items delivered or installed, without such approval shall be at the risk of the Contractor.

H. The Laboratory's approval of shop drawings shall not relieve the Contractor of responsibility for defects in design or other errors or omissions in such drawings nor from compliance with all requirements of this contract.

1.20 RECORD DRAWINGS

A. Deviations from the contract drawings may be made only after permission has been granted by the Laboratory in writing. Concurrently with the progress of construction, a set of record drawings, consisting of a marked set of the contract drawings shall be maintained by the Contractor. They shall denote and dimension accurately all changes in elevation, location, size of material or any other approved deviations from the contract drawings, and at the completion of the work, shall be returned to the Laboratory. (Reference Section 01 78 39 for detailed requirements.)

1.21 EQUIPMENT NAME PLATES

A. All manufacturers' nameplates on equipment items are to be kept visible and are not to be obscured by other equipment or piping nor are they to be covered by any paint or insulating material.

1.22 REPAIRS

A. Any damage to existing facilities such as roads, lawns, buildings, utilities, equipment, fixtures, etc., during the course of work by the Contractor and his Subcontractors of any tier or as the result of work performed by the Contractor and his Subcontractors of any tier must be repaired to the satisfaction of the Laboratory without additional cost to the Laboratory.

1.23 TEST REPORTS

A. Systems Testing: Whenever it is hereinafter specified that a particular mechanical, electrical, or other system be tested, three (3) copies of all test reports shall be furnished to the Laboratory.

B. Materials Testing: Whenever it is hereinafter specified that a particular material (except concrete) be tested, three (3) copies of all test reports shall be furnished to the Laboratory. Tests shall be performed by a reputable testing organization at no cost to the Laboratory. Whenever it is hereinafter specified that concrete samples be taken for testing, such tests will be performed by the Laboratory at no cost to the Contractor.

1.24 SAMPLES

A. Whenever it is required herein that sample of materials are to be furnished by the Contractor for approval, such samples shall be furnished in triplicate and shall be identified as to nature or make, proposed usage, location, size, color and other pertinent information. Upon approval, one (1) sample will be returned, properly marked "Approved", for reference of the Contractor. Each sample shall bear a tag or label giving the name of the Contractor, supplier or manufacturer, the trade name of material and any other information necessary to properly identify the material. Sufficient blank space shall be left on each identifying tag for the Laboratory's stamp of approval.

1.25 BARRICADES AND FLARES

A. The Contractor shall provide and inspect daily all barricades as required for open trenches, temporary backfilled areas, etc. and shall provide and maintain adequate lights and flares for the night marking of barricade locations and any other hazardous locations.

1.26 CLEANING AND PROTECTION OF PREMISES

A. The Contractor shall exercise care to prevent dust, debris, mud and water from being spread to areas other than the construction area. Daily and upon completion of construction, the work area shall be cleaned to a condition corresponding to the general cleanliness of the building and/or surrounding area as determined

by the authorized Laboratory representative. Such cleaning shall be conducted in a manner so as to prevent employee exposures to hazardous chemicals (e.g. dust, mists, fumes, vapors, and gases) in excess of established allowable exposure limits. The Contractor shall clean all apparatus thoroughly before placing same in operation and again after each operation. Finished surfaces, if damaged, shall be restored to the satisfaction of the authorized Laboratory representative. The Contractor shall remove all concrete, mortar, plaster and insulation droppings and all paint spots, and remove same regularly from premises. The Contractor shall place all flammable materials either in the original container, or in metal containers with metal covers that are UL listed and FM approved for the intended use, and remove same regularly from premises. Exterior openings into buildings occupied by the Laboratory, whether existing or to be made by the Contractor, shall be kept closed when not in use or completed to maintain the temperature and cleanliness of the occupied space.

B. When working on a roof, the contractor shall be responsible to protect the existing roof components, existing equipment and areas below the roof during construction. Prior to start of any construction work, the contractor shall inspect the site with the Laboratory representative to examine existing condition of the roof and related areas. Methods of protection to be used during construction for roof (e.g. walkways, work areas, storage areas, temporary roof openings, etc.) shall be agreed upon. All the openings made to the existing roof shall be sealed (water tight) before the end of each working day. Regular or overtime work required to protect Laboratory property from potential damage which may be caused as a result of contractor's work prior to acceptance shall be at his/her expense. Also, contractor shall schedule his/her work such that the permanent installation work related to these openings proceeds as expeditiously as possible.

1.27 DISPOSAL OF EXCESS MATERIALS, EQUIPMENT AND DEBRIS

A. The Contractor shall remove accumulated construction debris as the work progresses and upon completion shall remove from the property of the Laboratory all remaining construction debris, excess material, equipment, tools and temporary construction. Clean scrap metals may be delivered, at the Contractor's option and subject to approval by the Laboratory, to a scrap metal depository located at a Laboratory designated area. Unless specified elsewhere, the authorized Laboratory representative will decide and instruct the Contractor as to whether removed materials and equipment shall be considered salvageable or worthless. Salvageable materials and/or equipment, which are to remain the property of the Laboratory, and, unless otherwise specified, shall be transported by the Contractor to a location within the boundaries of the Laboratory. This location will be designated by the authorized Laboratory representative who will also arrange for the final disposition. Excess excavated materials, worthless materials, equipment, and/or construction debris removed from the construction site shall be disposed of off-site by the Contractor. Disposal shall be in accordance with all Federal, State and Local rules and regulations. A Health Physics survey of construction debris and items may be required and shall be performed by the Laboratory prior to the Contractors removal of such items from the work site. The Contractor is required to report to the Laboratory on a monthly basis the number of tons or fractions thereof of any waste materials which are removed from the site.

B. All Contractor generated debris and rubbish will be disposed of in trash dumpsters provided by the Contractor that are to be located within the Construction limits of the work area.

C. The contractor is responsible for cleaning out of concrete trucks and equipment. The Contractor will be responsible for clean-up and transportation of the hardened concrete from the clean-out area. The Contractor shall remove and transport the hardened concrete off-site and the concrete is to be disposed of in accordance with all Local, State, and Federal codes.

D. All surplus soil and materials (i.e. gravel, sand, pavement, etc.) generated during excavation and backfill is to be disposed of offsite in accordance with all local and State regulations.

E. All hazardous waste generated on site will be disposed of by the Laboratory. Hazardous waste will be collected and held for Laboratory pick-up in an approved container, stored in a designated area, in an approved manner. **Hazardous material shall only be brought to the site in sufficient quantities to accomplish the task for which its use is intended. Under no circumstances will bulk quantities be brought to or stored on the job-site by the Contractor, or any of the lower tier Subcontractors.**

1.28 SPECIAL TOOLS

A. Where special tools are required for operation or adjustment of any equipment or special items such as control components, instruments, registers, dampers, etc., the Contractor shall furnish same including all the necessary duplicates required for normal use or as requested by the Laboratory.

1.29 TELEPHONE FACILITIES

A. The Contractor shall provide for its own telephone facilities for all construction personnel. Phone lines can be extended to the Contractor's trailer at the Contractor's cost by arrangement with the Laboratory.

1.30 SIGNS AND ADVERTISEMENTS

A. Signs or advertisements will not be allowed on the building enclosure or on the site except as approved in writing by the Laboratory.

1.31 SAFETY AND FIRE PROTECTION

A. The contractor shall comply with the clause entitled "Safety and Health" of Appendix A, Terms and Conditions of the Contract.

1.32 REGULATIONS, CODES, AND STANDARDS

A. The following list of regulations, codes, and standards shall be considered minimum requirements:

B. Manual of Accident Prevention in Construction. The Associated General Contractors of America, Inc.

C. National Fire Codes, including the National Electric Code NFPA 70 and the Standard for Electrical Requirements for Employee Workplaces NFPA 70E, National Fire Protection Association (NFPA).

D. The BOCA National Building Code; Building Officials and Code Administrators International, Inc.

E. The International Building Code, 2009 (IBC)

F. Motor Carrier Safety Regulations, U. S. Department of Transportation.

G. Underwriters Laboratories, Inc. lists of inspected appliances, equipment and materials.

H. Safety and Health Regulations for Construction (29 CFR 1926) and Occupational Safety and Health Standards (29 CFR 1910) of the Occupational Safety and Health Administration, U. S. Department of Labor.

I. National Electrical Safety Code (ANSI C2), the Institute of Electrical and Electronics Engineers, Inc.

1.33 REPORTS

A. The reports required of the Contractor shall include, but shall not be limited to, the following:

B. "Incident Description" on Form "ANL 239" for all occupational injuries/illnesses requiring treatment more extensive than first aid or to report fire or other property damage.

C. All contractors and their subcontractors shall report the hours worked at the Laboratory on a monthly form as provided by the Procurement Department Manager of Construction Contracts.

1.34 SAFETY PROGRAM

A. The Contractor shall refer to General Conditions and Specification Section 01 49 90 for general safety requirements associated with the Work.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01 00 00

GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 Summary

A. Work covered by Contract Documents is as stipulated within this project manual and as accompanied by drawings.

B. Definitions. The following terms are used throughout the Contract Documents. The work will be governed in accord with the definitions.
1. Laboratory: Shall mean Argonne National Laboratory
2. Architect, Owner's Representative, Engineer, or Landscape Architect: Shall mean SmithGroup, Inc.
3. Fabricated: Fabricated pertains to items specifically assembled or made of selected materials or components to meet individual design requirements.
4. Manufactured: Manufactured means standard units, usually mass-produced by an established manufacturer of the respective item.
5. Provide: Provide means furnish and install.
6. Shop fabricated or shop made: Shop fabricated or shop made refers to items made by a Contractor or Subcontractor in their own Shop.

1.2 Contracts

A. The Laboratory will award a single construction contract for all work specified herein.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 Contractor Use of Premises

A. Confine operations at site to areas permitted by:
1. Laboratory
2. Law
3. Permits
4. Contract
5. Engineer
6. Required use of adjacent existing Facilities
7. Contract documents

B. Confer with Engineer and obtain full knowledge of all site rules and regulations affecting work.

C. Conform to site rules and regulations while engaged in project construction.

D. Site rules and regulations take precedence over others that may exist outside such jurisdiction.

E. Employees On Site: The Engineer may examine Contractor's list of employees, including those of his subcontractors and their agents for all employees working on site.

F. Vehicle use: Rigidly enforce the following:
   1. Keep all vehicles, mechanized or motorized equipment locked at all times when parked and unattended on Laboratory's premises.
   2. Do not, under any circumstance, leave any vehicle unattended with motor or engine running, or with ignition key in place.
   3. All traffic control subject to Engineer's approval.
   4. Contractor employee parking shall be limited to within the project limits.

G. Do not encumber site with materials or equipment in such a manner that could impede safety, housekeeping and general construction operations. .

H. Assume full responsibility for protection safety and safekeeping of products stored on premises.

I. Move all stored products or equipment, which interferes with operations of Laboratory or other subcontractors.

J. Obtain and pay for use of additional storage or work area needed for operations.

K. Limit use of site for work and storage:
   1. To areas indicated on the drawings.
   2. To areas approved in advance by Laboratory.

3.2 Duties of Contractor

A. Except as specifically noted, provide and pay for:
   1. Labor, materials and equipment.
   2. Tools, construction equipment and machinery.
   3. Utilities required for construction.
   4. Other facilities and services necessary for proper execution and completion of work.

B. Secure and pay for as necessary for proper execution and completion of work, and as applicable at time of receipt of bids.
   1. Licenses.

C. Give required notices.

D. Comply with codes, ordinances, rules, regulations, orders and other legal requirements of public authorities that bear on performance of work.

E. Promptly submit written notice to Engineer of known or observed variances of Contract Documents from legal requirements.
   1. Appropriate modifications to Contract Documents will adjust necessary changes.
   2. Assume responsibility for Work known to be contrary to such requirements.

F. Enforce strict discipline and good order among employees. Do not employ on Work:
   1. Unfit persons as defined by a Fitness for Duty evaluation.
   2. Persons not skilled in assigned task.

G. This Project is exempt from all State and Local use taxes.
   1. Obtain sales tax exemption certificate number from Laboratory.
   2. Place exemption certificate number on invoices for materials incorporated in work.
   3. Furnish copies of invoices to Laboratory.

4. Upon completion of work, file with Laboratory, notarized statement that all purchases made under exemption certificate were entitled to be exempt.
5. Pay legally assessed penalties for improper use of exemption certificate number.
6. Proceeds from the end-use or consumption items to construction contractors to perform real estate construction contracts for the State of Illinois and its political subdivision are taxable.

H. Purchase and maintain insurance in accordance with the Terms of Conditions of the contract.

I. Provide required bonds for all portions of the work.

J. Contractor shall protect existing site from damage.
1. Contractor shall clean areas of construction debris, equipment, and material prior to Date of Completion as described in the 1AO General Conditions, and including but not limited to Division 01 Sections 01 71 00 “Cleaning”, 01 74 19 “Construction Waste Management and Disposal”, and 01 77 00 “Closeout Procedures”.

3.3 Time of Completion

A. Completion of work shall be in accordance with the schedule as indicated in the Proposal Form.

3.4 Job Operations

A. Project Security:
1. Take necessary precautions such as barrier to protect Laboratory’s personnel, the public, in the area of construction.
2. Securely close off all areas of construction after working hours to prevent entry by unauthorized persons.
3. Provide barriers to prevent visitors from construction area.

3.5 Work Limitations:

A. Laboratory’s personnel may occupy all spaces around where work will be done. Any work done during times of occupancy shall be limited in scope to prevent disturbing it.

B. Give Laboratory three (3) days notice before starting Construction Work in any area, with the exception of work within Building 400 & 435 which required ten (10) business days notice.

C. All work, including material storage, shall be limited to the project area.

END OF SECTION

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SECTION 01 00 10

SPECIAL CONDITIONS

RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

These Special Conditions apply to all Divisions of these specifications.

LOCATION OF WORK

This project site is located at:

Argonne National Laboratory
9700 South Cass Avenue
Lemont, IL 60439

SCOPE OF WORK

Reference the attached: Statement of Work Document, Enclosure 1B.

QUALITY ASSURANCE

A complete set of the contract drawings and specifications shall be available at the job site at all times when workmen are present. All work may be stopped if these documents are not readily available to all construction personnel.

The drawings and specifications provide, under the appropriate specifications section, such references to codes and standards as are necessary to ensure adequate Quality Assurance for that portion of the project.

The Laboratory reserves the right to designate mandatory hold points for inspection and testing. The Laboratory also will perform inspection of work in progress as it deems appropriate to ensure compliance with the specifications, drawings, codes and standards. The Laboratory may employ an independent testing agency to perform soils, concrete and materials testing prepared by the agency. The Laboratory will provide the Contractor with copies of pertinent inspection and test data on a timely basis.

The following inspection hold points for inspection are required at the following times:

- Prior to backfill over utilities;
- After placement of each lift of backfill and pavement base course;
- Prior to placement of concrete;
- After cable termination;
- Prior to pressure testing of piping systems

Hold points shall be indicated on contractor's master schedule.

The Department of Energy and Argonne National Laboratory are very concerned that substandard/ suspect/counterfeit materials and parts must not be incorporated into the Work. As part of its implementation of its QA/QC program, the successful offeror shall ensure that no suspect/counterfeit materials or parts are installed in the Work.
Rigorously observe all the pertinent requirements of OSHA - Occupational Safety and Health Administration Regulations and EPA-Environmental Protection Agency Regulations. The Laboratory will closely monitor compliance with all OSHA and EPA Standards and may stop work at any time when violations are observed. Such stoppage shall not relieve the contractor from fulfilling the completion date, nor shall it be a basis for any claims or additional costs.

Quality of Equipment: Use specified equipment and supplies only. Any deviations require written Laboratory approval.

MSDS: Contractor is responsible for keeping Material Safety Data Sheets available at the job site. MSDS are required for all chemicals. (Examples: Paints, degreasers, adhesive materials used for mechanical insulation.)

Welding: All welding shall be performed in compliance with the current edition of the ASME Boiler and Pressure Vessel Code.

DEFINITIONS

Contract Specialist: Member of the Procurement Division with administrative responsibility for this work. All correspondence and other business contacts will clear through that office. Any addition, deletion or change to the work which may result in an extra charge or a credit to the Laboratory must be approved by the Contract Specialist prior to proceeding with the work.

Project Manager: Member of the Laboratory Office of Project Management (OPM) in whom primary responsibility for engineering control of the project has been vested.

Construction Manager: Member of the Laboratory staff in whom primary responsibility for day to day control of the construction site and construction progress has been vested.

Installer: The person or entity engaged by the Contractor or Subcontractor for the performance of a particular unit of work at the project site, including installation, erection, application and similar required operations. It is a general requirement that Installers be recognized experts in the work they are engaged to perform.

Indicated: The term "Indicated" is a cross reference to details, notes, or schedules on the drawings, other paragraphs or schedules in the specifications, and similar means of recording requirements in the contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for the purpose of helping the reader accomplish the cross reference, and no limitation of location is intended except as specifically noted.

Active Area: In the context of this specification is defined to be any area with existing or potential radiation hazard.

Controlled Area: Is defined to be any area, access to which is controlled for reasons of radiation safety or other designated hazard. Any particular location of the entire Laboratory site may be designated as a "Controlled Area." The Laboratory is responsible for the determination of designated "Controlled Areas."

Protected Area: In the context of this specification, is defined to be all the area within the boundary fence of Argonne National Laboratory, under administrative control for security reasons, and requiring gate passes for admittance.

Furnish: Except to the extent further defined, the term "furnish" is used to mean "...supply and deliver to the project site, ready for unpacking, assembly and installation...."

Provide: Except to the extent further defined, the term "provide" means to furnish and install, complete and ready for the intended use.

Guarantee and Warranty: One Year. For details of guarantee refer to the Contract Documents, "Warranty of Construction", Argonne Terms and Conditions For Fixed Price Construction Contracts.

Radiation Safety: The Contractor shall comply with LABRATORY radiation safety requirements and procedures as directed by the Laboratory for all work.

Full Body Harnesses and Lanyard: Contractor must use full body harness with lanyard limiting fall to 6 feet, in lieu of standard safety belts. Lanyard must be attached to secured anchor point.

SECURITY REQUIREMENTS

Only persons meeting the security requirements of the United States Department of Energy shall be employed. All persons shall comply with the security regulations of Argonne National Laboratory.

All persons visiting or performing work at the site are required to obtain a GATE PASS prior to entering the area.

Completion of DOE Form (ANL-593), Request for Foreign National Unclassified Visit of Assignment, will be required prior to issuance of a gate pass to any non-citizen who will be assigned by the contractor or sub-contractors to perform work under these specifications. All non-U.S. citizens will require a 593 to be processed by your ANL contact. Information required on the form includes:

1. Name of Visitor (Non- U.S. Citizen);
2. Alias;
3. Gender of Visitor (Male/Female);
4. City & Country of Birth;
5. Current Citizenship;
6. Date of Birth (Month/Day/Year);
7. Dual Citizenship (Y/N);
8. Current Employer Information (Name & Address);
9. Title or Position;
10. Type of Business (Contracting, etc.);
11. Education Background (Names of degrees, years degrees obtained & issuing institutions);
12. Field of Research; and
13. INS Documentation (LPR card, passport, visa & status documentation)

SANITARY FACILITIES

Contractor shall provide sanitary facilities for all Contractor and Subcontractor personnel. Contractor shall ensure construction personnel do not use existing Laboratory sanitary facilities.

USE OF EXISTING UTILITIES

The Laboratory will make existing utilities such as water, gas and electricity available to the contractor without cost where such utilities are conveniently located with respect to the work site. The contractor must provide all materials, labor and equipment necessary for extending existing utilities to the point of use. The method of connection into existing utilities must be approved by the Laboratory and these connections to utilities shall be under the immediate supervisor of the authorized Laboratory representative. The contractor will be held responsible for the proper installation, operation and maintenance of temporary utilities and must adhere to all uniform codes governing such installations. Upon completion of the work, the Contractor shall remove all temporary utility lines and restore existing utilities to the original condition as directed by the Laboratory.

Prior to use of any 120 volt, single phase, 15 and 20 ampere receptacle outlet, the contractor shall install or cause the installation of a UL approved ground fault circuit interrupter for personnel protection.

SUPERVISION BY CONTRACTOR

The contractor shall, at all times during the progress of the work, provide a competent supervisor. This supervisor shall be vested with the necessary authority to direct and schedule the work and represent his firm in matters that may be referred to him by the Laboratory Project Manager.

SCHEDULING OF WORK

Shutdowns of utilities must be performed during non-operational (Laboratory) working hours unless otherwise approved by the Laboratory. **Contractor to provide appropriate manpower and/or extended work hours to keep the shutdowns within the durations indicated on the proposed construction schedule.**

Allow latitude for coordination with Laboratory experimental schedules. Upon approval of the schedule, rigorously enforce the approved dates.

Use of large horsepower tools must be scheduled with the Laboratory.

Reference Section 01 31 00 for detailed schedule requirements.

Daily Report

The contractor shall make a daily written report to the Laboratory showing the following:

- Contract Number;
- Contract Name;
- Contractor Name;
- Number of Employees, by Craft, Listed by Contractor, Subcontractor, and Lower
- Number of Man-hours worked.

Tier Subcontractors;

- Names of Supervisors;
- Description of Work Performed, by Location;
- Description of Work prohibited or delayed due to weather conditions;
- Major Material/Equipment Items delivered to site;
- Description of unexpected delays which occurred or delays that are anticipated; Indicate the steps taken to offset the delay(s);
- Log of Visitors to the site;
- Inspections and Tests Performed;
- Safety Problems, if any, Including Corrective Action Taken;
- General Comments;
- Injuries, Including First-aid Cases; and
- Contractor Superintendent's Signature.

Time Extensions

In addition to the provisions of the various applicable Clauses of Appendix A, Argonne Terms and Conditions, any delay to one or more scheduled activities that is due to either acts or omissions to act by the Laboratory, shall be treated as follows:

- Time extensions granted to the Contractor by the Laboratory as the result of an equitable adjustment of the Contract shall apply to interim milestone dates and/or the Contract completion dates only to the extent that such adjustments apply to those activities affected by a Contract modification or excusable delay and only to the extent that such modifications and delays extend activity durations (critical and/or non-critical activities) beyond the available float within such activities.

SHUT DOWNS

All shut downs shall be scheduled at five (5) business days in advance with Laboratory.

SUBMITTALS

General: Refer to General Conditions and Section 01 33 00 for general submittal requirements. Refer to each technical section for specific submittal requirements.

EXISTING WORK AND INTERRUPTION OF SERVICES

Protect existing work during construction. Do not interrupt any existing services without prior coordination and approval by the Laboratory. Nothing in this Contract shall be construed to permit any action which would endanger existing equipment, facilities or the continuity of services. Any damage occurring in the progress of this work shall be repaired as a part of the Contract with no increase in Contract price.

Perform all patching of existing structure. Provide all equipment supports. Contractor and his Subcontractors of any tier are to be responsible for restoration of existing conditions to the satisfaction of the Laboratory.

DELIVERY AND STORAGE

Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and labeled with the following information:

Name and title of material;
Federal Specification Number;
Manufacturer's stock number and date of manufacturer;
Manufacturer's name;
Contents by volume for major pigment and vehicle constituents;
Thinning instructions;
Application instructions; and
Color name and number.

All flammable material shall be stored in labeled safe enclosures, and handled to prevent fire hazards. Waste materials and solvent shall be removed from the project promptly to minimize fire hazard. Contractor shall regularly inspect premises during painting operations to assure safe handling of all hazardous materials.

DISPOSAL OF EXCESS MATERIALS, EQUIPMENT AND DEBRIS

All other excess materials, equipment and debris shall be disposed or recycled as per requirements of Section 1AO-General Conditions and Specification Section 01 74 19.

VERIFICATION OF SITE

Offerors shall visit the site and verify all applicable conditions likely to affect the work under this Contract. Proposals shall include all incidental items as required to complete the work specified or shown in the contract documents.

ACCESS TO THE SITE

The main entrance to Argonne National Laboratory is through North Gate. Gate passes are issued at the Visitors Reception Area located at North Gate. All construction employees and construction deliveries should be made through North Gate. Gate Passes must be requested through the Laboratory designated representative a minimum of 24 hours in advance of a visitor's entrance into the laboratory.
Special exceptions may be made upon request and approval. Northgate is open at all times. Construction deliveries should never be made to the Argonne Receiving Department in Building 46.

WORK HOURS

Normal work hours are from 7:00 a.m. to 3:30 p.m., Monday through Friday. The Contractor must request and receive written authorization from the Laboratory to work outside of these hours. Written request for scheduled overtime must be received a minimum of 48 hours prior to the requested start of the work.

PRE-CONSTRUCTION MEETING

A pre-construction meeting will be scheduled by the Laboratory to occur within one week after the construction contract is awarded but prior to start of any construction work. Reference Section 01 20 00 for detailed requirements and Contractor pre-requisites.

The meeting will cover but will not necessarily be limited to the following items:

Laboratory Direction for Contractor;
Changes to Contract;
Work Entry Permits;
Construction Schedule;
Submittal Procedure;
Temporary Protection;
Material Storage;
Fire, Safety, and Security Procedures;
Payment Request Procedures;
OSHA Requirements;
As-Built Drawings;
Emergency Off-Hour Contacts;
Final Project Acceptance Procedure; and
Contractor's Environment, Safety and Health (ES&H) Program and Implementation Plan.

END OF SECTION

SECTION 01 01 00

OWNER FURNISHED/CONTRACTOR INSTALLED EQUIPMENT

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

A. The Project consists of construction of the Advanced Protein Crystallization Facility at Argonne National Laboratory in Lemont, Illinois, in accordance with the Contract Documents.

1.2 CONTRACTORS USE OF PREMISES

A. Confine operations on the site to areas indicated.

B. Do not encumber site with materials or equipment in such a manner that could impede safety, housekeeping and general construction operations.

C. Do not overload the structure with weight that would endanger it.

D. Assume full responsibility for protection and safekeeping of materials and tools stored at the site.

E. Obtain and pay for use of additional storage space or work areas needed for construction operations.

1.3 OWNER FURNISHED/CONTRACTOR INSTALLED ITEMS

A. Submittals

1. Obtain all necessary information from Laboratory (OFCI) as to manufacturer, model, and type of each Owner Furnished Contractor Installed item furnished by Laboratory.
2. Submit shop drawings, in accordance with the requirements of Section 01 33 00, showing dimensioned rough-in diagrams for each OFCI item requiring utility connections, dimensioned locations of backing plates required in walls and partitions, and details of connections to supports of all OFCI items.

B. General

Contractor is responsible for correct and properly located installation of the OFCI items in accordance with the various manufacturer's specifications and instructions.

1. If a conflict occurs between manufacturer's instructions and actual field conditions, do not install the affected items until the conflict is resolved. No extra payment will be made to the Contractor for correction of improper installation of OFCI items when reasonably adequate data and instructions for installation were furnished by Laboratory or various OFCI item manufacturers.
2. OFCI items will be delivered FOB jobsite. Contractor shall receive and unload OFCI items, place in covered storage or enclosed building, and be responsible therefore after delivery. OFCI items that are damaged, abused, lost, or stolen while in the Contractor's custody and control or damaged or defaced during installation shall be repaired, replaced, or otherwise made good to Laboratory 's satisfaction at the Contractor's expense.

3. Immediately after delivery of the OFCI items, open and uncrate the items for inspection (note subsection 1.3.B.5 below). Laboratory and the Contractor shall inspect each item and maintain a written record of all damage, missing parts, and other defects disclosed, all of which will be made good by Laboratory. After the inspection, Contractor shall be solely responsible for the equipment as specified above.
4. Contractor may request and receive from Laboratory any necessary additional information, such as specifications, templates, and like items from any of the manufacturers of the OFCI items. The Contractor may request a manufacturer's representative to supervise installation of any OFCI item, but at no extra cost to Laboratory.
5. Contractor shall be responsible for complying with all cleanroom and clean-build protocol requirements as identified by the OFCI equipment manufacturers and the Contract Documents as they pertain to tasks including, but not necessarily limited to, equipment receipt, inspection, storage, and installation.

C. Installation Materials

Provide attachments, fittings, fasteners, connectors, and other ancillary materials required to make complete workable installations.

D. Installation

Conform to each OFCI item manufacturer's specifications, templates, and information, including the necessary assembling of components or sub-assemblies.

1. Verify that space limitations, and mechanical and electrical services indicated and specified in other Sections are compatible with OFCI items.
2. Verify that modifications to OFCI items required to conform with space limitations or with utility services specified for rough-in shall not cause additional cost to Laboratory.
3. If Laboratory substitutes items similar to those scheduled, there shall be no change in rough-in cost, unless substitution occurs after rough-in has been completed or rough-in involves other mounting requirements, utilities or utilities are different capacity from that required by items originally specified.

1.4 LABELS

A. Except for Code-required labels, equipment name-plates and similar labels containing manufacturers name, address, model number, capacity and other rating information which are securely attached to each piece of equipment, the installation of any item, element, or assembly which bears on any exposed surface the name, trademark, vendor, fabricator or other sources from which the product has been obtained, is prohibited.

B. Also forbidden is the installation of any article which bears visible evidence that a name, trademark, or other insignia has been removed.

1.5 DEFINITIONS

A. In addition to other definitions included in these Specifications, the following also apply to the Work:

1. “Owner” or “client” shall mean Argonne National Laboratory (“Laboratory”)
2. "As shown", "as detailed", "as indicated", or other words of similar import refer to their use in relation to the Drawings.

3. "As selected", "as approved" or words of similar import refer to selection or approval or acceptance by Laboratory.
4. "Shall" refers to actions that are mandatory in nature.
5. "As required" refers to actions that must be taken under the terms of the Contract Documents.
6. "As necessary" refers to actions that are essential to the completion of the Work.
7. "Concealed" means embedded in masonry, concrete, or other construction materials, installed within furred spaces, within a wall/partitions or above suspended ceilings, in trenches, in crawlspaces, or in enclosures.
8. "Exposed" means not installed underground or concealed as defined above.
9. "Product" refers to all materials, systems, and equipment.
10. "Section" and "Division" refer to the specific Section or Division of these Specifications.
11. "OFCI" refers to Owner-Furnished, Contractor-Installed.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 02 50

UNIT PRICES

PART 1 - GENERAL

1.1 Requirements Included

A. This section describes the method of pricing the change in the work for which the price is stated and which may be ordered as the Work progresses.

B. The bidder agrees that if the quantities of Work shall change, the Contract Sum will be adjusted by an amount equal to the net difference of quantities multiplied by the agreed upon Unit Prices.

1.2 Related Requirements

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Individual Specifications Sections stipulate pertinent requirements for products and methods to achieve the work required for each Unit Price.

C. Payment for additional work and credit for deductions in work ordered under the applicable provisions of Appednix A, Argonne Terms & Conditions and Technical Sections of the Specifications shall be computed in accordance with the prices defined on the Fixed-Price Construction Contract between UChicago Argonne, LLC. and Contractor.

D. The unit prices shall be all inclusive of cost of the labor, materials, waste, loss, breakage, damage, equipment, work, layout, technical/data submittals, shop drawings, coordination, drafting, overhead, profit, bond and any and all other costs associated for each of the items listed.

E. The calculations for determining the number of units of work shall be of actual surface, volume, length, hours or number of individual items listed for the class of work, complete in place and accepted or omitted. No allowance for waste, loss, breakage or damage will be made.

F. The unit prices to be bid upon for each Subsystem are listed on Enclosure 1.M.
   1. These Unit Prices shall be all-inclusive (i.e., shall include costs for labor, supervision, material, equipment, bond, overhead, profit, etc.). Unit Price titles and their corresponding estimated quantities for *proposal preparation purposes only* are as follows (see technical specifications for complete descriptions). It should be noted that the Unit Prices will not be evaluated to determine the apparent low offeror. Reference Enclosure No. 1M. for details.

1.3 UNIT PRICE SCHEDULE

A. For Unit Price schedule information refer to Enclosure 1M provided by the Laboratory.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 04 00

PROJECT COORDINATION

PART 1 - GENERAL

1.01 PROJECT COORDINATION

A. The Contractor shall recognize the complex nature of the Project, the sequential nature of the Work and the concurrent operations of all Contractors and Subcontractors.

B. The Contractor shall become thoroughly familiar with the requirements of Division 1, Schedule of Dates, and scope of work of his Subcontractors and make any adjustments necessary to maintain the Detailed Construction Schedule. (Also sometimes called Detailed Project Schedule, Detailed Schedule, Project Schedule, The Schedule, and Schedule and the Project Master Schedule.)

C. Close coordination will be required of the Contractor with Laboratory or Laboratory's Designated Representative, Architect, Subcontractors, and others having an interest in the Project:

1. to assure that Work on the site, access to and from the site and the general conduct of operations is maintained in a safe and efficient manner;
2. and that disruption and inconvenience to existing streets and property is minimized; and
3. that the Project Master Schedule is maintained in an orderly and efficient manner.

1.02 OCCUPIED AREAS

A. During the construction period contemplated for the Work described herein, adjacent streets and areas will remain in use.

B. Adjacent areas or facilities shall be off-limits to all construction personnel.

1.03 MAINTAINING STREET SERVICE and ACCESS

A. The Contractor and his Subcontractors of any tier shall be subject to such rules and regulations for the conduct of the Work as Laboratory or Laboratory's Designated Representative may establish.

B. The Contractors Work must minimize disruptions or disturbances to the adjacent streets and Laboratory facilities. .

C. Construct the Work in stages to provide for public convenience. Do not close off public use of a street until completion of one stage of construction will provide alternative usage, if possible, and always through the coordination of Laboratory or Laboratory's Designated Representative.

D. The Contractor shall not block, obstruct or impede access through any designed jobsite entrance at any time without Laboratory or Laboratory's Designated Representative's prior approval.

E. No interruptions to the work of Laboratory or Laboratory's Designated Representative will be permitted without the prior written permission of Laboratory or Laboratory's Designated Representative. Arrangements for work interruptions shall be made with Laboratory or Laboratory's Designated Representative at such times and for durations as authorized by him.

1.04 COORDINATION WITH LABRATORY OR LABRATORY'S DESIGNATED REPRESENTATIVE

A. Observation of Work by others shall not be interpreted as relieving the Contractor from his responsibility for coordination of his Work with the Work of others, superintendency of his Work, sufficiency of his work, or scheduling and direction of his Work.

B. The Contractor shall provide full-time on-site Project Manager and Superintendent and such other personnel as required to properly manage the Project. Verifiable qualifications of the Project Management Team (Project Manager, Superintendent and Safety Manager) and Scheduler (See Section 01 31 00) must be submitted to Laboratory or Laboratory's Designated Representative for approval prior to the start of the Work. After approval the Project Manager, Superintendent and Scheduler shall remain assigned to the Project until it is substantially complete or until such time as Laboratory or Laboratory's Designated Representative approves their removal and/or replacement.

C. The duties of the Contractors' Project Manager, Superintendent, and Scheduler shall include but not be limited to:

1. Coordination and liaison with all other Contractors, Architect, and Laboratory or Laboratory's Designated Representative.
2. Plan and supervise all Contractor field operations.
3. Direction of all administrative and management requirements for the control of time and cost. The Project Manager and Superintendent shall be vested with the power, authority, experience and confidence needed to make binding decisions for the Contractor.

1.05 COORDINATION WITH CONTRACTORS

A. As various areas or parts of the site and buildings are complete, or otherwise suitable for the subsequent contractors to commence work, those contractors shall be allowed to deliver materials and must start work. Such phased commencement shall be in accordance with the Project Master Schedule. Prior to commencing work at any area or part, certain contract requirements shall be met for that area or part, such as verification of conditions as specified. Contractor must submit a complete set of MEP coordination drawings for Lab approval; drawings must be updated and resubmitted if any conditions change.

B. All Contractors are to coordinate their work with the work of the other Contractors for proper function and sequence to avoid construction delays.

C. The Contractor shall maintain free access to all buildings and areas to the site for emergency vehicles, service vehicles, and fire fighting equipment and at no time shall block off or close roadways or fire lanes without providing auxiliary roadways and means of entrance acceptable to Laboratory or Laboratory's Designated Representative. Adjacent fire hydrants, if any, must remain accessible at all times. The Contractor shall give Laboratory or Laboratory's Designated Representative and the Laboratory Fire Department at least five (5) business days notice of need for any such changes or alternate project access routes.

1.06 CONTRACTORS RESPONSIBILITY FOR COORDINATION

A. All Contractors shall work similar hours in performing the Work under an orderly and systematic means. Normal work hours for the Project are as indicated in Section 01 00 10, "Special Conditions".

B. Whenever the Contractor intends to depart from normal work hours, he shall notify Laboratory or Laboratory's Designated Representative at least forty-eight (48) hours in advance. Failure of the

Contractor to give such timely notice may be cause for Laboratory or Laboratory's Designated Representative to require the removal or uncovering of work performed without the knowledge of Laboratory or Laboratory's Designated Representative.

C. The Contractor shall work so as to proceed without delay and to maintain Schedule dates. All operations shall be conducted so as to comply with all applicable laws, ordinances, and regulations.

1.07 EXISTING UTILITIES and SERVICES

A. Utilities and/or other services which are shown or not shown but encountered, shall be protected by the Contractor from any damage from any work and/or operations of the contract, unless or until they are abandoned. If any utilities or services are not abandoned at time of damage, the Contractor shall be responsible for the repair of any damage from his work and/or operations and for restoration of the utilities and services to an equal or better condition that which existed prior to the damage as directed.

B. The Contractor and his Subcontractors of any tier shall be responsible for all damage to the Project buildings, facilities, and grounds due to his operations. Repair or replacement of damaged items shall be to the satisfaction of Laboratory and Laboratory's Designated Representative.

1.08 COORDINATION SHOP DRAWINGS

A. The Contractor shall establish a program for the preparation and submittal of coordination shop drawings. The Contractor's program shall ensure that all work, including but not necessarily limited to all ductwork, piping, plumbing, fire protection, electrical, instrumentation, voice and data raceway, and breechings installed shall be fully coordinated and meet all Contract Document requirements.

B. The Contractor's coordination shop drawing program shall include the requirement that coordination drawings shall be prepared at a minimum scale of ¼" per foot and shall include sufficient detail to demonstrate to Laboratory or Laboratory's Designated Representative that all work installed shall meet the requirements of the drawings and specifications and has been fully coordinated.

C. The Contractor shall, within 14 calendar days of contract award, submit a detailed description of its coordination shop drawing program for review and approval by Laboratory or Laboratory's Designated Representative. Laboratory or Laboratory's Designated Representative will complete its review of the program within 14 days of receipt. Contractor shall resolve comments and implement the program.

D. Any equipment, material, or other items brought onto the project work site without prior review and acceptance of shop drawing submittals shall be subject to removal from the site at the discretion of Laboratory or Laboratory's Designated Representative at the expense of the Contractor. Reference Section 01 33 00 for submittal requirements.

E. Any equipment, material, or piping, installed without prior shop drawing submittal, review, and acceptance shall be subject to removal and replacement at the discretion of Laboratory or Laboratory's Designated Representative at the expense of the Contractor. This includes any material installed without prior submission and acceptance of the required coordinated to scale plans and sections to be produced and coordinated by all trades. Reference Section 01 33 00 for submittal requirements.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 04 50

CUTTING AND PATCHING

PART 1 - GENERAL

1.01 REQUIREMENTS INCLUDES

A. Cutting, fitting, and patching, including attendant excavation and backfill, required to complete Work or to:

1. Make its several parts fit together properly;
2. Uncover portions of the Work to provide for installation of ill-timed work;
3. Remove and replace defective work;
4. Remove and replace work not conforming to requirements of Contract Documents;
5. Remove samples of installed work as specified for testing; and
6. Provide routine penetrations of non-structural surfaces for installation of piping and electrical conduit

B. Cutting, Patching, and Openings in Existing Construction:

1. Openings in existing construction required for plumbing or other work shall be provided by each respective Contractor.
2. Patching and finishing shall be provided by each Contractor and shall match the existing surfaces and include the refinishing of the entire surface, including painting, i.e., from corner to corner and floor to ceiling of walls.
3. Temporary protection must be installed and approved by Laboratory prior to commencing work.

C. Inserts:

1. Each respective Trade Contractor shall provide all inserts, sleeves, hangers, and other accessories as required for the installation of his work.
2. Inserts shall be set in proper positions and be so maintained during construction.
3. In the event that timely delivery of inserts and other accessories cannot be made, and to avoid delay, boxes or other forms shall be set where permanent material is to be installed.
4. Upon subsequent installation of permanent items they shall be filled around with materials as required by Contract Documents provided by the Contractor requiring the penetration.

1.02 SUBMITTALS

A. Submit a written request to Laboratory or Laboratory’s Designated Representative and copy the Architect in advance of executing any cutting or alteration which affects:

1. Work of any Contractor;
2. Structural value or integrity of any element of the Project;
3. Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems;
4. Efficiency, operational life, maintenance or safety of operational elements; and
5. Visual qualities of sight-exposed elements.

B. Request shall include:

1. Identification of the Project;

2. Description of affected work;
3. The necessity for cutting, alteration or excavation;
4. Effect on work of Laboratory or any separate contractor or on structural or weatherproof integrity of Project;
5. Description of proposed work:

    a. Scope of cutting, patching, alteration, or excavation;
    b. Trades who will execute the work;
    c. Products proposed to be used; and
    d. Extent of refinishing to be done.

6. Alternatives to cutting and patching;
7. Cost proposal, when applicable; and
8. Written permission of any separate Contractor whose work will be affected.

C. Should conditions of Work of the schedule indicate a change of products from original installation, Contractor shall submit request for substitution.

D. Submit written notice to Laboratory or Laboratory's Designated Representative and copy the Architect designating the date and the time when work will be uncovered.

END OF SECTION

SECTION 01 05 00

SURVEY & FIELD ENGINEERING

PART 1 - GENERAL

1.01 LINES and LEVELS

A. The survey furnished by Laboratory will identify the property line and permanent bench marks.

B. Contractor shall preserve survey control monuments, reference points, project control points, and bench marks unless directed otherwise by Laboratory or as noted in the contract.

C. Establish control points and bench marks adequate for the use of all trades for reference so that all parts of the work will be within the tolerance specified or standard within the industry, when not specified.

D. Any property corner or public land corner that is destroyed or disrupted by construction operations shall be reestablished by a qualified licensed surveyor at the expense of the Contractor causing said damage.

E. Maintain firm control points and bench marks in all undisturbed condition until final acceptance by Laboratory.

F. Discrepancies found at any time shall be reported to the Laboratory or Laboratory's Designated Representative immediately.

1.02 PROJECT RECORDS and SUBMITTALS

A. The Contractor shall prepare survey notes and records for staking and layout, and furnish Laboratory with certified original notes, drawings, calculations, and cut sheets. Additional copies of the survey shall be furnished to Laboratory at their request.

B. The Contractor shall submit name and address of Engineer or Surveyor along with a signed certificate stating that all elevations and locations of improvements are in compliance with the contract.

C. Project record documents must be correlated with Laboratory coordinate system.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 05 10

LAYOUT OF THE WORK

PART 1 - GENERAL

1.01 PROJECT LAYOUT

A. These Contract Documents have been prepared for the purpose of an contract award to qualified Contractors. Contractor shall review the Documents and immediately advise Laboratory or Laboratory's Designated Representative of any adverse factor which might affect the execution of this Work. Contractor will, if no objections are noted, agree to incorporate into his Contract, and coordinate work with the requirements of all subsequent documents.

1.02 COORDINATION WITH OTHERS

A. Contractor shall recognize the need to obtain accurate field dimensions in ample time to permit fabrication of certain items and allow for delivery and installation in time to maintain the construction schedule. The Contractor and all subcontractors shall cooperate in completing work phases to accommodate the schedule for obtaining dimensions and to prevent fabrication delay. In the event it is impractical to have work in place to permit field measurements, the Contractor shall guarantee necessary dimensions before construction to the various fabricators and be responsible to insure the dimensions.

B. Verify measurements at the site. No extra charges shall be allowed for differences between dimensions shown and actual measurements. Advise Laboratory or Laboratory's Designated Representative of any differences noted. Do not provide filler pieces or closures without approval.

C. Contractor shall furnish approved copies of all information (i.e., shop drawings, diagrams, templates, tech data, etc.) to Subcontractors and Laboratory or Laboratory's Designated Representative as required for the purpose of coordination of the Work.

D. Contractor shall protect and preserve the established control points, monuments, stakes, benchmarks or other datum points. The Contractor shall make no change in locations without the written approval of Laboratory or Laboratory's Designated Representative. Any of the control points which might be lost or displaced, through the neglect of the Contractor, shall be replaced at his cost.

1.03 CONTRACTORS EXECUTION

A. Contractor shall employ qualified personnel to stake out/locate the reference points as needed to properly locate his Work as well as his subcontractors Work. All significant points and benchmarks identified by Contractor shall be preserved for use by his Subcontractors.

B. Contractor shall verify the overall and critical dimensions and elevations for his Work prior to commencing the Work.

C. All Work, and in particular piping, and similar items, shall be neatly and carefully laid out to provide the most useful space utilization and the most orderly appearance. Valves shall be located in inconspicuous, but accessible locations before proceeding with any Work where exposed to view. The Contractor shall carefully plan the layout and review any questionable installations with Laboratory or Laboratory's Designated Representative.

D. Except as provided above, each Contractor shall examine the conditions under which the Work is to be installed and notify Laboratory or Laboratory's Designated Representative in writing of any discrepancies or conditions detrimental to proper performance of the Work. No Contractor is to proceed until the required corrections are accomplished. Each Contractor shall be responsible for the correct location, dimensions and elevations of his Work. As the Work progresses, the Contractors shall layout the exact locations of the Work as a guide for all trades.

1.04 COORDINATION

A. Refer to Specification Section 01 04 00 for Coordination Requirements.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 06 00

REFERENCE STANDARDS AND DEFINITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Fixed-Price Construction Contract between UChicago Argonne, LLC and Contractor.

B. Indicated: The term indicated refers to graphic representations, notes, or schedules on the Drawings, or other Paragraphs or Schedules in the Specifications, and similar requirements in the Contract Documents. Terms such as "shown," "noted," "scheduled," and "specified" are used to help the reader locate the reference. There is no limitation on location.

C. Regulation: The term regulations includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.

D. Furnish: The term furnish means supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

E. Install: The term install describes operations at the Project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

F. Provide: The term provide means to furnish and install, complete and ready for the intended use.

G. Installer: An Installer is the Trade Contractor or an entity engaged by the Contractor, either as an employee, subcontractor, or contractor of lower tier, to perform a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1. The term "experienced," when used with the term "Contractor" or "Installer" means having a minimum of three previous projects similar in size and scope to this Project, being familiar with the special requirements indicated, and having complied with requirements of the authority having jurisdiction.
2. Trades: Using terms such as carpentry is not intended to imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as carpenter. It also does not imply that requirements specified apply exclusively to trades persons of the corresponding generic name.

3. Assigning Specialists: Certain Sections of the Specifications require that specific construction activities shall be performed by specialists who are recognized experts in those operations. The specialists must be engaged for those activities, and their assignments are requirements over which the Contractor has no choice or option. However, the ultimate responsibility for fulfilling Contract requirements remains with the Contractor's.
   a. This requirement shall not be interpreted to conflict with enforcement of building codes and similar regulations governing the Work. It is also not intended to interfere with local trade union jurisdictional settlements and similar conventions.

H. Project Site is the space available to the Contractor for performing construction activities, either exclusively or in conjunction, with others performing other work as part of the Project. The extent of the Project Site is shown on the Drawings and may or may not be identical with the description of the land on which the Project is to be built.

I. Testing Agencies: A testing agency is an independent entity engaged to perform specific inspections or tests, either at the Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.3 SPECIFICATION FORMAT AND CONTENT EXPLANATION

A. Specification Content: This Specification uses certain conventions regarding the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations or circumstances. These conventions are explained as follows:

1. Abbreviated Language: Language used in Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words that are implied, but not stated, shall be interpolated as the sense requires. Singular words will be interpreted as plural and plural words interpreted as singular where applicable as the context of the Contract Documents indicates.
2. Imperative and streamlined language is used generally in the Specifications. Requirements expressed in the imperative mood are to be performed by the Contractor. At certain locations in the text, subjective language is used for clarity to describe responsibilities that must be fulfilled indirectly by the Contractor, or by others when so noted.
   a. The words "shall be" are implied wherever a colon (:) is used within a sentence or phrase.

1.4 INDUSTRY STANDARDS

A. Applicability of Standards: Except where the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with the standards in effect as of the bid due date or as referenced in applicable Building Codes.

C. Conflicting Requirements: Where compliance with two or more standards is specified and where the standards may establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to Laboratory or Laboratory's designated representative for a decision before proceeding.

1. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the

minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of the requirements. Refer uncertainties to Laboratory or Laboratory's designated representative for a decision before proceeding.

D. Copies of Standards: Each entity engaged in construction on the Project is required to be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, the Contractor shall obtain copies directly from the publication source.

E. Abbreviations and Names: Trade association names and titles of general standards are frequently abbreviated. Where such acronyms or abbreviations are used in the Specifications or other Contract Documents, they mean the recognized name of the trade association, standards-generating organization, authority having jurisdiction, or other entity applicable to the context of the text provision. Refer to the "Encyclopedia of Associations," published by Gale Research Co., available in most libraries.

1.5 GOVERNING REGULATIONS AND AUTHORITIES

A. Do not perform Work which is known to be, or which the Contractor or subcontractor is in a position to know, is contrary to applicable regulatory requirements which include, but are not necessarily limited to the building codes and regulations identified in the Contract Documents.

1.6 SUBMITTALS

E. Permits, Licenses, and Certificates: For Laboratory or Laboratory's Designated Representative and the Laboratory's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, and similar documents, correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of the Work.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

(Not Applicable)

END OF SECTION

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SECTION 01 18 00

PROTECTION OF WORK AND PROPERTY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 REQUIREMENTS INCLUDED

A. Protection of Work and Property.

1.3 PROTECTION OF WORK AND PROPERTY

A. The Contractor shall continuously protect the work and the work of others, including without limitation, property adjacent to the site, from damage, injury or loss arising from the Contractor's work and operations. The Contractor shall employ only methods of construction of erection that conform to OSHA regulations and local, State, and Federal safety laws and codes which provide adequate protection to the work and to the property of Laboratory and others.

B. The Contractor shall confine his construction equipment, the storage of materials, and the operations of workmen to the limits indicated by laws, ordinances, permits, and as may be established by Laboratory or Laboratory’s Designated Representative, and shall not unreasonably encumber the premises with construction equipment or materials.

C. The Contractor shall remove all snow and ice as may be required for the proper protection and execution of his work. The Contractor shall, at all times, provide and maintain adequate protection against weather, so as to preserve his work, materials, equipment, apparatus, and fixtures free from injury or damage.

D. The Contractor shall remove and dispose of all trash and debris in a timely and safe manner. Accumulation of trash, debris or construction materials that could constitute a fire or safety hazard within the structure or on the site, shall not be allowed. The Contractor shall, if so directed by Laboratory or Laboratory’s Designated Representative, immediately remove and dispose of any materials that create a fire or safety hazard.

Laboratory, if the Contractor fails to take appropriate and immediate action (in the Laboratory’s opinion), shall have all such materials removed from the site and disposed of at the Contractor's expense.

E. Welding, flame cutting or other operations involving the use of flame, arcs or sparking devices will not be allowed without adequate protection and shielding, particularly at the point of operation and without prior approval by Laboratory or Laboratory’s Designated Representative. All combustible and flammable material shall be removed from the immediate work area. If removal is impossible, all flammable or combustible materials shall be protected with a fire blanket or suitable non-combustible shields to prevent sparks, flames or hot metals from contacting the flammable or combustible materials. Contractor shall provide the necessary fire watch personnel and fire fighting equipment to effectively control incipient fires resulting from welding, flame cutting or other operations involving the use of flame, arcs or sparking devices.

F. The Contractor, as necessary for his work, shall provide flagmen and erect proper barricades and other safeguards, and post danger signs and other warnings as may be required due to hazards or existing conditions effecting the performance of the work.

G. Contractor is to furnish, install, and maintain a temporary chain link fence around the project site, including staging and parking areas for construction. All temporary fencing is to be relocated as necessary for work progress, and must be removed at the end of the project. Laboratory shall provide project security only to the extent of fences with locked gates or doors around the perimeter of the site. Each Contractor shall be responsible for the security of its own property.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 20 00

PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRE-CONSTRUCTION MEETING

A. Before beginning the work and after the Contract has been awarded the Laboratory will schedule a Pre-Construction Meeting to discuss: work entry, and other permits, daily manpower accountability, tool inspections, barricades, work hours, weekly tool box meetings, competent persons, postings, laydown areas, show drawings, temporary facilities and utilities, construction schedules and procedures, development of a plan for utility protection and reconstruction, arrangements for orderly movement of traffic, Contractor's use of the site, Contractor's movement of traffic, Contractor's use of existing facilities, Laboratory's regulations, including Environment, Safety, and Health and OSHA requirements, Project Record Documents and other matters deemed relevant to the effective performance of the work and as described in these specifications.

B. Requirements for Meeting. The Pre-construction Meeting will not be held until the Contractor has:

1. Submitted his Contractor's Environmental, Safety, and Health (ESH) Program and Implementation Plan/Job Safety Analysis
2. Submitted all other pre-construction submittal requirements described in the contract requirements; and
3. Submitted Contractor's construction schedule and sequence as specified in Section 01 31 00.
4. Storm Water Pollution Prevention Plan (SWPP)

C. The meeting shall be attended by:

1. The Contractor's Project Manager/Key Office Representative;
2. The Contractor's Field Superintendent and ESH representative;
3. Any subcontractor's or supplier's representative whom the Contractor may desire to invite or Laboratory may request; and
4. Laboratory Personnel.

1.2 PROGRESS MEETINGS

A. Weekly project meetings will be held at the job site by Laboratory or Laboratory's Designated Representative for the purpose of coordinating and expediting the Work in Progress. The duties of the Contractor's Project Manager, Superintendent, and Scheduler shall include direction of all administrative and management requirements for the control of time and cost. The Project Manager and Superintendent shall be vested with the power, authority, experience and confidence needed to make binding decisions for the Contractor.

A partial agenda follows:

a. Review of previous Meeting Minutes (Old Business);
b. Schedule:
   (1) Review of actual progress compared to Contractor's project schedule;
   (2) Review of Short Interval Schedule (reference Section 01 31 00.); and
   (3) Review delivery dates for specific equipment and materials.
c. Shop Drawings and Samples:
   (1) Review the status of shop drawings and sample submittals and
   (2) Review of approved shop drawings affecting other trades.
d. Change Orders:
   (1) Review of latest Contract changes and
   (2) Review status of Pending Change Orders and Work Authorizations
e. Review the status of Requests for Information (RFIs);
f. Review of specific coordination or construction problems;
g. Review Items of General Conditions;
h. Weekly work requirements;
i. Safety;
j. Laboratory or Laboratory's Designated Representative, Architect, and Contractor comments; and
k. Other Business.

B. Special meetings may also be called at the discretion of Laboratory or Laboratory's Designated Representative for the purpose of coordinating specific information or resolving special problems related to Project.

C. Each Contractor who has work in progress will be represented at the progress meeting by the Field Superintendent or Project Manager.

D. The essence of the discussion of each meeting will be entered into the minutes and copies will be furnished by Laboratory or Laboratory's Designated Representative to all interested parties within one week.

1.3 PLAN OF THE DAY (POD) MEETING

Daily project meetings referred to as "Plan of the Day or POD Meetings" will be held at the job site by the Contractor for the purpose of coordinating and planning daily activities, communicating hazards, interfacing with project personnel and other topics related to daily operations. POD meetings must be performed each day prior to commencing any on-site construction activities. It is the Contractors responsibility to coordinate, conduct and facilitate the POD meetings. The Contractor's Field Superintendent, ESH Representative and Project Engineer/ Superintendent and at least one (1) representative from each subcontractor performing work on-site that day must be in attendance.

Subcontractors and all lower-tier subcontractors shall identify all planned tasks on a POD form prepared by the general contractor. The level of detail must be appropriate to define all tasks' that may present a hazard to people, property or environment. The listed task(s) shall include the corresponding previously approved JSA(s) or reference the applicable section from a current health and safety plan or program. If the task proposed does not have a corresponding JSA, then a new JSA will need to be developed and reviewed prior to the work moving forward.

The completed POD must be reviewed against conflicting operations, regulatory hold points, required permits and acceptable level of detail. Upon approval by the General Contractor, the approved POD is then submitted to the Laboratory for review and work authorization. Once work authorization is received, each Subcontractor shall conduct a daily "tailgate" meeting with each work crew member prior to the start of each work shift, or when an individual arrives at work. Members shall acknowledge the daily "tailgate" meeting by signing an attendance roster. The meeting shall include a discussion of the specific POD and corresponding JSA or additional safety topics of interest to site personnel.

1.4 SITE WALKS

At a minimum of one (1) occurrence per week, a formal tour of the entire construction site will be performed with Laboratory and Department of Energy representatives The contractor shall have in attendance the following: Field Superintendent, ESH representative and Project Manager.

At a minimum of one (1) occurrence per month or 30 calendar days, management representatives from the contractor and each subcontractor performing work on-site shall participate in the formal tour described in the above paragraph. Acceptable management representatives shall be at least one (1) management/supervisory level higher than personnel responsible for this project's management or supervision.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 23 00
ALTERNATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS

A. Alternate: An amount proposed and stated on the Proposal Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Argonne National Laboratories decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
   2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. For Alternate schedule information refer to Enclosure 1N. Proposal Form

B. Refer to Drawings for listed alternates.

END OF SECTION

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SECTION 01 25 00

SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for
   1. Proposed Products List
   2. Substitutions after Agreement is executed and Proposed Products List has been approved..

B. Related Sections:
   1. The procedures governing substitution requests prior to Agreement execution are defined elsewhere.
   2. Division 01 Section governing unit prices for products selected under an unit price.
   3. Division 01 Section governing alternates for products selected under an alternate.
   4. Division 01 Section governing product requirements for comparable product submittals.
   5. Divisions 02 through 33 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes, proposed by the Contractor, in products, materials, equipment, or Contract requirements from those required by the Contract Documents. Where the proposed substitution is other than a product or material substitution, comply with provisions of this Section, except those obviously limited to products or materials.

1.4 SUBMITTALS

A. PROPOSED PRODUCTS LIST AND SUBSTITUTION REQUESTS
   1. The intent of the Documents is:
      a. To fully identify, prior to beginning the Work, the products Contractor intends to provide, and substitutions the Contractor requests.
      b. To facilitate timely submittal processing by avoiding rejection of unacceptable products and unspecified products later during construction.
   2. Proposed Products List
      a. Within 14 calendar days after date of receipt of notice to proceed and before submitting any Product Submittals, submit for approval an initial list of the products proposed for installation. Include the name of the manufacturer for each product and, where applicable, the name of Subcontractor. Update list as required in advance of forthcoming products proposed for installation
      b. The list shall be tabulated by and be complete for each Specification Section.
      c. For each product listed, clearly indicate: a) As Specified, or b) Not As Specified. For each product designated Not As Specified, clearly indicate: c) Comparable Product, or d) Proposed Substitution.
      d. Provide 3 copies of the list, unless another quantity has been agreed to.

B. Substitution Requests accompanying the Proposed Products List
   1. A request for substitution will be considered, subject to the following requirements:
      a. Complies with a circumstances specified under Article 1.5B.
      b. Where possible include with the proposed products list a completed substitution request form for each proposed substitution anticipated for the Project. Check the box indicating the request is submitted with the proposed products list.
      c. Submit each proposed substitution using a separate copy of the substitution request form. Use substitution request form included in the Project Manual, or request form from the Architect. Submit in number of copies specified for proposed product list.
      d. Include with the request complete data on the proposed substitution. Such data shall include:
         1) Product Data highlighted to show applicability to the proposed substitution and project conditions;
         2) Performance and test data;
         3) References, and samples, where applicable; and
         4) An itemized comparison of the proposed substitution with the product features specified in the Contract Documents, including data relating to design and artistic effect, where applicable. .
      e. Include copies of the pertinent Contract Documents, clearly marked and highlighted to show changes necessary to accommodate the proposed substitution.
      f. If the proposed substitution is due to unavailability of a specified product, a written statement shall accompany it, written by the supplier of the specified product, confirming lack of availability.
      g. By submitting the substitution request, Contractor affirms that: 1) the proposed substitution conforms to the required dimensions and meets or exceeds the standards of required function, appearance, and quality set by the specified product: and 2) the burden of proof rests with the Contractor.
      h. By submitting a substitution request, Contractor agrees to absorb all costs resulting from acceptance of the proposed substitution, including both known and subsequently discovered revisions to other construction needed to accommodate the substitution, and other expected and unforeseen costs, such as delays, code approval-related expenses, and additional architectural services.
      i. A request for substitution accompanying the Proposed Products List by the Contractor implies that the Contractor:
         1) Has investigated the proposed substitution.
         2) Has determined that the substitution will meet circumstance(s) specified in Article 1.5B.
         3) Will provide the same guarantee for the substitution that is required for the product specified in the Contract Documents.
         4) Waives all claims for additional costs that subsequently become apparent as a result of the substitution.
         5) Will coordinate the installation of the accepted substitution into the Work, and will make such changes in the Work of the various trades as may be required to provide a completed condition.

C. A request for a substitution to an approved product in the initial Proposed Products List will <u>not</u> be considered if:
   1. The substitution is merely indicated or implied on the Shop Drawing or Product Data submittal without the specified formal request and documented proof of conformance. Submittal approvals for items not meeting specifications are not valid. Completed construction related to such items is subject to rejection.
   2. Implementation requires a revision of the Contract Documents in order to accommodate the substitution.
   3. The substitution request is substantially incomplete.

D. Architect's Review of Proposed Products List and accompanying Substitution Requests
   1. The Architect and Laboratory will review properly submitted proposed products list and accompanying substitution requests.
   2. The Architect and Laboratory will evaluate each substitution request and inform Contractor in writing whether the proposed substitution is accepted, accepted as noted, or not accepted.
      a. Substitution requests that do not conform to requirements, including submittal timing, are subject to return without review.
   3. The Architect's decision as to conformance and acceptability will be consistent with the intent of the Contract Documents.
   4. In the absence of written acceptance of a substitution request, proposed substitutions shall be understood as not accepted.
   5. The Architect will endeavor to evaluate the substitution request in a reasonable period of time. With the request, the Contractor shall inform the Architect of the deadline for final decision on the request. In the absence of Architect's decision within the critical time, the Contractor shall proceed with the specified product.

1.5 SUBSTITUTION REQUESTS AFTER APPROVAL OF PROPOSED PRODUCTS LIST SUBMITTAL

A. Use no product in the Work that is not named in the Contract Documents, or not listed in the Proposed Products List, or not approved as a substitute or comparable product. Products specified solely by reference standard or performance requirements do not require naming.

B. During construction of the Work, products not listed on the accepted Proposed Products List shall not be used without receipt of an approved substitution request for a listed product. **A substitution request will ONLY be considered under one of the following circumstances**:
   1. The product listed on the accepted Proposed Product List becomes unavailable. Include with the substitution request a letter from the listed manufacturer, on the manufacturer's letterhead, verifying that the product is no longer available.
   2. Conditions uncovered at the Site render the listed product inappropriate, or an undesirable choice for the conditions uncovered. Include with the substitution request a full description of the uncovered conditions and why the requested substitution is preferable to the listed product.
   3. The substitution represents a cost saving to the laboratory of at least five thousand ($5000.00) dollars.
   4. The substitution represents a significant reduction in the schedule.
   5. The substitution will improve overall quality of the installation or system.
   6. The substitution will improve safety of the installation and/or building operations.

C. Make each substitution request on the specified substitution request form. Fully execute form in accordance with the provisions of Article, Proposed Products List and Accompanying Substitution Requests, except for provisions requiring submittal concurrent with proposed products list. Check the box indicating the Contractor's request is being submitted separate from and after submittal of the proposed products list.

1.6 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.7 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
   1. Requested substitution offers Laboratory a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities. Additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Laboratory, and similar considerations.
   2. Requested substitution is consistent with the criteria as stated in Article 1.5B.
   3. Requested substitution does not require revisions to the Contract Documents.
   4. Requested substitution is consistent with the Contract Documents and will produce indicated results.
   5. Substitution request is fully documented and properly submitted.
   6. Requested substitution will not adversely affect Contractor's construction schedule.
   7. Requested substitution has received necessary approvals of authorities having jurisdiction.
   8. Requested substitution is compatible with other portions of the Work.
   9. Requested substitution has been coordinated with other portions of the Work.
   10. Requested substitution provides specified warranty.
   11. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 25 10

SUBSTITUTION REQUEST FORM

Date of Request: _____ CM/GC Tracking No.: _____ SG Tracking No.:

This substitution request is governed by the provisions of Section 01 25 00.

☐ This Substitution Request is submitted during the bidding period.
☐ This Substitution Request is submitted with Proposed Products List dated _____
☐ This Substitution Request is submitted separate from and after submittal of the Proposed Products List.

RE: _____
Specifications Section Title Section No. Page Paragraph

PROPOSED SUBSTITUTION:
Reason for Substitution:

General Description:

The accompanying attachments, per 01 25 00, provide a full description of the proposed substitution.
Proposed change:

☐ To Contract Sum: ☐ None ☐ Add: ☐ Deduct: $_____
☐ To Contract Time: ☐ None ☐ Add: ☐ Deduct: _____ days

Assumption of Responsibility for Equal Performance

Requester affirms that the proposed substitution conforms to required dimensions and meets or exceeds the standards of required function, appearance, and quality set by the specified product. Requester understands and affirms compliance with the provisions of Section 01 60 00.

_____
Requester's Name Date

_____
Requester's Firm

ARCHITECT'S EVALUATION:
The proposed substitution is:
☐Not Reviewed; ☐Not Acceptable; ☐Acceptable As Noted; ☐Acceptable
Remarks: _____

_____
Name Date
cc: Owner; Requester; Contractor; SmithGroup Specs Group

OWNER'S EVALUATION:
The proposed substitution is:
☐Not Reviewed; ☐Not Acceptable; ☐Acceptable As Noted; ☐Acceptable
Remarks: _____

_____
Name Date
cc: Owner; Requester; Contractor; SmithGroup Specs Group

END OF SECTION

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SECTION 01 29 00

PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and facilitate Applications for Payment. Refer to Supplementary Conditions for rights and responsibilities of Laboratory and Contractor.

B. Related Sections: For procedural and administrative requirements governing the following, refer to other Sections in Division 01 General Requirements:
   1. Construction progress documentation, including the Contractor's construction schedule.
   2. Submittal procedures, including the submittal schedule.
   3. Sustainable design requirements including submittal of cost breakdown information.

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
   1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule; that is, the planned schedule of product and other submittals.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to the Laboratory at earliest possible date but no later than 14 days before the date scheduled for submittal of initial Applications for Payment.
   3. Subschedules for Phased Work: Where the Work is separated into phases or separate elements requiring separately phased payments, provide subschedules showing values so correlated.

B. Format and Content: Illinois Department of Commerce & Economical Opportunity (DCEO) categories provided by the Laboratory shall establish subtotal items for the schedule of values.
   1. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
      a. Include separate line items under Contractor and principal subcontracts for LEED documentation and other project closeout requirements.
   2. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
      a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
   3. Overhead and Profit: Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

4. Changes and Schedule:
   a. Reflect fully executed Change Orders by adding new line items at end of schedule.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment shall be consistent with schedule of values as accepted and previous applications and payments as certified by the Laboratory.
   1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements, described elsewhere under this article.

B. Payment Application Times: Submit progress payments in 2 steps, draft and final versions.
   1. Submit Draft Version for Review: Submit for review a draft version, not final version, of Application for Payment seven days prior to due date. Laboratory will make notations and return draft version. Draft version should not be notarized. Revise final copy per Laboratory's comments.
   2. Final versions of progress payments shall be due and submitted to Laboratory by the same day each month. The day of the month shall be as agreed by Laboratory and Contractor. The period covered by each Application for Payment is one month, ending on the last day of the month, except as otherwise agreed.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 or alternative form approved by the Laboratory as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize form, and execute by a person authorized to sign legal documents on behalf of Contractor. Laboratory will return incomplete applications without action.
   1. Entries shall match data on the schedule of values and Contractor's construction schedule.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
   4. Indicate separate amounts for work being carried out under Laboratory-requested project acceleration.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
   1. Provide certificate of insurance, evidence of transfer of title to Laboratory, and consent of surety to payment, for off-site stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:
      a. Materials previously stored and included in previous Applications for Payment.
      b. Work completed for this Application utilizing previously stored materials.
      c. Additional materials stored with this Application.
      d. Total materials remaining stored, including materials with this Application.

F. Transmittal: Submit Application for Payment to Laboratory by a method ensuring receipt no later than close of business on the due date, or on the last business day prior if the due date is not a business day. Provide one signed and notarized original, unless directed to submit additional copies. With original payment request form, include original waivers of lien and similar attachments. Provide a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
   1. Laboratory reserves the right to designate which entities involved in the Work must submit waivers.
   2. Waiver Forms: Submit waivers of lien on forms, and executed in a manner, acceptable to Laboratory.
   3. Procedure: As directed by Laboratory. The procedure will employ conditional and/or partial waivers to provide assurance that subordinate entities are properly paid and Laboratory's interests are properly protected, while the amounts due the Contractor are paid as agreed.

H. Initial Application for Payment: Administrative actions and submittals that shall precede or coincide with submittal of first Application for Payment include the following:
   1. Schedule of values.
   2. Construction schedule (preliminary if not final), compiled to show all work by all contractors having direct contract with Laboratory.
   3. Submittal schedule (preliminary if not final); that is, the planned schedule of product and other submittals.
   4. Initial progress report.
   5. Report of preconstruction conference.
   6. Certificates of insurance and insurance policies.
   7. Performance and payment bonds.

I. Application for Payment at Substantial Completion: After Certificate of Substantial Completion is issued, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Laboratory occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that fees and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
   6. AIA Document G707, "Consent of Surety to Final Payment."
   7. Evidence that claims have been settled.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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SECTION 01 31 00

CONSTRUCTION SCHEDULE REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section. The following schedule requirements modify and/or supplement Clause 28 in "Appendix A – Argonne Terms and Conditions" and "Section 1A0 – General Conditions".

1.2 SUMMARY

A. The work under this contract will be planned, scheduled, executed, and reported using Earned Value Management (hereinafter referred to as EVM) and supplemented with Critical Path Method scheduling (hereinafter referred to as CPM). The construction schedule will be developed using a EVM and CPM schedule demonstrating complete fulfillment of all contract requirements. The schedule (both the working and baseline versions) shall be kept up-to-date in accordance with the requiremen

B. ts of this section and utilized in planning, coordinating, and performing the work under this contract (including all activities of subcontractors, equipment vendors and suppliers). The schedule will be in precedence format, computer generated and updated using Oracle Primavera P6, and the controlling schedule document utilized for managing construction and measuring performance.

C. It is expressly understood and agreed that the time of beginning, the rate of progress, and the time of completion of the work are of the essence to this Contract. Therefore, the primary objectives of EVM and CPM scheduling are to insure the adequate planning, scheduling, and execution of the construction activities so they may be performed in an orderly and expeditious manner within the Schedule of Dates stipulated by the Contract, to provide optimum coordination of the work, to establish the basis for measuring and monitoring contractor progress, to detect problems for the purpose of taking corrective action, to provide a mechanism or tool for determining and monitoring such corrective actions, and to be used as the basis for determining the schedule of values, payment schedule, progress payments, and EVM metrics.

1.3 DEFINITIONS

A. Activity - Any portion or element of work, action, and/or reaction that is precisely described, readily identifiable, and is a function of a logical sequential process.

B. Baseline Schedule - Represents the approved plan against which the project's actual performance – with respect to accomplishing the work scope contained within each detail activity – is measured. This baselined information will be integrated with performance reporting software to obtain the planned value and, when combined with actual performance, will be the basis for a formal performance reporting system to the Laboratory's Earned Value Management System. Once the schedule is approved by Laboratory or Laboratory's Designated Representative (Laboratory), it will be considered baselined. At this time, the dates, resource costs, activity codes, work breakdown structure, and activity descriptions are no longer subject to any changes unless these changes are part of a documented and approved change control process (see Section 1.9 Schedule Revisions).

C. Construction Schedule - Same as EVM and CPM schedule. Also referred to as 'the Contractor's schedule.'

D. EVM and CPM Schedule - The schedule developed by the Contractor and approved by Laboratory that will be used for managing and monitoring the progress of the contract. This is a plan that defines when specified work is to be done to accomplish program objectives on time. Also referred to as 'the schedule.'

E. Float Time - Float is defined as the amount of time between the early start date and the late start date, or the early finish date and the late finish date, of any activity in the project schedule. Total float is defined as the amount of time any given activity or path of activities may be delayed before it will affect the project completion time. Float is not time for the exclusive use or benefit of either Laboratory or the Contractor, but must be used in the best interest of completing the project on time. The Contractor shall typically proceed according to the early start dates unless circumstances prevent, such as resource leveling requirements. Once an activity has been started the Contractor shall continue the work on that activity as scheduled until it is completed unless circumstances prevent. Laboratory reserves the right to request a report on such circumstances that delay the start of activities or require their suspension. Laboratory may require the Contractor to proceed utilizing the early dates if the circumstances are not justified in Laboratory's opinion. Laboratory will not be responsible for delays caused by the Contractor not proceeding per the early start dates or suspending the work if such actions were within Contractor's control. If in Laboratory's opinion the delay/suspension is justifiable, Laboratory shall authorize the Contractor to prepare a supplemental or ‘what if’ schedule for Laboratory's approval including all activities in the EVM and CPM schedule necessary to clearly represent the impact. Pursuant to the float sharing requirements as set forth above, (1), use of float suppression techniques such as preferential sequencing, special lead lag logic restraints, extended Activity durations or imposed dates and (2), use of float time disclosed or implied by the use of alternate float suppression techniques shall be shared to the proportionate benefit of Laboratory, Laboratory’s CM, Architect, Engineer, contractors, and subcontractors. The Contractor shall revise the Contractor's schedule as reasonable to mitigate the impact of delays to the project with no change in Contract price. Extensions of time for performance required under the General Conditions pertaining to equitable time adjustment will be granted only to the extent that the equitable time adjustment exceeds total float in the activity or path of activities affected at the time notice to proceed was issued for the change.

F. Network Diagram - Graphical representation of relationships that exist between different activities of the schedule drawn to time scale.

G. Percentage Complete - The physical percentage of completion, NOT the resource or duration percentage complete.

H. Precedence Method - Scheduling system where relationships between activities are expressed from start or finish of an activity to start or finish of the succeeding activity, with minimal use of lead or lag time.

I. Remaining Duration - Shall be equal to the factor of the remaining percentage of completion times the original as-planned duration, or as approved by Laboratory.

J. Supplemental Schedules - Those schedules that are not part of the baseline schedule hierarchy (working and baseline). They are often used for day-to-day operational planning and management, and as the name suggests, simply supplement the baseline and working schedules, but are not under configuration control. This category would include “what-if” schedules generated to evaluate potential alternate management options.

K. Working Schedule - Once the baseline EVM and CPM schedule has been established, it will be necessary to update actual progress on a predetermined basis and compare it to the baseline schedule. The Working Schedule is used for that purpose. The updated activities, when compared with the baseline dates, provide management with an indication of the schedule performance for the overall project. In addition, the information obtained from statusing will be integrated with other performance reporting software to obtain earned-value information for formal performance reports. It is important to note, that the Working Schedule and Baseline Schedule are not the same file within the scheduling software. They may be attached but at no time should the Baseline Schedule contain status.

1.4 QUALIFICATION REQUIREMENTS

A. The Contractor shall employ a person or retain the services of a consultant, (hereinafter referred to as Scheduler), for the duration of the contract with at least three (3) years of experience with EVM and CPM scheduling software applications similar to the requirements of this project (i.e., Oracle Primavera P6). The individual will, also, need at least two (2) years of experience with scheduling as it pertains to Earned Value Management (EVM). Said person(s) shall cooperate with Laboratory and shall be on-site as required, to monitor, modify, or update the EVM and CPM schedule (including baseline, working, and supplemental).

1.5 SUBMITTALS

A. QUALIFICATIONS: Prior to commencing performance of the work required under this section, submit to Laboratory:

1. The name and address of the proposed Scheduler;

2. Information sufficient to show that the proposed Scheduler has computer facilities meeting the requirements specified; and

3. A list of prior projects, not less than two (2), for which the proposed Scheduler has performed services similar to those required under this contract. Laboratory shall have the right to approve or disapprove the Scheduler proposed, or the performance of the requirements herein by the Contractor's own organization.

B. SCHEDULE:

1. INTERIM SCHEDULE: As soon as is practical, but no later than thirty (30) calendar days following Contract Award, the Contractor shall submit to Laboratory a preliminary schedule in precedence format detailing planned work, operations, and/or procurement activities for the first 120 days of construction. Laboratory will review the Contractor’s submittal to ensure sufficient detail will be provided to support progress payments to be made while the baseline schedule is being developed and approved. The Contractor's interim schedule is a necessary tool for the proper execution of the Contractor's work. Therefore, the Contractor will not be permitted to begin work or receive payment until the interim schedule has been submitted and approved. The interim schedule shall be updated, while the baseline schedule is being developed.

2. BASELINE SCHEDULE: As soon as is practical, but no later than eight (8) calendar weeks following Contract Award, the Contractor shall submit to Laboratory a baseline EVM and CPM schedule in precedence format for the entire Contractor's construction work scope. The Contractor's schedule is a necessary tool for the proper execution of the Contractor's work and against which all progress shall be measured. Therefore, the Contractor will not be permitted to begin work or receive payment beyond the interim schedule until the baseline schedule has been submitted and approved. Activities comprising the interim schedule shall be included in the baseline schedule. The baseline schedule shall be used by the Contractor and Laboratory as the basis for evaluating changes and claims and for evaluation of Application for Payment. The Schedule of Values and the Payment Schedule shall be developed using the values indicated in the baseline schedule and organized in accordance with the Laboratory WBS.

3. WORKING SCHEDULE: Once schedules have been approved by Laboratory, a reporting cycle will begin where the Contractor shall submit to Laboratory a statused EVM and CPM schedule. The Contractor's schedule is a necessary tool for the proper evaluation of the Contractor's work performance. Therefore, the Contractor will not be permitted to receive payment until the statused schedule has been submitted and approved.

C. CONTENT: The EVM and CPM schedules shall meet the following criteria:

1. All activities shown in the Interim schedule shall be cost loaded. Summary level planning activities for the balance of the work through completion shall also be included and cost loaded. Approximate duration for the summary planning activities shall be shown. Summary planning activities shall be replaced and expanded with detailed activities when the Interim schedule is incorporated into the Baseline schedule.

2. The Interim schedule shall include those activities that are necessary to properly indicate:
   a. The project will begin on the date of contract award and will be completed within the number of calendar days specified in the Contract Documents;
   b. Approach to scheduling the remaining work areas or phases. Work for each major phase or area shall be represented by at least one summary planning activity such that the activities cumulatively indicate the entire Construction Schedule;
   c. Approximate cost and duration for each summary planning activity shall be shown on the Preliminary Schedule and shall include Contractor's best estimate of the Work it represents; and
   d. Procurement activities to be accomplished during the first 180 days of the Contract.

3. The following should be depicted for each activity in the schedule:
   a. Activity descriptions and identification codes shall be clear and concise. For example, work related to each activity should be limited to one work trade, one construction area, and/or one floor.
   b. The beginning and end of each activity shall be readily verifiable.
   c. All activity starts and finishes must be tied into the schedule by logical restraints.
   d. Activity numbers shall be unique and shall not change as revisions are made to the schedule.
   e. Activities shall be assigned separate activity codes to create a Work Breakdown Structure (WBS) consistent with the Laboratory WBS to be provided to the Contractor. These activity codes may be used to:
      i. Define specific performance responsibility by discipline or subcontractor;
      ii. Define concise work areas, such as building, floor, site electrical, paving, etc;
      iii. Identify phase of each activity;
      iv. Identify the Specification Section for the activity; and/or
      v. Integrate into the Laboratory WBS.

   f. The durations of activities shall be expressed in whole working days.
   g. An Laboratory global resource will be used to load cost resources on those activities with cost in the schedule.

4. The level of detail of the schedule shall be a function of the complexity of the work involved. Generally, no activity shall have a duration of longer than twenty (20) work days nor have a value of over $20,000.00 without prior acceptance by Laboratory, except for procurement, delivery of equipment or materials, and concrete curing in the baseline schedule and summary planning activities in the interim schedule. The selection and number of activities will be subject to the approval of Laboratory. All durations shall be the result of definitive manpower and resource planning by the Contractor and Subcontractors to perform the work in consideration of the requirements of the Contract and the on-site work conditions. The twenty (20) work day limitation is not intended to impede or restrict Contractor's flexibility to properly plan and schedule the work.
5. The schedule shall be based on and incorporate the WBS and provide a complete and detailed sequence of operations of the work within the time limits specified in the Contract including specified mandatory milestone dates.

6. Schedules shall indicate the relationship and time frames in which the various phases of the facilities will be made substantially complete and placed into service as indicated in the Contract Documents.
7. Schedules shall depict major components of the work and the sequenced relationships between major components and subdivisions of major components.
8. For all major equipment and materials fabricated or supplied for this project, the schedule shall show a sequence of activities including:
    a. Negotiation and execution of contracts between the Contractor and subcontractors associated with the Work;
    b. Preparation of shop drawing and sample submissions;
    c. Review of shop drawing and samples (allow for one resubmittal);
    d. Shop fabrication and delivery;
    e. Erection or installation;
    f. Testing of equipment and materials;
    g. Final operational testing for each major piece of equipment or building system
    h. Submittal of Operation and Maintenance Manuals; and
    i. Training.

9. Responsibility Codes for each activity shall be identified with a single performing organization including interfaces with the work of other Contractors or agencies (i.e., Contractor, subcontractors, suppliers, utilities, Laboratory agencies, etc.). Contractor shall involve all such organizations in the development and management of the schedule and shall secure their individual and collective express commitment to satisfy the requirements of the schedule. In addition to identification of responsible organization, each activity shall have codes identifying CSI division, location by area, and, code fields to be maintained by the Contractor solely for the use of Laboratory.
10. Total planned value shall equal the total contract value. Activities shall have an assigned dollar value (cost loading) that shall cumulatively equal the Contract Amount. General Conditions, General Requirements, insurance, bonds, permits, and all other overhead costs and profit shall be identified and the corresponding dollar valves indicated for each. Planned value each month shall equal the amounts reported in the Payment Schedule.
11. Resource requirements (labor by craft, commodity, type, equipment, services, etc.) shall be required for each activity. All crafts necessary to execute an activity must be shown. No more than five (5) crafts may be assigned to a specific activity. If more crafts are required, then the activity in question must be broken down into additional activities.
12. All schedule activities shall utilize a five (5) day, one shift, work week calendar including established holidays. This calendar shall be in accordance with the Laboratory working day calendar. All work to be scheduled on a different calendar, to account for weather – for example, must be pre-approved by Laboratory and the calendar(s) must be provided to Laboratory for incorporation into Laboratory's Primavera P6 system.
13. The schedule shall indicate a completion date for the project that is no later than the project's required completion date for construction. All activity durations shall be given in work days.
14. The schedule shall contain constraints only for Contract milestones including the completion date. No other constraints shall be used.
15. Monthly anticipated adverse weather days shall be considered and included in the planning and scheduling of all weather affected work activities in order to complete all work within the Contract Dates.
16. Contractor shall ensure that the schedule represents an accurate, efficient, reasonable, and feasible plan and method for accomplishing the work throughout the time of performance. While Laboratory will review the Construction Schedule, the schedule itself is the Contractor's, who has full responsibility for its preparation, content, revisions, and updating in accordance with the requirements of the Contract Documents.
17. Abbreviations shall be fully described in legend attached to the schedule.

D. FORM: The schedule shall be submitted in the following formats: 1) network diagram, 2) reports, and 3) electronic media.

1. The network diagram shall contain the following features:
   a. The order and interdependencies of the Contractor's activities and the major points of interface or interrelation with the activities of others, including Specific Dates for completion;
   b. Conformance with an identification of the specified mandatory milestone dates specified in the Contract Documents;
   c. The activity ID code, description, remaining duration, percent complete and total float for each activity;
   d. Delivery of Laboratory furnished material and equipment;
   e. The critical path/paths for the project with said paths of activities being clearly and easily recognizable on a time-scaled network diagram. The relationship between all noncritical activities and activities on the critical path shall be clearly shown on the network diagram;
   f. The network diagram shall be sorted and grouped by floor, area and responsibility for ease of understanding and simplification; and
   g. All network diagrams shall be a 22" x 34" media with suitable notation relating the interface points among sheets or as approved by Laboratory.

2. In addition to the Network Diagram, the contractor shall submit the following schedule reports including all of the activities and sorted by activity number including the following information: Activity Number; Activity Description; Original Duration; Remaining Duration; Percentage Complete; Responsibility Code; APM Code; Early/Actual Start; Early/Actual Finish; Late Start; Late Finish; Total Float (except as specifically indicated otherwise). All reports shall be submitted on 8½" x 11" media or as approved by Laboratory.
   a. The Precedence Report shall be per the above requirements and shall include this information for each activity, that activity's immediate predecessors, and that activity's immediate successors.
   b. The Master Schedule Report shall be per the above requirements.
   c. The Early Start Report shall be per the above requirements with the exception that it shall be sorted first by early start and then by responsibility code.
   d. The Total Float Report shall be per the above requirements with the exception that it shall be sorted first by total float and then by early start.
   e. The Responsibility Report shall be per the above requirements with the exception that it shall be sorted and grouped by responsibility code and then by early start.
   f. The Variance Report shall be per the above requirements with the inclusion of a comparison between the original as-planned schedule and the current update, indicating the variances between the two.
   g. The Monthly Progress Payment Report shall include all activities with the following information sorted by activity number:
      i. Activity number.
      ii. Activity description.
      iii. Physical percentage of work.

3. The Contractor shall also submit the schedule in native electronic data form, utilizing Primavera P6 scheduling software. The Contractor shall have the capability of furnishing data reports or sorts in the following formats/layouts acceptable to Laboratory:
   a. Activity listing by Activity ID Number;
   b. Activity listing by early and late start and finish dates;
   c. Activity listing by Work Breakdown Structure;
   d. Critical Path for the project, with said path of activities being clearly and easily recognizable on the time-scaled network diagram;

e. Activity listing by responsibility code or subcontractor or specification section;
f. Actual start date for each activity begun;
g. Actual finish date for each activity completed;
h. Planned and remaining duration time for each activity;
i. Activity listing by total float;
j. The percent complete of each activity in progress or completed;
k. Planned and earned dollar value of each activity and the planned and earned dollar value each month;
l. Software produced time scaled network diagram; and
m. Software produced bar chart.

1.6 REVIEW AND ACCEPTANCE

A. Laboratory will review the Contractor's schedule submittals, including logic diagrams and computer generated mathematical analysis for sound logic, constructability, and adherence to plans and specifications. Laboratory will assume that the Contractor has accurately correlated the schedule in its entirety and its individual elements to the Contractor's and Subcontractor's as-bid project execution plans including but not limited to subcontracts, purchase orders, delivery dates, crew strategies, etc. Non-conformance of any of the Contractor or subcontractor project execution plans to the Contract Documents shall not relieve Contractor or his subcontractor of any of the requirements of the Contract Documents. Meetings will be held between Laboratory and Contractor to resolve any apparent conflicts between the Contractor's interim and baseline schedule and the intent of the Contract Documents. The Contractor shall revise the Contractor's schedule as required by Laboratory and shall submit Contractor's revised schedule to Laboratory within seven (7) days. Within ten (10) calendar days following submission of an acceptable schedule, the Contractor will provide three (3) copies of the Contractor's Schedule Submittal as outlined in Section 1.3 above. Acceptance by Laboratory of the Contractor's schedule is advisory only and shall not relieve the Contractor of the responsibility for accomplishing the work within all of the Contract requirements, including but not limited to, each and every Contract-required Milestone and Completion date. Omissions and errors in the approved schedule shall not excuse performance which is not in compliance with the Contract. Approval by Laboratory in no way makes Laboratory an insurer of the schedule's success or liable for time or cost overruns flowing from its shortcomings. Laboratory hereby disclaim any obligation or liability by reason of Laboratory's approval of or acquiescence to the schedule.

1.7 WEEKLY PROGRESS MEETING

A. Once every week, on a day established by Laboratory, a meeting will be held to assess the progress achieved by the Contractor during the previous work week. The Contractor shall submit a bar chart indicating progress for the previous week (the Weekly Schedule Report) and the activities scheduled for the succeeding 2 weeks [the Short Interval Schedule (SIS)]. The Weekly Schedule Report shall indicate for each day of the preceding week the actual manpower for each activity which was in progress. This report shall be equal to the actual number of tradesmen which were working for the Contractor and each Subcontractor each day. The Weekly Schedule Report shall also indicate for each day the weather conditions, potential delays and inspections occurring on that day. The Weekly Schedule Report shall be a report derived from the schedule which may be completed by hand providing that the handwriting is legible to Laboratory. The SIS bar chart shall be directly derived from the schedule and shall include all information required for network diagrams with the exception of logic ties. All activities shown in this SIS will be identified by the same activity numbers and descriptions as shown in the schedule.

1.8 PROGRESS REPORTING AND CHANGES

A. Once each month, prepare and submit to Laboratory a revised baseline schedule showing all approved changes in network logic, including but not limited to changes as the result of change orders and any changes in contract completion dates which have been approved by Laboratory within this section since the last revision of the baseline schedule. If the Contractor desires to make changes in its method of operating and scheduling, the Contractor shall follow the procedures set out in Paragraph 1.9, Schedule Revisions of this Section.

B. Once each month on the date specified, prepare and submit to Laboratory an updated working schedule as outlined in Paragraph 1.3 above, including the following:
   1. Activities in progress or to be performed in the future, and the percentage complete of each activity;
   2. Critical path for the project based upon the latest update data; and
   3. Earned value for each activity.

C. Once each month, on the date specified by Laboratory for submission of updated schedule, submit those reports and network diagrams as indicated in the preceding sections.

D. In addition to the foregoing, submit a typewritten narrative report once each month with the updated schedule. The narrative shall include:
   1. A narrative report describing:
      a. Description of actual work accomplished during the reporting period and causes of any variances from the baseline (positive or negative);
      b. Any deviations or changes in the Payment Schedule during the reporting period;
      c. What problems or changes are anticipated or expected by the Contractor and what is the Contractor's plan to deal with same so as to minimize or prevent any delay to completion; and
      d. Description of work planned during the next period.

   2. A list of major construction equipment used on the work during the reporting period and any construction equipment idle during the reporting period;
   3. A total number of men by craft actually engaged on the work during the reporting period with such total stated separately as to office, supervisory, and direct labor;
   4. A list of contractor-supplied permanent plant materials, long lead items, and equipment indicating current availability and anticipated job site delivery date; and
   5. A list of proposed modifications, additions, deletions, and changes in logic or sequence to the approved construction schedule.

E. In addition to the above, the Contractor may be required to submit at Laboratory's request, the following typewritten report:
   1. A Critical Items Report - The Critical Items Report identifies items by cause and impact that are or will seriously affect the Contractor's progress or ability to perform work in accordance with the current schedule. Such report will not be required more than once every fourteen (14) days and shall be furnished in sufficient detail to define the cause and potential impact of any actual or anticipated changes in material or equipment deliveries (Contractor or LABRATORY-furnished), manpower availability, weather conditions or other items critical to maintaining schedule.

1.9 PAYMENTS TO CONTRACTOR

A. If the Contractor fails to submit the interim or baseline schedule within the time prescribed, or the updated monthly schedule within the time requested, Laboratory may withhold approval of progress payment estimates until such time as the Contractor submits the required schedules.

1.10 RESPONSIBILITY FOR COMPLETION

A. If, in the opinion of Laboratory, the Contractor falls behind the progress schedule, the Contractor shall take any and all steps necessary to improve Contractor's progress at no additional cost to Laboratory, including cost impacts to other contractors, agencies or Laboratory directly caused by Contractor's delay, including but not limited to the following:
1. Increase construction manpower in such quantities and crafts as will substantially eliminate the lag in scheduled progress;
2. Increase the number of working hours per shift, shifts per working day, working days per week, or the amount of construction equipment, or any combination of the foregoing, sufficiently to substantially eliminate lag in scheduled progress; and/or
3. Resequence activities to achieve maximum practical concurrent accomplishment of work activities.

B. Laboratory may also require the Contractor to submit for approval and at no additional cost to Laboratory such supplementary recovery schedules as may be deemed necessary to demonstrate the manner in which the approved schedule will be regained during the immediate subsequent pay period. The Contractor and Laboratory shall take following steps after determination of the requirement for a Recovery Schedule:
1. Within four (4) work days, the Contractor shall meet with Laboratory to prepare and complete the Recovery Schedule. The Contractor and major subcontractors shall provide Laboratory with such information as is required to assist in preparation of a Recovery Schedule. The Recovery Schedule shall represent the Contractor's best judgment as to how Contractor shall reorganize Contractor's work and resources so that Contractor may return to the schedule within the immediate subsequent pay period. The Recovery Schedule shall be prepared to a similar level of detail as the schedule and shall give a maximum duration of one (1) month which shall coincide with the pay period.
2. Within five (5) calendar days, the Contractor shall participate in a conference with Laboratory to review and evaluate the Recovery Schedule. Any revisions necessary as a result of this review shall be resubmitted by the Contractor for approval within two (2) work days after the conference. The approved Recovery Schedule shall then be the schedule which the Contractor shall use in planning, organizing, directing, coordinating, performing and executing the work (including all activities of subcontractors, equipment vendors and suppliers) for its one (1) month duration to regain compliance with the schedule.

C. Laboratory and the Contractor will meet for the normal monthly update to determine the effectiveness of the Recovery Schedule and to determine whether the Contractor has regained compliance with the schedule. At the direction of Laboratory, one of the following will occur:
1. If, in the opinion of Laboratory, the Contractor is still behind schedule, the Contractor, in conjunction with Laboratory will prepare another Recovery Schedule at the Contractor's expense, to take effect during the immediate subsequent pay period.
2. If, in the opinion of Laboratory, the Contractor has sufficiently regained the time lost, then compliance with the schedule will be resumed.

D. Failure of the Contractor to comply with the requirements of Laboratory under this paragraph shall be grounds for determination by Laboratory that the Contractor is not prosecuting the work with such diligence as will insure completion within the time specified. Upon such determination Laboratory may terminate the Contractor's right to proceed with the work, or any separable part thereof, in accordance with the applicable provisions of the Fixed-Price Construction Contract between UChicago Argonne, LLC and Contractor.

1.11 SCHEDULE REVISIONS

A. Should the Contractor, after approval of the interim and/or baseline schedules, desire to change Contractor's plan of construction, Contractor shall submit Contractor's requested revisions to Laboratory along with a written statement of the revisions including a description of the logic for rescheduling the work, methods of maintaining adherence to intermediate milestones, specific dates, and the reasons for the revisions. If the

requested changes are acceptable to Laboratory, they will be incorporated into the schedule in the next reporting period, unless a contract modification is required. No change to historical (previous period) data is allowed.

B. When Laboratory orders changes which have the potential to impact the schedule of Dates, a supplemental 'what if' schedule of the new and existing activities directly affected by the change will be prepared by the Contractor and provided with the Contractor's price proposal or extra work tabulation as required to Laboratory for concurrence or revision as Laboratory deems necessary. After the schedule has been approved by Laboratory, it will be incorporated into the baseline schedule by the Contractor. Change Order logic will affect only those activities and performance dates directly concerned. Adjustments in scheduled intermediate completion dates or for the Contract as a whole, will be considered only to the extent that there is insufficient remaining float to absorb these changes. No changes will be made to historical (previous period) data.

C. Neither the updating or revision of the Contractor's schedule, nor the submission, updating, change or revision of any report or schedule submitted to Laboratory by Contractor under this Section, nor Laboratory's review or nonexistence of any such report or schedule shall have the effect of amending or modifying, in any way, the Schedule of Dates or modifying or limiting in any way Contractor's obligations under this Contract.

1.12 TIME OF COMPLETION

A. If the Contractor should desire or intend to complete the work earlier than the Schedule of Dates, Laboratory shall not be liable to the Contractor for any costs or other damages should the Contractor be unable to complete the work before his early milestone completion dates or before the Schedule of Dates. Approval by Laboratory of a schedule which indicates completion prior to Schedule of Dates shall be for the convenience of the Contractor and shall not change any of the Contract requirements including but not limited to the Schedule of Dates. All Contract requirements shall be consistent with and applicable only to the completion of the work in accordance with the Schedule of Dates required by the Contract unless Laboratory and Contractor otherwise agree by issuance of the appropriate Change Order.

B. The updated schedule submitted by Contractor shall not show a completion date later than the Schedule of Dates, subject to any time extensions approved by Laboratory. If Contractor believes Contractor is entitled to an extension to the Schedule of Dates under the Contract Documents; the Contractor shall submit to Laboratory a formal time extension request as required by the Contract and a detailed narrative justifying the time extension requested. The time extension request shall include schedule forecasts that predict the actual Project Completion Date, and any separable portions thereof specified by Laboratory plus a forecast of the actual achievement of any milestones listed in the Schedule of Dates. Laboratory shall have no obligation to consider any time extension request unless the Contractor is in full compliance with the requirements of the Contract Documents. Laboratory shall not be responsible or liable to Contractor for any constructive acceleration due to failure of Laboratory to grant time extensions under the Contract Documents should Contractor fail to substantially comply with the submission requirements and the justification requirements of this Contract for time extension requests. The Contractor's failure to perform in accordance with the schedule shall not be excused, nor be chargeable to Laboratory because Contractor has submitted time extension requests.

1.13 COORDINATION

A. The Contractor shall coordinate the Contractor's work and that of subcontractors and shall cooperate fully with Laboratory in maintaining orderly progress toward completion of the work as scheduled. Laboratory's decisions regarding priority between the Contractor's work and the work of other trade contractors at the site shall be final and shall not be cause for extra compensation or extension of time, except where extension of time is granted because of a delay for which Contractor is otherwise entitled to an extension of time under the Contract Documents.

B. Failure of other trade contractors to meet their schedule shall not be justification for an extension of time, except where such failure causes, in the opinion of Laboratory, an unreasonable delay in the Contractor's Work, in which case the provisions of the Fixed-Price Construction Contract between UChicago Argonne, LLC and Contractor regarding extensions of time and extra work shall apply.

1.14 FAILURE TO PERFORM SCHEDULING TASKS

A. Should the Contractor fail to substantially comply with the provisions of the Contract Documents relating to planning, scheduling, reporting, and execution of the work as called for in the schedule, Laboratory shall have the right, at Laboratory's option, to retain the services of scheduling consultants or experts (including attorneys, if necessary in Laboratory's opinion) to prepare a schedule in accordance with the Contract Documents. This schedule will be used to allow Laboratory to evaluate the program of the Work by Contractor and to determine whether Contractor is substantially complying with the Contract Documents. This schedule will be used to direct such action on the part of the Contractor as permitted by the Contract Documents, and as required to ensure that the Contractor will comply with such schedule. All costs incurred by Laboratory in preparing this schedule shall be charged to the Contractor's account and/or deducted from any monies due to the Contractor. If Contractor fails to substantially comply with the scheduling and execution of the work requirements of the Contract Documents, the Contractor hereby agrees in such instance to comply with such schedules as Laboratory develops or direct activity sequences and durations as Laboratory may reasonably require, without additional cost to Laboratory (subject only to cost adjustments for such changes in the work as Laboratory may direct), to ensure completion within the Schedule of Dates.

1.15 CONTRACTOR COVENANTS AND GUARANTEES

A. Contractor covenants and guarantees that Contractor will not:
1. Misrepresent to Laboratory its schedule and all of its components or Contractor's actual execution of the work.
2. Utilize schedules materially different from those made available by Contractor to Laboratory, any Subcontractor or separate Contractors for the direction, execution, or coordination of the Work.
3. Prepare schedules, updates, revisions or reports for the work which are not feasible or realistic; or which do not accurately reflect the actual intent or reasonable and actual expectations of Contractor and its Subcontractors.

1.16 PAYMENT FOR SCHEDULING

A. The cost of performing all work incidental to preparing the Project Construction Schedule, including preparation, execution, updates, maintenance, revisions, and adjustments shall be included in the Bid Proposal as overhead distributed to appropriate bid items and schedule activities.

PART 2 - PRODUCTS

(Not Applicable)

PART 3 - EXECUTION

(Not Applicable)

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SECTION 01 31 05

PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations within scope of Contractor's work, including, but not limited to, the following:
1. General project coordination procedures.
2. Administrative and supervisory personnel.
3. Coordination drawings.
4. Requests for Interpretation (RFIs).
5. Project Web site.
6. Project meetings.

B. Related Sections:
1. Division 01 Section that specifies preparing and submitting Contractor's construction schedule.
2. Division 01 Section that specifies procedures for coordinating general installation and field-engineering services, such as for benchmarks and control points.
3. Division 01 Section specifying closeout of the Contract.
4. Division 01 Section that specifies general commissioning requirements for coordinating the Work with Laboratory's commissioning authority.

1.3 COORDINATION

A. Coordinate construction operations of the Contract to ensure efficient and orderly installation of each part of the Work within Contract scope. Coordinate operations and procedures with work that will be performed by others, where necessary for efficient and orderly installation of each part of the Work. Coordinate activities that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings. Prepare similar memoranda for Laboratory and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate administrative procedures with other construction activities, whether within or outside of Contract scope, to avoid conflicts and to ensure orderly progress of the Work. Coordinate procedural and temporary matters such as, but not limited to: schedule, meetings, temporary facilities, submittals, closeout, system startup.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. Refer to other Sections for disposition of salvaged materials that are designated as Laboratory's property.

1.4 SUBCONTRACTOR'S CONSTRUCTION SCHEDULE

A. Refer to Section 01 31 00

1.5 SCHEDULE OF INSPECTIONS AND TESTS

A. Prepare a schedule of inspections, tests and similar services required by the Contract Documents. Submit the schedule within 15 days of the date established for commencement of the Work.

B. Form: The Schedule shall be in tabular form and shall include but not be limited to the following data:
   1. Specification Section number.
   2. Description of the test.
   3. Identification of applicable standards.
   4. Identification of test methods.
   5. Number of tests required.
   6. Time schedule or time span for tests.
   7. Entity responsible for performing tests.
   8. Requirements for taking Samples.
   9. Unique characteristics of each service.

C. Distribution: Distribute the Schedule to the Laboratory.

1.6 KEY PERSONNEL

A. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and email addresses. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
B. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.7 REQUESTS FOR INTERPRETATION/INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. RFIs shall be submitted through the Contractor. RFI’s submitted otherwise will be returned unprocessed, without response.
   2. In order to expedite processing, each RFI shall include only one distinct issue.
   3. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Project schedule.
   4. RFI’s that do not contain adequate references to the Drawings and Specifications are subject to immediate rejection.
   5. Unnecessary RFI’s: If an RFI can be answered clearly by referencing the Contract Documents, the RFI will be considered unnecessary. The Laboratory reserves the right to be reimbursed by the Contractor, for the Architect’s fees for processing unnecessary RFI’s.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation, providing the related information pertinent to understand the issue.

C. RFI Response: Each RFI will be reviewed, required action will be determined, and a response will be issued. Allow seven working days for response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day.

D. RFIs may be returned without action for reasons such as:
   1. Requests involving submittals or substitutions.
   2. The Contract Documents contain the information needed to answer the request.
   3. Incomplete or poorly prepared RFIs, or RFI's based on superseded Documents.

E. The action may include a request for additional information, in which case the time period for response will begin upon receipt of the additional information.

F. When the response described on RFI may result in a change to the Contract Time or the Contract Sum, Contractor may submit Change Proposal according to Contract Document provisions dealing with Contract Modification Procedures. Give notification of such changes within 10 days of receipt of the RFI response.

G. If in disagreement with RFI response, Contractor shall give notice of such disagreement within seven days of receiving the RFI response.

H. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. When requested, submit log within one working day of request.
   1. Number RFI's consecutively. Follow-up RFI's on the same topic should retain number of original and add "R__" number suffix.

1.8 PROJECT MANAGEMENT & CONTROL SYSTEM (PMCS)

A. Use Laboratory's Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site may include the following functions:
   1. Project directory.
   2. Project correspondence.
   3. Meeting minutes.
   4. Contract modifications forms and logs.
   5. RFI forms and logs.
   6. Task and issue management.
   7. Photo documentation.
   8. Schedule and calendar management.
   9. Submittals forms and logs.
   10. Payment application forms.
   11. Drawing and specification document hosting, viewing, and updating.
   12. Online document collaboration.
   13. Reminder and tracking functions.
   14. Archiving functions.

B. Upon completion of Project, provide one complete archive copy of Project Web site files to Laboratory and to Architect in a digital storage format acceptable to the Laboratory.

C. Files shall be organized and named to provide reasonably direct information retrieval.

D. The following PMCS software packages under their current published licensing agreements will be utilized:
   1. Meridian Systems, Prolog.

E. Contractor, subcontractors, and other parties granted access to project Web site shall execute a data licensing agreement in the form of an Agreement acceptable to the Laboratory.

1.9 PROJECT MEETINGS AND CONFERENCES

A. General: All entities involved in the Project shall participate in meetings and conferences called for the benefit of the Project. Contractor shall be responsible for attendance of all entities performing work under the Contract, as requested or appropriate to meeting purpose.

1. Contractor shall attend meetings called by Laboratory or Architect.

2. Notify Laboratory and Architect within a reasonable period in advance of scheduled meetings and conferences. Architect's and Laboratory's attendance shall not be required at meetings for subcontractor or general construction coordination, except as specifically requested by Contractor.

3. Except as otherwise agreed, the entity calling the meeting/conference shall conduct it as follows:
   a. Inform participants and others involved, and individuals whose presence is required, of date and time. Notify Laboratory and Architect of scheduled meeting dates and times.
   b. Attendees: Entities concerned with current progress or involved in planning, coordination, or performance of future activities, except as special purpose meetings or conferences require otherwise. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   c. Agenda: Prepare the meeting agenda and distribute it to all invited attendees. Review progress of construction activities, procedures, and preparations. Discuss items that could affect Project progress.
   d. Record significant discussions, agreements, and disagreements, including required corrective measures and actions. Resolve the items or identify steps to resolution. Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Laboratory and Architect, within a time period sufficient to permit actions pursuant to the meeting.

B. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
   1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting.
   2. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

C. Project Closeout Conference: Arrange a Project closeout conference, at a time convenient to Laboratory and Architect. Except as otherwise agreed, schedule conference no later than 30 days prior to the scheduled date of Substantial Completion.
   1. Review requirements and responsibilities related to Project closeout.
   2. Agenda: Discuss items of significance that could affect or delay Project closeout.
   3. Discuss need for, and arrange follow-up conferences as agreed.

D. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
   1. Attendees: In addition to representatives of Laboratory, Laboratory's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity

concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.

2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
   a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
   b. Review present and future needs of each contractor present, including the following:
      1) Interface requirements.
      2) Sequence of operations.
      3) Status of submittals.
      4) Deliveries.
      5) Off-site fabrication.
      6) Access.
      7) Site utilization.
      8) Temporary facilities and controls.
      9) Work hours.
      10) Hazards and risks.
      11) Progress cleaning.
      12) Quality and work standards.
      13) Change Orders.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 01 32 00

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
   1. Startup construction schedule.
   2. Contractor's construction schedule.
   3. Construction schedule updating reports.
   4. Daily construction reports.
   5. Material location reports.
   6. Site condition reports.
   7. Special reports.

B. Related Requirements:
   1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
   2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
   2. Predecessor Activity: An activity that precedes another activity in the network.
   3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

D. Event: The starting or ending point of an activity.

E. Float: The measure of leeway in starting and completing an activity.
   1. Float time is not for the exclusive use or benefit of either Laboratory or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.

3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:
1. Working electronic copy of schedule file, where indicated.
2. PDF electronic file.

B. Startup construction schedule.
1. Approval of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities. Reference Section 01 31 00

C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities. Reference Section 01 31 00

D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label. Reference Section 01 31 00

E. Scheduling Reports: Concurrent with schedule, submit each of the following reports. Format for each activity in reports shall contain at a minimum: activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

F. Construction Schedule Updating Reports: Submit with Applications for Payment.

G. Daily Construction Reports: Submit at weekly intervals.

H. Material Location Reports: Submit at weekly intervals.

I. Site Condition Reports: Submit at time of discovery of differing conditions.

J. Special Reports: Submit at time of unusual event.

K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: Refer to Section 01 31 00 “Construction Schedule Requirements”.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including interim milestones.
   4. Review delivery dates for Laboratory-furnished products, if any.
   5. Review schedule for work of Laboratory’s separate contracts.
   6. Review submittal requirements and procedures.
   7. Review time required for review of submittals and resubmittals.
   8. Review requirements for tests and inspections by independent testing and inspecting agencies.
   9. Review time required for Project closeout and Laboratory startup procedures, including commissioning activities.
   10. Review and finalize list of construction activities to be included in schedule.
   11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from entities involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Substantial Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized.

B. Activities: Treat separate area as a separate numbered activity for each main element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Laboratory.
   2. Procurement Activities: Include procurement process activities long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
   4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Laboratory’s administrative procedures necessary for certification of Substantial Completion.
   6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Work under More Than One Contract: Include a separate activity for each contract.
   2. Work by Laboratory: Include a separate activity for each portion of the Work performed by Laboratory, if required.
   3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   4. Laboratory-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   5. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Provisions for future construction.
      g. Seasonal variations.
      h. Environmental control.
   6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.
      g. Deliveries.
      h. Installation.
      i. Tests and inspections.
      j. Adjusting.
      k. Curing.
      l. Building flush-out.
      m. Startup and placement into final use and operation.
   7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
      a. Structural completion.
      b. Temporary enclosure and space conditioning.
      c. Permanent space enclosure.
      d. Completion of mechanical installation.
      e. Completion of electrical installation.
      f. Substantial Completion.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.

E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
   1. Unresolved issues.

2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

G. Recovery Plan/Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate (working) recovery schedule & plan indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 STARTUP CONSTRUCTION SCHEDULE

A. Reference 01 31 00

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Reference 01 31 00

2.4 Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Count of personnel at Project site.
4. Daily Man-Hour Totals
5. Equipment at Project site.
6. Material deliveries.
7. High and low temperatures and general weather conditions, including presence of rain or snow.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events (see special reports).
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Work Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

A. General: Submit special reports directly to Laboratory within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Laboratory in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Reference 01 31 00

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Administrative and procedural requirements for making submittals
   2. Detailed requirements for:
      a. The submittal schedule
      b. Product submittals, such as Shop Drawings, Product Data, Samples

B. Related Requirements: The following requirements are specified in other Division 01 sections except as otherwise indicated.
   1. Proposed products list is specified with substitution procedures.
   2. Quality requirements, including mock-ups and sample installations
   3. Submittals for sustainability design requirements
   4. Payment procedures for submitting Applications for Payment and the schedule of values.
   5. Construction progress documentation such as schedules, reports, and Contractor's construction schedule.
   6. Operation and maintenance data.
   7. Project record documents such as Drawings, record Specifications, and record Product Data.
   8. Demonstration and training submittals, such as video recordings of demonstration of equipment and training of Laboratory's personnel.

1.3 DEFINITIONS

A. Contractor: Refers to an entity in direct Contract with the Laboratory to perform the Work of the Contract. Contractor shall review and approve product submittals.

B. Product Submittals: In general, Product Submittals show characteristics of the proposed construction in one of the following forms:
   1. Shop Drawings: Drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.
   2. Product Data: Illustrations, standard schedules, performance charts, color charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.
      a. Product Data does not include Material Safety Data Sheets. Do not submit MSDS. They will be returned without review.
   3. Samples: Physical examples that illustrate materials, equipment, or workmanship and establish standards by which the Work will be judged.

C. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

D. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.

E. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

F. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 SUBMITTALS SCHEDULE

1. Submit a schedule of submittals, arranged in chronological order by dates as required by construction schedule. For action submittals, allow for time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections. Note that submittal schedule is to be included in the master construction schedule.
2. Submit the Submittals Schedule for information.

B. Submit all required types of submittals for each product together. For example: Shop Drawings will not be reviewed when related Samples, Product Data, and test reports have not been submitted.

C. Coordinate submittal schedule with list of subcontracts, the schedule of values, Contractor's construction schedule, and proposed products list.

D. Initial Submittal: Submit initial Submittals Schedule not more than 7 days after receipt of reviewed Proposed Products List, or concurrently with start-up construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.

E. Submit revised submittal schedule to reflect changes in current status and timing for submittals. Final Submittal: Submit concurrently with the first complete submittal of Contractor’s construction schedule. Categorize submittal items by type, and designate the respective types by type code. Refer to code definitions below.

F. “Latest possible date” means the date of receipt by Architect. This date allows for review and return to Contractor in time to meet the construction schedule.

Type	Code Explanation
SD	Shop Drawings
PD	Product Data
S	Sample
DC	Design calculations
L	Letter
SoC	Statement of Compliance
Cer	Certificate/Certification
Q	Qualifications statement (such as for Contractor, fabricator, or erector.)
SC	Sample construction (such as mock-up or sample installation.)
InI	Installation instructions
AT	Acceptance Test

Type	Code Explanation
OpI	Operating instructions
MaI	Maintenance instructions
MAA	Maintenance agreement
MaM	Maintenance materials
Rcp	Receipt (such as for keys, tools, and detachable parts, including delivery tickets.
RD	Record Documents
SW	Special Warranty
TR	Test Report

1.5 GENERAL SUBMITTAL PROVISIONS

A. Submittals must be transmitted using the Laboratory's Project Management & Control System (PMCS)

B. Requirements specified for submittals are intended to provide efficient handling, while permitting review responsibilities to be carried out.

C. Architect via the Laboratory will accept submittals only from the Contractor. Only items specified to be submitted will be accepted.

D. Bind submittals in a manner suitable for 215 x 275-mm (8-1/2 x 11-inch) file folder storage, except where doing so is not workable.

E. Transmit submittals with all transportation charges prepaid.

F. Avoidable Resubmittals
   1. The first two reviews of each specified submittal will be processed without cost to the Contractor. After the second review, the Laboratory may charge the Contractor for the cost of such additional processing, unless the processing results from approved Change Orders causing revisions to previously approved submittals.

G. MSDS: Do not submit Material Safety Data Sheets. If MSDS are required by the Contract Documents, request clarification of instructions from the Architect.

H. Review Stamp

   1. Through the use of a "Review Stamp" the Contractor shall sign and date each instance, providing evidence that Contractor has reviewed the submittal and fulfilled contractual requirements for verification and coordination.

1.6 GENERAL SUBMITTAL PROCEDURES

A. General: Prepare and submit submittals required by individual Specification Sections.

B. Before preparing the initial submittal of each type, request the Architect's direction regarding format.

C. Hardcopy/electronic Submittal Requirements: The Specifications are based on submittal of hardcopy documents. Requirements shall apply to submittals made through electronic means, except as necessary to accommodate and use the benefits of electronic document processing. The basic intent will be that, electronic documents, if printed, shall comply with the respective requirements for hardcopy. Specific details of submittals will be subject to mutually agreed procedures.

D. Submittals shall be performed electronically via the Laboratory's PMCS.
   1. Submit electronic submittals as PDF electronic files by attaching to the files in PMCS

2. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
3. Provide a digital signature with digital certificate on electronically-submitted certificates and certifications where indicated.

E. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 section governing closeout procedures.

F. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

G. Where notarized statement is required, provide a notarized statement on original paper copy certificates and certifications where indicated.

H. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 section governing quality requirements.

I. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 section governing quality requirements.

J. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

K. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

L. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

M. Contractor's Construction Schedule: Comply with requirements specified in Division 01 section governing construction progress documentation.

N. Application for Payment: Comply with requirements specified in Division 01 section payment procedures.

O. Schedule of Values: Comply with requirements specified in Division 01 section governing payment procedures.

P. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

Q. Sustainable Design Submittals: Comply with requirements specified in Division 01 section governing sustainable design requirements.

R. Coordination Drawings: Comply with requirements specified in Division 01 section project management and coordination."

S. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and Laboratory's, and other information specified.

T. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.

U. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

V. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

W. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

X. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

Y. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

Z. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

AA. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

BB. Maintenance Data: Comply with requirements specified in Division 01 Section governing operation and maintenance data.

1.7 PRODUCT SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files:
1. With the Laboratory's concurrence, electronic copies of files used to create the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals
2. The files will not be identical to the Contract Drawings. Prior to requesting files, discuss with the Architect how the files will differ from the Contract Documents, and related limitations, such as which Drawings will not be represented, the file format, what information will be included, and method of transmittal.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
   3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
   4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. The right is reserved to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals. Time for review shall commence on Laboratory's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Normally, allow not less than 10 working days for initial review of each submittal. Allow additional time if coordination with other submittals is required.
   2. When a large volume of submittal materials is scheduled, additional review time may be required. Similarly, a particular submittal may require review completion in less than the agreed normal time. Due to variations in submittal volume and processing needs, agreed review time is not intended to apply to extreme conditions.
   3. Resubmittal Review: Allow 10 working days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Laboratory, or other parties is indicated, allow 15 working days for initial review of each submittal.

D. Maintain at the Project Site ready access to the latest reviewed Shop Drawings and Product Data, and one set of samples.

1.8 PREPARING PRODUCT SUBMITTALS

A. Title Block for Product Submittals
   1. Shop Drawings, the cover sheets for Product Data, and the labels for Samples shall each have an identifying title block containing:
      a. Project title.
      b. Architect’s name, Project Number, and Contract Package title.
      c. Brief description of submittal item matching the description on the Submittal Form.
      d. Contractor's name and project or contract number.
      e. Name and phone number of manufacturer, supplier, subcontractor, or other such organization furnishing the submittal to the Contractor.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
   1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
      a. Identification of products.
      b. Schedules.
      c. Compliance with specified standards.
      d. Notation of coordination requirements.
      e. Notation of dimensions established by field measurement.
      f. Relationship and attachment to adjoining construction clearly indicated.
      g. Seal and signature of professional engineer if specified.

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
3. Submit Shop Drawings in the following format:
   a. PDF electronic file.
   b. If requested, two opaque copies of each submittal. Architect will retain one copy; remainder will be returned.
4. Each sheet of the same item or system shall be uniform in size and numbered consecutively.
5. Each sheet shall contain the title block specified below plus an unobstructed space at the right side or bottom, of size not less than 150 x 200 mm (6 by 8 inches) for submittal review stamps and notations.
6. Include the Review Stamp to each sheet.
7. Dimensions on Shop Drawings shall be the same system of measure (i.e., metric or inch-pound) as on the Contract Drawings.

C. Product Data
1. Submit the manufacturer's Product Data, 3 copies of each submittal item. Bind the material to form identical bound copies. Attach to each a 215 x 275-mm (8-1/2 x 11-inch) cover sheet containing the title block specified below plus an unobstructed space for submittal review stamps and notations.
2. The Architect will return one copy.
3. If the Contractors Review Stamp cannot be placed on the submittal item without obstructing information, affix the Review Stamp to a separate piece of paper for that item, same size as cover sheet.
4. Where the publication displays more products than the product intended to be submitted, prominently mark to indicate the exact product and product options and accessories being submitted, and strike-out non-applicable information.
   a. Mark where selections are to be made.
   b. Tailor large catalogs so that excessive unrelated products are not included.
5. To highlight and mark-up Product Data information, use bold markings that will be easily seen after photocopying. Do not use highlighter, pencil, or color.
6. Clearly convey the differences between similar products included in the submittal.
   a. Clearly highlight information that differs for different sizes or grades.
7. Correlate Product Data with Contract Documents:
   a. Where the Contract Documents include designations such as types or marks, mark Product Data with these designations and include them on the Submittal Form. For example: glass types; fixture item numbers.
   b. Clearly highlight information on Product Data that shows compliance with specified requirements. For example: manufacturer (not supplier, distributor, etc.); model number; rating; performance characteristics.
8. If multiple manufacturers or products are being submitted for similar items, include manufacturer or product name in separate line item descriptions on the Submittal Form. Don't use distributor or other supplier names other than manufacturer.
9. Dimensioning on Product Data shall be the same system of measure (metric vs. inch-pound) as on the Contract Drawings. If preprinted catalogues display only the system not used in the Contract Drawings, mark-up the Product Data with the other system's dimensions.

D. Samples
1. Submit Samples in triplicate, except where a different number is specified, with identifying labels firmly attached.
   a. Labels shall be of a size to contain the title block specified below plus unobstructed space for submittals review stamps and notations.
   b. Each sample shall display, as a minimum, the Laboratory's project number, and the submittal and item numbers. Where Sample size does not permit the full title block and Review Stamp without obstructing information, provide a separate sheet of paper, 215 x 275-mm (8-1/2 x 11-inch), securely attached to each sample (or sample set), with the Review Stamp affixed.

c. The Architect will retain one sample or sample set and return the others.
d. Maintain at least one sample or sample set at the site.

2. Sample Sets Showing Range of Variation: Where variations are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Attach samples in sets together unless doing so is not reasonably practical.
3. Recording of Sample Installation: Note and preserve the on-site indicators of each area constituting a sample installation, but remove indicators at final clean-up of Project. Use normal submittal form and process to provide record of sample.
4. When color, texture, or pattern is specified by naming a particular manufacturer and style, include one sample of the specified product for comparison if another product is submitted.

1.9 AFFIXING REVIEW STAMP

A. Separate Line Items: Affix an image of the Contractors Review Stamp to each separately-reviewable item of the submittal package. For example:
   1. On each separate Shop Drawing sheet, affix a Review Stamp image.
   2. For each separate item appearing on a Contract Document schedule, affix a separate Review Stamp image. For example: lighting fixture; plumbing fixture.
   3. For each separate type of a product identified for the specified item, affix a separate Review Stamp image. For example, glass type; masonry unit type; metal panel type.

B. When affixed, the Review Stamp shall not obscure information contained in the submittal.

C. Fill in name of Contractor and Contractor’s project or contract number, if not already entered on stamp.

D. Provide the following information on or with the Contractor Review Stamp
   1. Submittal number:
   2. Date submitted by Contractor.
   3. Signature of authorized representative of the Contractor who has performed the Contractor's review and approval of the submittal item, and the date.

1.10 DELEGATED-DESIGN SERVICES

A. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

B. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
   1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

C. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
   1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.11 ARCHITECT REVIEW

A. General: Architect will not review submittals that do not display Contractor's signature indicating that Contractor has reviewed submittal and that Contractor affirms that it is complete and meets submittal requirements.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Informational Submittals: Architect’s staff and consultants will review the submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

E. Action Submittals: Architect’s staff and consultants will review the submittals, and mark the Review Stamp on each submittal item with an action code. When more than one action code is assigned to the item, the most restrictive designation marked on the stamp will govern what next shall be done with the item. The code meanings are described below.

F. Action Codes Permitting Use
   1. When an action code permitting use is assigned to a submittal, it does not authorize work that does not comply with the requirements of the Contract Documents. Acceptance of the Work will depend on compliance.
   2. Code AP – Approved: The Work covered by the submittal item may proceed.
   3. Code AN – Approved as Noted: The Work covered by the submittal item may proceed, provided it complies with the Architect's notations and Contract Document requirements.
   4. Code AN-R - Approved as Noted - Resubmit: Do not deliver or install the related work until the resubmittal has received Code AP or AN. However, fabrication and other off-site work covered by the submittal item may proceed, at the Contractor’s risk, provided it complies with the Architect's notations and Contract Document requirements.

G. Action Code Prohibiting Use
   1. Action Code REJ – Not Approved: The Work covered by the submittal item, including purchasing, fabrication, delivery, and other activity, shall not proceed. Revise the submittal item or prepare a new item in accordance with the Architect's notations. Resubmit the corrected or new item without delay; do not permit submittal items marked "Not Approved" to be used. Work incorporating such items will be rejected.

H. Action Code for Items Not Required
   1. Action Code X – Not Requested by Contract Documents: The submittal item is not called for by the Contract Documents and is being returned unreviewed by the Architect except to the extent necessary to determine its status.

1.12 ADDITIONAL SUBMITTAL INSTRUCTIONS

A. Submittal Definition
   1. Each submittal consists of items from only ONE Specifications section.
   2. Complete Submittal: If ALL the items required by the Specifications section are listed on one Submittal (including continuation sheet), it is a complete submittal.
   3. All items in each submittal, will be processed together: Individual items will not be ‘broken out’ for special handling. Arrange submittals accordingly.

B. Submittal Numbering
   1. Number submittals as described below to permit tracking.
   2. **Submittal Package Number:** Assign a permanent, five-digit number to each submittal. Begin with 00001 and advance the number by one for each new submittal throughout the Project. Do not use the same submittal number for more than one submittal package, that is, for the submittals from more than one section.
   3. **Submittal Register Item Number: :** Each individual submittal register item shall be number as follows: six digit specification section-four digit number beginning with 0001 and advance the number by one for each new item.
   4. **R-Number for Re-submittals:** Number each re-submittal in the R space. Begin with 1 for the first re-submittal and advance the number by one for each subsequent resubmittal. Enter the number zero for the initial submittal.

C. **Item Kind:** Identify each submittal item using the type code specified for submittal schedule entries.

D. **Shop Drawings:** Show the number of copies. Include a description of each drawing, matching the description on the drawing itself.

E. **Description:** Provide a brief, clear generic description of each line item, using the Drawings or Specifications as a guide. If more than one manufacturer's model numbers are included in the submittal package, indicate the model numbers in parentheses in the affected line items. Do not list distributors or suppliers other than the manufacturer.

F. **Resubmittals:** In addition to providing the R-number, enter the information using the same line item number as the original submittal package. Doing so will avoid delay in handling the resubmittal package. Resubmit only those items that previously received Code No. AN-R or REJ.

1.13 OBTAINING AND USING SUBMITTAL COMPLIANCE FORM

A. **Obtain Form** through Architect's Construction Administrator.
   1. During Project start-up, discuss changes to the Form that can be made to customize the template to the Project e.g., routing, contact names, project numbers, etc. and reduce entry of repetitious information.
   2. Note that the Form will be supplied in a 1-sheet hardcopy or electronic file, each with a continuation sheet for use with larger submittals.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION (not used)

END OF SECTION

Project: _____

Architect: SmithGroupJJR **Project No:** _____

Contractor: _____ **Project No:** _____

Subcontractor: _____

SECTION 01 33 10
PROJECT SUBMITTAL STAMP

Contractor Action

This submittal is required by Spec Section No. & Para No's:

Section No: _____ and **Paragraph No(s):** _____

Submittal Package No. / Partial No. / Revision No. (*below):*

_____ / _____ / _____

Item No: _____

Date Submitted: _____

☐ Shop Drawings ☐ Product Data ☐ Compliance Certif.

☐ Test Reports ☐ LEED ☐ Samples

☐ Mock-ups ☐ Other: _____

☐ **Re-Submittal** ☐ **Partial Submittal**

Contractor affirms that:
(1) It is responsible for quantities, weights, and dimensions to be confirmed and correlated at the site; for information that pertains solely to the fabrication processes and to the means, methods, techniques, sequences, and procedures of construction; and for coordination of the work of all trades.
(2) The Submittal to which this stamp is affixed is in conformance with information given and the design concept expressed in the Contract Documents. Reviewed and approved for Contractor by:

_____ _____ _____
Signed Date

Architect Action

Architect's review is only for the limited purpose of checking for general conformance with information given and the design concept expressed in the Contract Documents. The results of Architect's review are entered in the table below. The Final Review Code prevails.

Legend - Submittal is:	**Code**
APPROVED	**AP**
APPROVED AS NOTED	**AN**
APPROVED AS NOTED – RESUBMIT	**AN-R**
REJECTED	**REJ**
NOT REQUESTED BY CONTRACT DOCUMENTS	**X**

Discipline	Reviewed By	Date	Code
☐ _____:	_____	_____	_____
☐ _____:	_____	_____	_____
☐ _____:	_____	_____	_____
☐ _____:	_____	_____	_____
☐ _____:	_____	_____	_____
Final Code:			_____

Contractor Notes:	**Reviewer Comments:**

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SECTION 01 33 30

SUBMITTAL COMPLIANCE FORM

Construction Manager/General Contractor _____ Project No: _____

Subcontractor: _____

This submittal is required by:

Spec Section No _____ Paragraph No(s): _____

Submittal Package No / / Revision No: __ __ __ __ ____ __ __ __ __ / __ __ __ _

Item No. __ __ __ __ __ __ -__ __ __- __ __

Date Submitted: _____/_____/201 __

Instructions:

1. This *Submittal Compliance Form* shall be used only when specified to use this form.
2. Do not submit Product Data and/or Samples that are addressed by this form.
3. Do not use this Form for other Submittal items. Such submittals will be returned without review.

By signing below, Contractor certifies that:

1. Submittal items represented by this form conform to all Contract Requirements and the intent expressed in the Contract Documents.
2. There is no Substitution of specified products, and the exact named product and characteristics will be provided.
3. Contractor is responsible for: quantities, weights, and dimensions to be confirmed and correlated at the site; information that pertains solely to the fabrication processes; the means, methods, techniques, sequences, and procedures of construction; coordination of the work of all trades.

Description of Item: _____

_____

Manufacturer: _____

Model No. or Series: _____

Reviewed and approved for Contractor by:

Signed: _____ Print Name: _____ Date: _____

Architect Action:

Architect's review is only for the limited purpose of checking that the item is allowed to be submitted under this form.

Legend - Submittal is:	Code
APPROVED	AP
APPROVED AS NOTED	AN
APPROVED AS NOTED-RESUBMIT	AN-R
REJECTED	REJ
NOT REQUESTED BY CONTRACT DOCUMENTS	X

Discipline	Date	Reviewed By	Code
☐ Architect:	_____	_____	_____
☐ Structural:	_____	_____	_____
☐ Mechanical:	_____	_____	_____
☐ Electrical:	_____	_____	_____
☐ Other:	_____	_____	_____

END OF SECTION

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SECTION 01 35 10

ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Each trade shall perform all cutting, patching, removal and re-installation or replacement of existing constructions specified and required for installation of that trade's Work.

B. Do not endanger any Work by cutting or altering Work or any part of it.

C. Do not cut or alter Work of another Contractor without written consent of Laboratory's designated Project Manager.

D. Coordinate work of trades and schedule elements of alterations and renovation work by procedures and methods to expedite completion of the Work.

E. Include in the Contract removal and reinstallation or replacement of reasonably observable existing construction required by the Work of the Project.

F. Conform to the requirements of authorities having jurisdiction, including lead, asbestos, PCB's, environmental and health hazards, air, water and ground quality and legal disposal of waste.

PART 2 - PRODUCTS

2.1 MATERIALS

A. For replacement of Work removed:

1. Comply with Specifications for type of Work to be done.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect existing conditions of Work, including elements subject to movement or damage.

B. Inspect the reasonably observable existing construction of the facility for removal and re-installation or replacement of existing construction required by the Work of the Project and for patching of existing construction of the facility required by the Work of the Project.

C. After uncovering Work, inspect conditions affecting installation of new products or performance of the Work.

3.2 ASBESTOS CONTAINING MATERIALS

A. Exercise extreme care when working around known, indicated and/or suspected asbestos containing materials such as, but not limited to, spray-on fireproofing, insulation or sound absorbing materials; duct coverings, pipe coverings, etc.

3.3 EXISTING SPECIAL SYSTEMS

A. Inspect the facility for the presence of special utilities or systems that must be maintained operational during construction in the presence of the Laboratory. Such systems include steam and condensate systems, scientific process systems, electrical equipment, fire and smoke detection, alarm, and communication systems.

B. Develop a strategy with the Laboratory to maintain such systems operational during alterations including temporary re-working, unavoidable down time, acceptable discontinuing of service intervals and contingencies for notification of involved agencies.

C. Instruct every Subcontractor as to the procedures to be followed and supervise the process to ensure implementation.

D. Restore such systems and extend them into the altered.

E. Include all services and materials in the Contract Sum.

3.4 PREPARATION

A. Provide shoring, bracing and support as required to maintain structural integrity of Project.

B. Provide protection for other portions of Project.

C. Provide protection from elements.

3.5 PERFORMANCE

A. Execute Work by methods which will prevent damage to other Work, and will provide proper surfaces to receive installation of repairs and new Work.

B. Restore Work which has been cut or removed, install new products to provide completed Work in accord with requirements of Contract Documents.

C. Where existing construction is removed, patch and finish exposed surface or construction to match adjacent existing.

D. When new work abuts or finishes flush with existing work, make a smooth and workmanlike transition. Patched work shall match existing adjacent work in texture and appearance.

E. Provide workmen skilled in the type of patching required in each case. Patch with materials as specified, where not specified Contractor to match existing.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
   1. Specific quality-assurance and -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
   2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
   3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Laboratory, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:
   1. Divisions 02 through 33 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
   1. Laboratory Mockups: Full-size physical assemblies constructed at testing facility to verify performance characteristics.
   2. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
   3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
   1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior and laboratory mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

B. Sample Construction: Process submittal for field samples as specified for product submittal, for documentation.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
   2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
   1. Specification Section number and title.
   2. Entity responsible for performing tests and inspections.
   3. Description of test and inspection.
   4. Identification of applicable standards.
   5. Identification of test and inspection methods.
   6. Number of tests and inspections required.
   7. Time schedule or time span for tests and inspections.
   8. Requirements for obtaining samples.
   9. Unique characteristics of each quality-control service.

F. Mock-up Completion: Process submittal for documentation when mock-up is complete.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Laboratory. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
   1. Project quality-control manager may also serve as Project superintendent or Project engineer.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
   1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
   2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."

3. Laboratory-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Laboratory's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.9 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
   1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
   2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
   1. Contractor responsibilities include the following:
      a. Provide test specimens representative of proposed products and construction.
      b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.

c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed unless otherwise indicated.

L. Integrated Exterior Mockups: Construct integrated exterior mockup as indicated on Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.

M. Room Mockups: Construct room mockups incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work.

N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections in Divisions 02 through 33.

1.10 QUALITY CONTROL

A. Laboratory Responsibilities: Where quality-control services are indicated as Laboratory's responsibility, Laboratory will engage a qualified testing agency to perform these services.
1. Laboratory will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Laboratory are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Laboratory, unless agreed to in writing by Laboratory.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
   1. Distribution: Distribute schedule to Laboratory, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Laboratory will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Laboratory, and as follows:
   1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
   2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
   3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
   4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
   5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
   6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted.
   2. Description of the Work tested or inspected.
   3. Date test or inspection results were transmitted to Architect.
   4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

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SECTION 01 45 00

FINAL OPERATIONAL TESTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Principal work in this Section:

1. Testing of all operational systems and assemblies in the facility for a continuous fourteen (14) day period after all systems are operational.
2. The test(s) shall be planned, coordinated and performed by qualified personnel of the Contractor and qualified subcontractors and manufacturer's representative, as required by the applicable tests, under direction of and with the participation of Laboratory or Laboratory's Designated Representative personnel. Prior to the Final Operational Test all personnel conducting the testing shall be fully trained in the operation of the systems tested. The Contractor shall maintain full responsibility for the facility and equipment operated during the Final Operational Test, maintain all guarantees and warranties, and repair any damage to the facility caused by the Final Operational Test.
3. The test period shall occur after published list of items on all of the equipment involved has been corrected and prior to acceptance or Substantial Completion.

B. Related work:

1. Specific test procedures to be performed on building components as required and specified in Divisions 02 through 41 of the Specifications, including but not limited to the following.

a. Soils and structural tests: Divisions 32.
b. Testing of underground utilities: Division 33
c. Testing of materials specified to be tested by other agencies under other sections.
d. Commissioning: Division 01.

C. Definitions:

1. Final Operational Test: Series of tests, as determined by Laboratory or Laboratory's Designated Representative , to be performed by the Contractor, subcontractors and manufacturers to determine the operational capabilities of the facility after all systems, except minor punch list items to be determined by Laboratory or Laboratory's Designated Representative, are completed and in operation.

1.2 TEST CRITERIA

A. The Contractor shall advise the Laboratory in writing at least fourteen (14) days in advance of scheduling the Final Operational Test.

B. All submittals, including operation and maintenance manuals, parts manuals, and record documents required by the Contract Documents Division 1 through 41 and all other tests, required by those Divisions (except the Final Operational Test) shall have been completed and furnished to Laboratory or Laboratory's Designated Representative.

C. All component and assembly(ies) tests specified in Divisions 2 through 41 of the Specifications shall have been completed, shall have successfully passed and shall have been approved before performance of the Final Operational Test.

D. Operational and maintenance training of Laboratory or Laboratory's Designated Representative or designated personnel required by the Specifications shall have been successfully completed.

E. Testing of all systems shall be made simultaneously in whatever combinations directed by Laboratory or Laboratory's Designated Representative.

F. All installed systems under the responsibility of the Contractor (underground utilities shall be complete and proven fully operational before start of the Final Operational Test.

H. Testing procedures shall be designed so as to simulate actual operation of the system. Additional information about the operation of the facility may be obtained from Laboratory or Laboratory's Designated Representative during planning of the Final Operational Test.

J. During the Final Operational Test should any system malfunction or operate improperly, the Contractor shall repair the observed system malfunction within 24 hours of observation or written notice from Laboratory or Laboratory's Designated Representative.

1. If repairs cannot be achieve satisfactorily within 24 hours, the Final Operational Test shall cease at the option of Laboratory or Laboratory's Designated Representative.
2. Under that condition, a new Final Operational Test shall commence after the necessary repairs and/or re-work has been completed.

1.3 TEST COSTS

A. Contractor shall pay all costs associated with the Final Operational Test including costs of utilities required to run the tests, but excluding cost of Laboratory or Laboratory's Designated Representative personnel witnessing or directing the tests, unless failure occurs.

B. Contractor shall pay for any retesting as required or any re-start of the test as required.

1.4 TEST REPORTS

A. Contractor shall furnish ten (10) type written copies of the test results, signed and certified.

B. Reports shall include the following:

- Date issued and date of the test.
- Project title and Specifications number.
- Testing personnel - name and affiliation.
- Name and signature of personnel supervising the test.
- Record of exterior weather temperature.
- Log of testing procedures and operational sequences.
- Log of operational failures and corrections of failures.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 49 90

SPECIAL SAFETY CONDITIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. General provisions of the Contract, including "Argonne Terms and Conditions" and "Section 1A0 – General Conditions" apply to this Section.

B. It is OSHA policy that all employers provide a safe and healthful workplace for their employees. In part, Argonne National Laboratory helps provide for safe and healthful work environment by implementing the program established in 10 CFR Part 851—Worker Safety and Health Program. To that end each Argonne contractor is responsible for ensuring compliance with "all applicable requirements" that govern their work at Argonne facilities, including any consensus standards incorporated therein by reference.

C. Construction Safety Program Requirements

D. APCF Contractor Site Specific Construction Safety Plan

E. These references apply to all divisions of these specifications.

1.2 DESCRIPTION OF WORK

A. Reference Enclosure 1.B.2 – Scope of Work

1.3 GENERAL

A. The object of this specification section is to identify known and potential safety issues that exist in this contract. The additional guidelines and technical information are provided to insure that required and necessary safety precautions are planned for and executed on this project; however, this section is not fully comprehensive of all safety issues that could occur. The scope could change or unanticipated safety related issues could present themselves.

1.4 CONTRACTOR SAFETY ORIENTATION (CSO)

A. All contractor employees expecting to work at Argonne National Laboratory (Laboratory) shall attend the CSO. It is given Monday, Tuesday, Thursday, and Friday starting at 7:30 AM. No one is allowed into the training class after 7:35AM. The training is provided by the Laboratory in Building 202.

1.5 QUALITY ASSURANCE

A. The contractor shall come prepared to protect the safety of their employees, providing necessary safety equipment and standby personnel as required by all existing applicable industry related standards. Rigorously observe all the pertinent requirements of OSHA - Occupational Safety and Health Administration Regulations, 10 CFR Part 851—Worker Safety and Health Program, EPA - Environmental Protection Agency Regulations, recognized industry standards or recommendations including, but not necessarily limited to OSHA, ANSI, NIOSH, AWWA, ACGIH and SSPC.

B. The Contractor's Site Specific Construction Safety Plan must be structured to address all the anticipated safety hazards to be encountered during the execution of the project. It will be the Contractor's responsibility to demonstrate the methodology followed by the Contractor to define the project related hazards and the development of appropriate procedures to eliminate or mitigate those hazards.

C. The Laboratory will closely monitor compliance with all OSHA and related standards and may stop work at any time violations are observed. Such stoppage shall not relieve the contractor from fulfilling the completion date, nor shall it be a basis for any claims or additional costs.

1.6 CONSTRUCTION SAFETY

A. The contractor may employ a variety of methods to protect its workers and anyone near or entering the work area. A detailed description of the manner and methods used should be included in the safety documents. This specification discusses a number of safety related issues that are expected to be encountered on this job but are not all inclusive.

B. The contractual requirements for the contractor's Safety Program are given in Appendix A, Argonne Terms and Conditions. The Laboratory will evaluate and approve the contractor's Environment, Safety, and Health Plan, otherwise known as a Site Specific Construction Safety Plan as described in the Appendix A, Argonne Terms and Conditions.

C. The Laboratory will evaluate the contractor's Site Specific Construction Safety Plan on the basis of recognized standards including, but not necessarily limited to OSHA - Occupational Safety and Health Administration Regulations, 10 CFR Part 851—Worker Safety and Health Program, EPA - Environmental Protection Agency Regulations, recognized industry standards or recommendations including, but not necessarily limited to OSHA, ANSI, NIOSH, AWWA, ACGIH and SSPC.

1.7 CONTRACTOR JOB SAFETY ANALYSIS (JSA)

A. The Laboratory will participate in the evaluation of JSAs developed by each subcontractor for the first three hands-on activities they will perform. The JSA is to define the steps that will take place on the job, the hazards expected to present within each step, and the precautions that will be taken to mitigate the anticipated hazards

B. Reference "Construction Safety Program Requirements"

1.8 SPECIFIC SAFETY TOPICS

A. Must be detailed in the Site Specific Construction Safety Plan and Guide.

1.9 SUBMITTALS

A. General: Refer to General, Special Conditions, and Appendix A for general submittal requirements.

PART 2 - PRODUCT – NOT USED

PART 3 - EXECUTION – NOT USED

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 DESCRIPTION

A. Provide all temporary facilities and controls required for the performance of the work. Maintain temporary facilities and controls as long as needed for the safe and proper completion of the Work. Remove temporary facilities and controls as rapidly as progress of work will permit and restore surfaces damaged by temporary facilities and controls to their original condition.

B. Supervise the use of all temporary facilities and controls. Enforce compliance with applicable standards. Prevent abuses of services.

C. Submit a mobilization and staging plan.

D. Temporary facilities include, but are not limited to:
1. Temporary utilities:
a. Temporary electric lighting and power.
b. Temporary water.
c. Temporary telephone and data service.
d. Temporary sanitary facilities.
e. Temporary first aid, fire protection and other temporary facilities in accordance with legal requirements.

2. Construction aids.
3. Barriers.
4. Special controls.
5. Traffic regulations.
6. Construction fence.
7. Temporary project signage.
8. Temporary sidewalks, canopies, bridge, curbs, gutters and pavement markings.
9. Hoisting

E. Unless otherwise noted elsewhere in the Contract Documents, all costs of installation, operation, maintenance and removal of all temporary facilities shall be borne by the Contractor.

1.2 MOBILIZATION AND STAGING PLAN

A. Submit a mobilization and staging plan to Laboratory or Laboratory's Designated Representative before starting any work on the site.

B. Include staging for major equipment, material deliveries, parking and temporary structures.

1.3 LIGHT AND POWER

A. Provide and maintain in a safe manner and utilize so as not to constitute a hazard to persons or property.

B. Comply with legal requirements.

1.4 WATER

A. Provide and maintain temporary water service for drinking and construction purposes for all parts of the work.

1.5 TELEPHONES AND DATA

A. Provide temporary telephone service for construction needs throughout the construction period. Provide at least one (1) telephone and one (1) data jack in the Contractor's field office.

1.6 TOILETS

A. Provide and maintain temporary portable toilets and other sanitary facilities for all workmen on the Project as required by, and in accordance with, legal requirements.

1.7 CLEANUP

A. Each Contractor will be responsible to furnish labor and disposal means to adequately keep project clean and uncluttered at all times of construction. Debris, shipping containers, etc. will be removed from the site on a daily basis and disposed of off-site.

B. Contractor shall take steps to prevent construction traffic dirt and debris deposits on Laboratory roadways. Contractor shall promptly remove such dirt and debris from Laboratory roadways. During operations involving continuous construction traffic, contractor shall perform continuous maintenance.

1.8 FIRST AID/FIRE PROTECTION/OTHER TEMPORARY FACILITIES

A. Provide as required by, and in accordance with, legal requirements. The local fire authority shall be consulted regarding on-site fire protection during the demolition and construction phases.

1.9 TEMPORARY GRADING AND DEWATERING

A. As specified in Specification Division 31, maintain temporary protection as long as needed, and until permanent draining and grading is completed and operating.

1.10 HOISTING

A. Provide and maintain all temporary hoisting, hoists, elevators or lifts necessary to complete the work.

1.11 MISCELLANEOUS TEMPORARY CONSTRUCTION AIDS

A. Provide and maintain all miscellaneous temporary construction aids required for proper execution of the work, such as stairs, ladders, ramps, railings, canopies, scaffolds and hoists, chutes, barricades, enclosures, platforms, swing staging and walks.

B. Locate in and about the Project as is practical and where they will not interfere with the progress of the work. Relocate when necessary during construction, and remove promptly when no longer needed.

1.12

BARRIERS

A. At the perimeters of the Construction site, provide and maintain a 6 foot high chain-link fence with "wind screen" material affixed.

B. Security:
   1. Laboratory shall not in any way be liable or responsible for the damage or loss to the work due to trespass or theft.
   2. Provide protection for materials, tools and equipment employed on the Project including the workmen tools. Laboratory shall not be held to have incurred any liability for loss of, and damage to, materials, tools and equipment of the Contractor, or of those employed by Contractor, by contract or otherwise.

B. Protection:
   1. Continuously maintain protection as necessary to protect the work as a whole and in part, and adjacent property and improvements from accidents, injuries or damage.
   2. Properly protect the work:
      a. With lights, guard rails, temporary covers, and barricades.
      b. Enclose excavations with proper barricades.
      c. Brace and secure all parts of the work against storm and accident.
      d. Provide such additional forms of protection which may be necessary under existing circumstances.

   3. Provide and maintain in good condition all protective measures as may be required to adequately protect the public from hazards resulting from the work and to exclude unauthorized persons from the work. When regulated by Building Code and other public authorities having jurisdiction, such legal requirements for protection shall be considered as minimum requirements; be responsible for the protection in excess of such requirements as required.

1.13 SHORING

A. Work included: Provide shoring at excavations and elsewhere as required to protect workmen, materials, utilities, other properties, and the public. Shoring shall not damage or interfere with the operation of any utilities or adjacent properties and shall not interfere or hamper the completion of the construction work on site.

B. The Contractor is solely responsible for means and methods of construction and for the sequences and procedures to be used.

C. Employ a qualified engineer, properly permitted to provide such services at the location of the Work, to design the shoring system and to inspect and report on the quality of its construction.

D. Comply with pertinent requirements of governmental agencies having jurisdiction.

1.14 POLLUTION CONTROL

A. Comply with all pollution control regulations in effect at site for all materials, equipment and work procedures used on the Project.

B. Control dust during demolition and sitework. Continuously control dust during all operations when trucks are running. Provide truck roll-off measures.

C. Require all trailers carrying debris, fill and earth from the site to be covered.

1.15 TRAFFIC REGULATION

A. Traffic maintenance: Provide measures to prevent construction traffic or deliveries of any kind from passing by Building 440, unless otherwise approved by a Laboratory representative. Personnel vehicles will be permitted.

B. Determine the routing of construction vehicles before starting work, based on restrictions indicated on the Drawings and the safeguards and procedures necessary to carry out the work. Document proposed routing of construction vehicles and submit to Laboratory or Laboratory's Designated Representative two weeks before start of construction traffic activities. Upon approval of proposed routing of construction vehicles by Laboratory or Laboratory's Designated Representative, distribute document to all subcontractors and trades performing work.

1. In addition:
   a. Be responsible for controlling construction traffic within and adjacent to the site.
   b. Provide all entrances, lifts and safeguards required or necessary to the progress of the work, end effectively control such traffic to provide minimum hazard to the work and all persons.
   c. Route all construction equipment, trucks, and similar vehicles via existing public streets to and from the site as approved by the governing authorities.
   d. Obtain and pay for permits and inspections necessitated by the use of public streets, sidewalks, curbs, and paving. Post guarantees and bonds that may be required, and repair and make good any damages thereto, acceptable to the authorities having jurisdiction.
   e. Construct and maintain temporary walks and ridges for pedestrians. Keep streets adjacent to the site open to vehicular and pedestrian traffic.
   f. Maintain constant access for police, fire and ambulance service.
   g. Provide and maintain for proper control of traffic and safety of all concerned:
      1. All necessary barricades, suitable and sufficient lights, reflectors, and danger signals.
      2. Warning and closure signs, directional and detour signs.

   h. Indicate on a twenty four (24) hour basis all restricted and dangerous conditions existing on or adjacent to the site.
      1. Illuminate barricades, danger signals, warning signs and obstructions at night.
      2. Keep warning lights burning from one hour before sunset until one hour after sunrise.

B. Parking: Parking shall be subject to the requirements and designated area as determined by Laboratory.

1.16 PROJECT SIGNAGE

A. Furnish and install project signage as directed by Laboratory or Laboratory's Designated Representative.

1.17 FIELD OFFICES AND STORAGE SHEDS

A. Furnish, install and maintain a field office for the Contractor's use. Equip the office with lights, heat, air conditioning, desks, chairs, plan racks, telephones and other items necessary for the performance of the work.

B. Furnish, install and maintain storage sheds needed for construction.

C. Comply with requirements of regulatory agencies having jurisdiction. Obtain and pay for permits required by governing authorities.

D. Locate temporary structures to avoid interference with work in progress and relocate as required by job progress.

1.18 REMOVAL

Remove temporary facilities and controls upon completion of construction operations or when they are no longer needed, whichever occurs first. Remove temporary fencing, sign, foundations, debris; grade to required elevations and clean area of debris. Restore areas to original condition as directed by Laboratory or Laboratory's Designated Representative.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 52 00

CONSTRUCTION AIDS

PART 1 - GENERAL

1.1 Requirements Included:

A. Unless specifically noted otherwise in Section 01 00 10 and attachments, each Contractor shall furnish, install and maintain required construction aids and upon completion of their use such aids shall be removed from the site.

B. Related requirements:

1. Section 01 04 00: Project Coordination.
2. Section 01 50 00: Temporary Facilities and Controls.
3. Section 01 53 00: Barriers.
4. "Contractor Staging Plan"

PART 2 - PRODUCTS

2.1 Materials, General:

A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.

2.2 Construction Aids:

A. Provide construction aids and equipment required by personnel and to facilitate the execution of the work, i.e., scaffolds, shoring, piling, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes, and other such facilities and equipment.
1. Refer to respective Specification Sections for particular requirements for each trade.
2. When permanent stair framing is in place, provide temporary treads, platforms, and railings for use by construction personnel.
3. Maintain all facilities and equipment in a first-class condition.

2.3 Temporary Enclosures:

A. Provide temporary enclosures per Specification Section 01 50 00.

PART 3 - EXECUTION

3.1 Preparation:

A. Consult with Laboratory or Laboratory's Designated Representative, review site conditions and factors which affect construction procedures and construction aids, including adjacent properties and public facilities which may be affected by execution of the Work.

3.2 General:

A. Comply with applicable requirements specified in Specification Sections of Divisions 02 through 41.

B. Relocate construction aids as required by progress of construction by storage or work requirements, and to accommodate legitimate requirements of Laboratory and other Contractors employed at the site.

3.3 Removal:

A. Completely remove temporary materials, equipment, and services:

1. When construction needs can be met by use of permanent construction.
2. At completion of the Project.

B. Clean and repair damage caused by installation or by use of temporary facilities.

1. Remove foundations and underground installations for construction aids.
2. Grade the areas of the site affected by temporary installation to required elevations and slopes, and clean the area.

C. Restore permanent facilities used for temporary purposes to specified condition.

END OF SECTION

SECTION 01 53 00

BARRIERS

PART 1 - GENERAL

1.1 Requirements Included:

A. Furnish, install, and maintain suitable barriers as required to prevent public entry, and to protect the Work; remove when no longer needed or at completion of Work.

1.2 Related Requirements:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
B. Section 01 04 00: Project Coordination.
C. Section 01 52 00: Construction Aids.

PART 2 - PRODUCTS

2.1 Materials, General:

A. Materials may be new or used, suitable for the intended purpose, but must not violate requirements of applicable codes and standards.
B. Apply Wind Screen material to barrier along the entire perimeter of the construction site limits.

PART 3 - EXECUTION

3.1 General:

A. Install facilities of a neat and reasonably uniform appearance, structurally adequate for required purposes.
B. Maintain barriers during entire construction period.
C. Relocate barriers as required by progress of construction.

3.2 Removal:

A. Completely remove barricades, including foundations when construction has progressed to the point that they are no longer needed, and when approved by Architect and Laboratory or Laboratory's Designated Representative.
B. Clean and repair damage caused by installation, fill and grade areas of the site to required elevations and slopes, and clean the area.

END OF SECTION

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SECTION 01 55 00

SITE SECURITY

PART 1 - GENERAL

1.1 Security Requirements

A. Laboratory or Laboratory's Designated Representative assumes no responsibility for loss, theft or damage to the work, tools, equipment and/or construction. In the instance of any such loss, theft or damage, the Contractor shall be responsible to renew, restore or remedy the work tools, equipment and construction in accordance with requirements of the Contract Documents without additional cost to Laboratory.

B. The Contractor, at his own cost and expense may provide means of site security as he deems necessary.

1. Contractors shall advise Laboratory or Laboratory's Designated Representative of any theft or damage which might delay the execution of the Work.
2. Contractors are to furnish Laboratory or Laboratory's Designated Representative with a copy of any theft report filed with local, county or state agencies.

C. Site-parked equipment, operable machinery and hazardous parts of the new construction subject to mischief and accidental operation shall be inaccessible, locked or otherwise made inoperable when left unattended.

D. Laboratory may, as a courtesy only, provide surveillance and security as it deems necessary within the construction site.

E. No Contractor personnel are allowed in any Argonne National Laboratory facilities unless specifically granted access or accompanied by Laboratory personnel.

1.2 Security Procedures

A. Selected entrances to the construction site will remain open during normal working hours for use by all Contractors. Contractors shall utilize specific entrances for material deliveries, equipment deliveries and workmen access to the construction site as directed by Laboratory or Laboratory's Designated Representative.

B. Laboratory or Laboratory's Designated Representative may, as the project progresses, establish additional security policies and procedures. Contractors shall cooperate with Laboratory or Laboratory's Designated Representative in implementing additional procedures.

C. Laboratory or Laboratory's Designated Representative is not responsible for damage, liability, theft, casualty or other hazard to the automobiles or other vehicles, nor to injury including death to occupants of automobiles or other vehicles on Laboratory's property.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 57 00

FIRE PROTECTION

PART 1 - GENERAL

1.1 Description of Requirements

A. Specific administrative and procedural minimum actions are specified in this Section, as extensions of provisions in Fixed-Price Construction Contract between UChicago Argonne, LLC and Contractor and other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this Section is intended to limit types and amounts of fire protection required, and no omission from this Section will be recognized as an indication by Laboratory or Laboratory's Designated Representative that such temporary activity is not required to successful completion of the work and compliance with requirements of Contract Documents. Provisions of this Section are applicable to, but not by way of limitation, security/protection provisions.

1.2 Quality Assurance

A. NFPA Code: Comply with NFPA Code 241 "Building Construction and Demolition Operations".

B. Contractor shall also comply with all applicable state, city and local fire codes.

PART 2 – FIRE PRECAUTIONS AND PROTECTION

2.1 The Contractor shall take all necessary precautions to guard against all possible fire hazards and to prevent damage to any construction work, building materials, equipment, field offices, storage sheds and all other property, both public and private, in accordance with all fire protection and prevention laws and codes. Assume full responsibility for damage caused by fire to construction and building materials, equipment and all property, both public and private.

2.2 The location of the nearest corporation or public fire alarm box and the number of the local fire department shall be conspicuously posted by the Contractor in field offices and in the building construction adjacent to the Work.

2.3 Prevent heavy concentrations of materials where they might be consumed by a single fire. Equipment stored in the open should be kept in low piles and with adequate space between piles. This arrangement will provide fire breaks and access for fire fighting.

PART 3 – EXECUTION - NOT USED

END OF SECTION

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SECTION 01 59 00

FIELD OFFICES, STORAGE & PARKING FACILITIES

PART 1 - GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. "Contractor Staging Plan"

1.2 Requirements Included.

A. Temporary Field Offices and Storage Trailers.

B. Employee and Vehicle Parking.

C. Temporary Storage Areas.

D. Security of Stored Materials.

1.3 Related Requirements

A. Section 01 00 10 – Special Conditions.

B. Section 01 50 00 - Temporary Facilities and Controls.

1.4 Temporary Field Offices and Storage Trailers

A. The contractor shall provide, install and maintain one (1) temporary mobile office trailer for use by the Laboratory and/or Laboratory's Designated Representatives. The trailer shall be independent from the contractor's trailer(s) and shall be for sole use/occupancy by the Laboratory. The temporary mobile office trailer shall meet the following requirements:
   a. Size: 36'L x10'W or larger.
   b. Two (2) office areas, with at least one (1) being a private office that can be securely locked from the adjacent areas of the trailer.
   c. HVAC
   d. Skirting
   e. Tie-Downs
   f. Two (2) sets of stairs
   g. Contain Smoke & Carbon Monoxide Detectors
   h. Equipment with Fire Extinguisher (s)
   i. Furniture
      i. Two (2) desks or built-in desks.
      ii. Two (2) Office chairs
      iii. Four (4) 2-drawer, lockable file cabinets
      iv. Plan Table
      v. Six (6) Rectangular Folding tables
      vi. Eighteen (18) folding chairs
      vii. One (1) Metal Storage Cabinet
      viii. Water cooler, maintained by contractor

B. Laboratory or Laboratory's Designated Representative reserves the right to prohibit office or storage trailers that are of flammable construction, in need of repair or otherwise objectionable.

C. The Contractor shall keep its assigned office and storage area clean and dispose of its debris and trash promptly. The office and/or storage trailers shall not be used for living quarters and shall be of suitable design and appearance. The Contractor shall remove all office and storage trailers within ten (10) days of written notice from Laboratory or Laboratory's Designated Representative. Trailers not removed in a timely manner will be removed by Laboratory or Laboratory's Designated Representative at the Contractor's expense. Contractor shall provide for a field office trailer for Argonne's use for the duration of the project. Provide temporary electric power.

1.5 Employee and Vehicle Parking

A. Employee parking shall be as shown on the "Contractor Staging Plan"

B. Employee vehicles shall not be used within the construction work area. The Contractor shall restrict the use of vehicles to company owned vehicles having appropriate insurance. Any vehicle within the construction work area will be attended by the driver or operator at all times.

1.6 Temporary Storage Areas

A. There will be limited space on site for storage of materials and equipment. Contractors shall not bring materials and/or equipment to the site until they are needed for the progress of the work, unless otherwise approved by Laboratory or Laboratory's Designated Representative.

B. Storage of materials within the building structure will only be allowed when approved by Laboratory or Laboratory's Designated Representative. The Contractor shall not store flammable materials within or adjacent to the building structure, and all such flammable materials shall be clearly identified and properly stored, with approval of Laboratory or Laboratory's Designated Representative.

C. The Contractor shall coordinate the extent of fuels stored on site and location of fuel storage tanks with Laboratory or Laboratory's Designated Representative. Fuel shall be stored and located in accordance with the requirements of Local Authorities and governing laws. Spill protection shall be provided at all fuel storage areas and at any area where flammable solvents or other liquids are stored or dispensed.

1.7 Security of Stored Materials

A. Laboratory assumes no responsibility for materials stored in the building or on the site. The Contractor accepts the full responsibility for damage or theft due to on-site storage of construction related material and equipment.

B. The Contractor shall coordinate its security procedures with Laboratory or Laboratory's Designated Representatives and receive approval prior to proceeding with additional security measures.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 60 00

MATERIAL & EQUIPMENT

PART 1 GENERAL

1.1 Requirements Included

A. Products

B. Transportation and handling

1.2 Related Requirements

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section 01 40 00 - Quality Control: Submittal of manufacturers' certificates.

C. Section 01 73 00 – Operation Manuals: Operation and Maintenance Data.

D. Section 01 73 50 – Maintenance Manuals: Spare Parts and Maintenance Materials.

1.3 Products

A. Products include materials, equipment and systems.

B. Comply with specifications and referenced standards as minimum requirements.

C. Components required to be supplied in quantity within a specification section shall be the same, and shall be interchangeable.

D. Do not use materials and equipment removed from existing structure, except as specifically required, or allowed, by Contract Documents.

E. Buy American Act Compliance: Refer to Argonne Terms and Conditions, a supplemental document available from the Laboratory, for Buy American Act requirements.

1.4 Transportation and Handling

A. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage.

C. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

D. For hoisting provisions see Specification Section 01 50 00.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 61 50

PRODUCT HANDLING

PART1 GENERAL
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1.1 DESCRIPTION

A. Principal work in this Section:
1. This Section establishes general requirements for product handling and storage, whether on or off the site, and supplements similar provisions found elsewhere in the Contract Documents.

B. Related work or requirements:
1. Handling provisions for Laboratory furnished items are specified in Section 01 01 00 ‘Special Conditions”.
2. Storage of materials on site must be in accordance with the approved mobilization and staging plan specified in Section 01 50 00 “Temporary Facilities and Controls”.

1.2 HANDLING

A. General: Transport, deliver, handle, and store all materials and equipment used on the Project to prevent the intrusions of foreign matter, moisture, and to prevent damage. In all cases comply with the following.
1. Material and equipment manufacturer's instructions regarding temperature limitations.
2. Other environmental conditions which are required to maintain the original quality of the materials and equipment.

B. Packaging:
1. Provide packaged materials in their manufacturer's original containers with seals unbroken and labels intact until incorporating into the work.
2. Wrapped or bundled materials shall clearly bear the manufacturer's name and trade mark.

C. Damaged materials: Remove damaged or otherwise unsuitable material and equipment promptly from the site. Do not install damaged materials.

1.3 STORAGE

A. Inspect products upon delivery to ensure compliance with the Contract Documents, and to ensure that products are undamaged and properly protected.

B. Store products at the site in a manner that will facilitate inspection and measurement of quantity or counting of units.

C. Store heavy materials away from the Project structure in a manner that will not endanger the supporting construction.

D. Store products subject to damage by the elements above ground, under cover in a weather tight enclosure, with ventilation adequate to prevent condensation. Maintain temperature and humidity within range required by manufacturer's instructions.

E. Schedule delivery to minimize long-term storage at the site and to prevent overcrowding of construction spaces.

F. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

G. Locate storage piles, stacks or bins to avoid being disturbed, and protect from damage of any sort.

H. Store materials and equipment in accord with manufacturer's instructions, above grade, and properly protected from weather and construction activities.

I. Payment may be withheld for improperly packaged and stored materials.

1.4 PROTECTION

A. Protect all finished surfaces, including floors jambs and soffits of all openings used as passageways or through which materials and equipment must travel.

B. Keep finished surfaces clean and unmarred until the date of acceptance.

C. Refer to individual Specification Sections for additional specific product handling and protection requirements.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 71 00

CLEANING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Principal work in this Section:
1. Keep premises, adjacent private properties and public properties free from accumulations of waste, debris and rubbish caused by construction operations.
2. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all exposed surfaces. Leave Project clean and ready for use / occupancy.

B. Related Sections:
1. Section 01 74 19, “Construction Waste Management” for additional information related to cleaning and waste management during construction.

1.2 SAFETY REQUIREMENTS

A. Standards: Maintain Project in accord with State and local safety and insurance standards.

B. Hazard control:
1. Store volatile wastes in covered metal containers, and remove from premises daily.
2. Prevent accumulation of wastes which create hazardous or un-safe conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
1. Do not burn or bury rubbish and waste materials on Project site.
2. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains. Store in containers with tight-fitting lids and remove to legal dump site.

PART 2 - PRODUCTS

(Not applicable)

PART 3 - EXECUTION

3.1 DURING CONSTRUCTION

A. Keep premises, adjacent properties and public properties free from accumulations of waste materials and rubbish. Remove debris and dirt from public property promptly; sweep sidewalks and adjacent streets daily when soiled by work performed under this Contract.

B. Wet down materials and rubbish as required to lay dust and prevent it from blowing.

C. At least once a day, or more often if required, clean site and dispose of waste materials, debris and rubbish off the site in a legal manner. Remove combustible materials such as paper and cardboard daily.

D. Provide on-site containers for collection of waste materials, debris and rubbish. Provide a collection can at each location used as an eating area. Pick-up all garbage daily.

E. Remove waste materials, debris and rubbish from site and legally dispose of at legal public or private dumping areas off Laboratory's property.

F. Do not allow debris and combustible materials to accumulate on site. Clean out areas thoroughly before being sealed or closed off by final construction.

G. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

3.2 FINAL CLEANING

A. Employ experienced workmen for final cleaning.

B. In preparation for Substantial Completion or Occupancy conduct final inspection of sight-exposed areas.

C. Remove grease, dust, dirt, stains, and other foreign materials from sight-exposed paved surfaces. No stains or discolorations will be allowed on exposed concrete surfaces.

D. Remove all glazing compound and sealant, markers, stains and paint from glass. Wash and polish glass to remove all stains and marks. Replace stained, broken, and scratched glass and leave in condition specified above.

E. Contaminated earth:
1. Final clean-up operation includes the removal and disposal of earth contaminated or unsuitable for support of plant life in planting areas, and filling of resulting excavations with suitable soil.
2. Contaminated areas include those used for disposal of waste concrete, and similar materials, areas in which washing out of concrete mixers or washing of tools and like cleaning operations have been performed, and areas that have been oiled, paved, or chemically treated.
3. Do not dispose of waste oil, solvents, paints, solutions, or like penetrating material by depositing or burying on Laboratory's property.

G. Broom clean paved surfaces; rake clean other surfaces of grounds.

H. Provide an additional final cleaning in compliance with above requirements following Start-up and Testing.

H. Keep Project clean until it is occupied by Laboratory.

END OF SECTION

SECTION 01 74 00

WARRANTIES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Compile specified warranties and specified service and maintenance contracts.

B. Review submittals to verify compliance with Contract Documents.

C. Submit to Laboratory or Laboratory's Designated Representative as specified in Sections 01 33 00 "Submittal Procedures" & 01 77 00 "Closeout Procedures".

1.2 SUBMITTAL REQUIREMENTS

A. Assemble warranties and service and maintenance contracts executed by each of the respective manufacturers, suppliers, and subcontractors.

B. Submit two (2) original signed copies, and one (1) electronic/digital copy.

C. Furnish a typed Table of Contents, in orderly sequence, with the following complete information for each item:

1. Product or assembly.
2. Firm, with name of principal, address and telephone number.
3. Scope.
4. Date of beginning of warranty or service and maintenance contract.
5. Duration of warranty or service maintenance contract.
6. Provide information for proper procedure to be followed in case of failure, and in instances which may affect the validity of warranty.
7. Name of responsible principal of Contractor, and address and telephone number.

1.3 FORM OF SUBMITTALS

A. Prepare and bind in a 3-ring binder of commercial quality, with durable and cleanable plastic covers. Label binding edge of binder with project name, location, project specification number and contents.

B. Format:
1. Size: 8-1/2" x 11"; punch sheets for standard 3-ring binder. Fold larger sheets to fit into binders.
2. Cover: Identify binder with typed or printed title "WARRANTIES," title of Project and Contractor's name.

C. Electronic/Digital Copy Format:
1. Submit a Portable Document Format (PDF) file of each original document.
2. Assemble, organize and group documents by specific systems or assembly.

1.4 TIME OF SUBMITTALS

A. For equipment or component parts of equipment put into service during construction: Submit documents within ten (10) days after inspection and acceptance. Otherwise, make submittals as specified in Sections 01 33 00 “Submittal Procedures” & 01 77 00 “Closeout Procedures”.

B. For items whose acceptance is delayed materially beyond date of Substantial Completion, provide updated submittal within ten (10) days after acceptance, listing date of acceptance as start of warranty period.

PART 2 – PRODUCTS – NOT USED

PART 3 – EXECUTION - NOT USED

END OF SECTION

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. The Laboratory has established that this Project shall include proactive measures for waste management participation by all parties to the contract.
   1. The purpose of this program is to ensure that during the course of the Project all diligent means are employed to pursue practical and economically feasible waste management and recycling options.
   2. Upon award, each subcontractor shall be required to furnish documentation from suppliers or manufacturers regarding waste management and recycling options for those products and procedures furnished.
   3. Waste disposal to landfills shall be minimized.

B. Section includes administrative and procedural requirements for the following:
   1. Salvaging nonhazardous demolition and construction waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

C. Related Requirements:
   1. Division 02 Section "Selective Structure Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
   2. Division 31 Section "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

A. Waste: Any material that has reached the end of its intended use. Waste includes salvageable, returnable, recyclable and reusable construction materials that would otherwise be discarded or destroyed.

B. Construction waste: Solid wastes including, but not limited to, building materials, packaging materials, debris and trash resulting from construction operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

G. Hazardous waste: Any material or byproduct of construction that is regulated by the Environmental Protection Agency and that may not be disposed in any landfill or other waste end-source without adherence to applicable laws.

H. Trash: Any product or material unable to be returned, reused, recycled, or salvaged.

I. Landfill: Any public or private business involved in the practice of trash disposal.

J. Waste Management Plan: A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site.

1.3 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials.

1.4 SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.
   1. Include in the waste management plan, sample progress report forms intended for tracking purposes from the waste management company for approval by the laboratory and the LEED Administrator.

B. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:
   1. Material category.
   2. Generation point of waste.
   3. Total quantity of waste in tons (tonnes).
   4. Quantity of waste salvaged, both estimated and actual in tons (tonnes).
   5. Quantity of waste recycled, both estimated and actual in tons (tonnes).
   6. Total quantity of waste recovered (salvaged plus recycled) in tons (tonnes).
   7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

C. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. LEED Submittal: LEED letter template for Credits MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

I. Qualification Data: For refrigerant recovery technician.

J. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.5 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

D. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

E. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

F. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

H. LEED Submittal: LEED letter template for Credits MR 2.1 and 2.2, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met.

I. Qualification Data: For waste management coordinator and refrigerant recovery technician.

J. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements, that employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator. Waste management coordinator may also serve as LEED coordinator.

B. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

C. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

D. Waste Management Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
   1. Review and discuss waste management plan including responsibilities of waste management coordinator.
   2. Review requirements for documenting quantities of each type of waste and its disposition.
   3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
   4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
   5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
   1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
   2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
   3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
   4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Waste Management Plan shall include locations of sorting and waste storage facilities on the Site Plan of the project.

E. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use Form CWM-5 for construction waste and Form CWM-6 for demolition waste. Include the following:
   1. Total quantity of waste.
   2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
   3. Total cost of disposal (with no waste management).
   4. Revenue from salvaged materials.
   5. Revenue from recycled materials.
   6. Savings in hauling and tipping fees by donating materials.
   7. Savings in hauling and tipping fees that are avoided.
   8. Handling and transportation costs. Include cost of collection containers for each type of waste.
   9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
   1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."

B. Hazardous Wastes: Store in secure areas and comply with the following:
   1. Hazardous wastes shall be separated, stored, and disposed of in accordance with loxcal and EPA regulations and additional criteria listed below:
      a. Building products manufactured with PVC or chlorinated compounds shall not be incinerated.
      b. Disposal of florescent tubes to open containers is not permitted.

C. Unused fertilizers shall not be co-mingled with construction waste.

D. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

E. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
   1. Distribute waste management plan to everyone concerned within 7 days of submittal return.
   2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

F. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
   2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

G. Submit “Waste Management Progress Reports” each month as part of the Application for payment.
   1. Materials identified in the report shall be reported by weight,

2. Where weight is not applicable, Contractor shall report materials by units applicable to materials recipient.
3. Procure receipts or other validation of waste management procedures and include them as part of the submittal.

3.2 SALVAGING DEMOLITION WASTE

A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

B. Salvaged Items for Sale and Donation: Not permitted on Project site.

C. Salvaged Items for Laboratory's Use: Salvage items for Laboratory's use and handle as follows:
1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Laboratory.
4. Transport items to storage area designated by Laboratory.
5. Protect items from damage during transport and storage.

A. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

B. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

C. Plumbing Fixtures: Separate by type and size.

D. Lighting Fixtures: Separate lamps by type and protect from breakage.

E. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
   a. Inspect containers and bins for contamination and remove contaminated materials if found.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Laboratory's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
   1. Pulverize concrete to maximum 4-inch (100-mm) size.
   2. Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.

B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
   1. Pulverize masonry to maximum 4-inch (100-mm) size.
   2. Clean and stack undamaged, whole masonry units on wood pallets.

C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

D. Metals: Separate metals by type.
   1. Structural Steel: Stack members according to size, type of member, and length.
   2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

E. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

G. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

H. Carpet Tile: Remove debris, trash, and adhesive.
   1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

I. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

J. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   2. Polystyrene Packaging: Separate and bag materials.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.

4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
a. Comply with requirements in Division 32 Section "Plants." for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
a. Comply with requirements in Division 32 Section "Plants." for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Laboratory’s property and legally dispose of them.

3.7 ATTACHMENTS

A. Forms CWM-1 through CWM-6 are provided for use by the Contractor during the Work on this project. The Contractor can propose additional or alternate Forms which can be considered upon approval by the Laboratory and the Architect.
1. Form CWM-1 for construction waste identification.
2. Form CWM-2 for demolition waste identification.
3. Form CWM-3 for construction waste reduction work plan.
4. Form CWM-4 for demolition waste reduction work plan.
5. Form CWM-5 cost/revenue analysis of construction waste reduction work plan.
6. Form CWM-6 cost/revenue analysis of demolition waste reduction work plan.

END OF SECTION

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FORM CWM-1: CONSTRUCTION WASTE IDENTIFICATION

MATERIAL CATEGORY	GENERATION POINT	EST. QUANTITY OF MATERIALS RECEIVED* (A)	EST. WASTE - % (B)	TOTAL EST. QUANTITY OF WASTE* (C = A x B)	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Packaging: Cardboard							
Packaging: Boxes							
Packaging: Plastic Sheet or Film							
Packaging: Polystyrene							
Packaging: Pallets or Skids							
Packaging: Crates							
Packaging: Paint Cans							
Packaging: Plastic Pails							
Site-Clearing Waste							
Masonry or CMU							
Lumber: Cut-Offs							
Lumber: Warped Pieces							
Plywood or OSB (scraps)							
Wood Forms							
Wood Waste Chutes							
Wood Trim (cut-offs)							
Metals							
Insulation							
Roofing							
Joint Sealant Tubes							
Gypsum Board (scraps)							
Carpet and Pad (scraps)							
Piping							
Electrical Conduit							
Other:							

* Insert units of measure.

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FORM CWM-2: DEMOLITION WASTE IDENTIFICATION

MATERIAL DESCRIPTION	EST. QUANTITY	EST. VOLUME CY (CM)	EST. WEIGHT TONS (TONNES)	REMARKS AND ASSUMPTIONS
Asphaltic Concrete Paving				
Concrete				
Brick				
CMU				
Lumber				
Plywood and OSB				
Wood Paneling				
Wood Trim				
Miscellaneous Metals				
Structural Steel				
Rough Hardware				
Insulation				
Roofing				
Doors and Frames				
Door Hardware				
Windows				
Glazing				
Acoustical Tile				
Carpet				
Carpet Pad				
Demountable Partitions				
Equipment				
Cabinets				
Plumbing Fixtures				
Piping				
Piping Supports and Hangers				
Valves				
Sprinklers				
Mechanical Equipment				
Electrical Conduit				
Copper Wiring				
Light Fixtures				
Lamps				
Lighting Ballasts				
Electrical Devices				
Switchgear and Panelboards				
Transformers				
Other:				

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FORM CWM-3: CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Packaging: Cardboard						
Packaging: Boxes						
Packaging: Plastic Sheet or Film						
Packaging: Polystyrene						
Packaging: Pallets or Skids						
Packaging: Crates						
Packaging: Paint Cans						
Packaging: Plastic Pails						
Site-Clearing Waste						
Masonry or CMU						
Lumber: Cut-Offs						
Lumber: Warped Pieces						
Plywood or OSB (scraps)						
Wood Forms						
Wood Waste Chutes						
Wood Trim (cut-offs)						
Metals						
Insulation						
Roofing						
Joint Sealant Tubes						
Gypsum Board (scraps)						
Carpet and Pad (scraps)						
Piping						
Electrical Conduit						
Other:						

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FORM CWM-4: DEMOLITION WASTE REDUCTION WORK PLAN

MATERIAL CATEGORY	GENERATION POINT	TOTAL EST. QUANTITY OF WASTE TONS (TONNES)	DISPOSAL METHOD AND QUANTITY			HANDLING AND TRANSPORTION PROCEDURES
			EST. AMOUNT SALVAGED TONS (TONNES)	EST. AMOUNT RECYCLED TONS (TONNES)	EST. AMOUNT DISPOSED TO LANDFILL TONS (TONNES)	
Asphaltic Concrete Paving						
Concrete						
Brick						
CMU						
Lumber						
Plywood and OSB						
Wood Paneling						
Wood Trim						
Miscellaneous Metals						
Structural Steel						
Rough Hardware						
Insulation						
Roofing						
Doors and Frames						
Door Hardware						
Windows						
Glazing						
Acoustical Tile						
Carpet						
Carpet Pad						
Demountable Partitions						
Equipment						
Cabinets						
Plumbing Fixtures						
Piping						
Supports and Hangers						
Valves						
Sprinklers						
Mechanical Equipment						
Electrical Conduit						
Copper Wiring						
Light Fixtures						
Lamps						
Lighting Ballasts						
Electrical Devices						
Switchgear and Panelboards						
Transformers						
Other:						

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FORM CWM-5: COST/REVENUE ANALYSIS OF CONSTRUCTION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Packaging: Cardboard								
Packaging: Boxes								
Packaging: Plastic Sheet or Film								
Packaging: Polystyrene								
Packaging: Pallets or Skids								
Packaging: Crates								
Packaging: Paint Cans								
Packaging: Plastic Pails								
Site-Clearing Waste								
Masonry or CMU								
Lumber: Cut-Offs								
Lumber: Warped Pieces								
Plywood or OSB (scraps)								
Wood Forms								
Wood Waste Chutes								
Wood Trim (cut-offs)								
Metals								
Insulation								
Roofing								
Joint Sealant Tubes								
Gypsum Board (scraps)								
Carpet and Pad (scraps)								
Piping								
Electrical Conduit								
Other:								

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FORM CWM-6: COST/REVENUE ANALYSIS OF DEMOLITION WASTE REDUCTION WORK PLAN

MATERIALS	TOTAL QUANTITY OF MATERIALS (VOL. OR WEIGHT) (A)	EST. COST OF DISPOSAL (B)	TOTAL EST. COST OF DISPOSAL (C = A x B)	REVENUE FROM SALVAGED MATERIALS (D)	REVENUE FROM RECYCLED MATERIALS (E)	LANDFILL TIPPING FEES AVOIDED (F)	HANDLING AND TRANSPORTATION COSTS AVOIDED (G)	NET COST SAVINGS OF WORK PLAN (H = D+E+F+G)
Asphaltic Concrete Paving								
Concrete								
Brick								
CMU								
Lumber								
Plywood and OSB								
Wood Paneling								
Wood Trim								
Miscellaneous Metals								
Structural Steel								
Rough Hardware								
Insulation								
Roofing								
Doors and Frames								
Door Hardware								
Windows								
Glazing								
Acoustical Tile								
Carpet								
Carpet Pad								
Demountable Partitions								
Equipment								
Cabinets								
Plumbing Fixtures								
Piping								
Supports and Hangers								
Valves								
Sprinklers								
Mech. Equipment								
Electrical Conduit								
Copper Wiring								
Light Fixtures								
Lamps								
Lighting Ballasts								
Electrical Devices								
Switchgear and Panelboards								
Transformers								
Other:								

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SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Substantial Completion procedures.
   2. Final completion procedures.
   3. Warranties.
   4. Final cleaning.
   5. Repair of the Work.

B. Related Requirements:
   1. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
   2. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
   3. Division 01 Section "Demonstration and Training" for requirements for instructing Laboratory's personnel.
   4. Divisions 02 through 33 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Laboratory unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
   3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Laboratory. Label with manufacturer's name and model number where applicable.
      a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
   5. Submit test/adjust/balance records.
   6. Submit sustainable design submittals required in Division 01 sustainable design requirements Section and in individual Division 02 through 33 Sections.
   7. Submit changeover information related to Laboratory’s occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
   1. Advise Laboratory of pending insurance changeover requirements.
   2. Make final changeover of permanent locks and deliver keys to Laboratory. Advise Laboratory‘s personnel of changeover in security provisions.
   3. Complete startup and testing of systems and equipment.
   4. Perform preventive maintenance on equipment used prior to Substantial Completion.
   5. Instruct Laboratory’s personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
   6. Advise Laboratory of changeover in heat and other utilities.
   7. Participate with Laboratory in conducting inspection and walkthrough with local emergency responders.
   8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   9. Complete final cleaning requirements, including touchup painting.
   10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Laboratory will either proceed with inspection or notify Contractor of unfulfilled requirements. Laboratory will prepare the Certificate of Substantial Completion after inspection or will notify

Contractor of items, either on Contractor's list or additional items identified by Laboratory, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to "Payment Procedures."
   2. Certified List of Incomplete Items: Submit certified copy of Laboratory's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Laboratory. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Laboratory will either proceed with inspection or notify Contractor of unfulfilled requirements. Laboratory will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
   1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.
   4. Submit list of incomplete items in the following format:
      a. MS Excel electronic file. Architect will return annotated file.
      b. PDF electronic file. Architect will return annotated file.
      c. Three paper copies. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Laboratory for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Laboratory's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Laboratory during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning before and after start-up & testing. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
   1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
      a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
      b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
      c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
      d. Remove tools, construction equipment, machinery, and surplus material from Project site.
      e. Remove snow and ice to provide safe access to building.
      f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
      g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
      h. Sweep concrete floors broom clean in unoccupied spaces.

i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
k. Remove labels that are not permanent.
l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
   1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Division 01 Section "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
   1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
   2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
      a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
   3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
   4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
   1. Operation and maintenance documentation directory.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Product maintenance manuals.
   5. Systems and equipment maintenance manuals.

B. Related Requirements:
   1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
   2. Section 01 91 00 "Commissioning" for verification and compilation of data into operation and maintenance manuals.
   3. Divisions 02 through 33 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
   1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:
   1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.
   2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
   1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.

C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.

D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
   1. Title page.
   2. Table of contents.
   3. Manual contents.

B. Title Page: Include the following information:
   1. Subject matter included in manual.
   2. Name and address of Project.
   3. Name and address of Laboratory.
   4. Date of submittal.
   5. Name and contact information for Contractor.
   6. Name and contact information for Architect.
   7. Name and contact information for Commissioning Authority.
   8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.

9. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
   1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
   1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
   2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
   1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf or post-type binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
      a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
      b. Identify each binder on front and spine, with printed title "BUILDING 446 OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
   2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
   3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
   4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
   5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
      a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
      b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:
   1. Type of emergency.
   2. Emergency instructions.
   3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
   1. Fire.
   2. Flood.
   3. Gas leak.
   4. Water leak.
   5. Power failure.
   6. Water outage.
   7. System, subsystem, or equipment failure.
   8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Laboratory's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:
   1. Instructions on stopping.
   2. Shutdown instructions for each type of emergency.
   3. Operating instructions for conditions outside normal operating limits.
   4. Required sequences for electric or electronic systems.
   5. Special operating instructions and procedures.

2.4 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
   1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
   2. Performance and design criteria if Contractor has delegated design responsibility.
   3. Operating standards.
   4. Operating procedures.
   5. Operating logs.
   6. Wiring diagrams.
   7. Control diagrams.
   8. Piped system diagrams.
   9. Precautions against improper use.
   10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:
   1. Product name and model number. Use designations for products indicated on Contract Documents.
   2. Manufacturer's name.
   3. Equipment identification with serial number of each component.
   4. Equipment function.
   5. Operating characteristics.
   6. Limiting conditions.
   7. Performance curves.
   8. Engineering data and tests.
   9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:
   1. Startup procedures.
   2. Equipment or system break-in procedures.
   3. Routine and normal operating instructions.
   4. Regulation and control procedures.

5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Product Information: Include the following, as applicable:
1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
   1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
   2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
   1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Laboratory's operating personnel for types of emergencies indicated.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
   1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
   2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Laboratory's operating personnel.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
   1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
   1. Do not use original project record documents as part of operation and maintenance manuals.
   2. Comply with requirements of newly prepared record Drawings in Section 01 78 39 "Project Record Documents."

G. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

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SECTION 01 78 39

PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for project record documents, including the following:
   1. Record Drawings.
   2. Record Specifications.
   3. Record Product Data.
   4. Miscellaneous record submittals.

B. Related Requirements:
   1. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
   2. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.
   3. Divisions 02 through 33 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set(s) of marked-up record prints.
   2. Number of Copies: Submit copies of record Drawings as follows:
      a. Initial Submittal:
         1) Submit one paper-copy set(s) of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and one of file prints.
         3) Submit record digital data files and one set(s) of plots.
         4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
      b. Substantial Completion Submittal:
         1) Submit three paper-copy set(s) of marked-up record prints.
         2) Submit PDF electronic files of scanned record prints and three set(s) of prints.
         3) Print each drawing, whether or not changes and additional information were recorded.
      c. Final Submittal:
         1) Submit one paper-copy set(s) of marked-up record prints.
         2) Submit record digital data files and three set(s) of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit one paper copy and annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit one paper copy and annotated PDF electronic files and directories of each submittal.
   1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
   1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
      a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
      b. Accurately record information in an acceptable drawing technique.
      c. Record data as soon as possible after obtaining it.
      d. Record and check the markup before enclosing concealed installations.
      e. Cross-reference record prints to corresponding archive photographic documentation.
   2. Content: Types of items requiring marking include, but are not limited to, the following:
      a. Dimensional changes to Drawings.
      b. Revisions to details shown on Drawings.
      c. Depths of foundations below first floor.
      d. Locations and depths of underground utilities.
      e. Revisions to routing of piping and conduits.
      f. Revisions to electrical circuitry.
      g. Actual equipment locations.
      h. Duct size and routing.
      i. Locations of concealed internal utilities.
      j. Changes made by Change Order or Construction Change Directive.
      k. Changes made following Architect's written orders.
      l. Details not on the original Contract Drawings.
      m. Field records for variable and concealed conditions.
      n. Record information on the Work that is shown only schematically.
   3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
   4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
   5. Mark important additional information that was either shown schematically or omitted from original Drawings.
   6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
   1. Format: Same digital data BIM software program, version, and operating system as the original Contract Drawings.
   2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
   3. Refer instances of uncertainty to Architect for resolution.
   4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
      a. See Section 01 33 00 "Submittal Procedures" for requirements related to use of Architect's digital data files.
      b. Architect will provide data file layer information. Record markups in separate layers.

C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
   1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
   2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
   1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
   2. Format: Annotated PDF electronic file with comment function enabled.
   3. Record Digital Data Files: Organize digital data BIM information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
   4. Identification: As follows:
      a. Project name.
      b. Date.
      c. Designation "PROJECT RECORD DRAWINGS."
      d. Name of Architect.
      e. Name of Contractor.

2.2 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
   3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
   4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
   5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
   1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
   2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
   3. Note related Change Orders, record Specifications, and record Drawings where applicable.

B. Format: Submit record Product Data as annotated PDF electronic file.
   1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.
   1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION

SECTION 01 79 00

DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Laboratory's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.
   3. Demonstration and training video recordings.

B. Related Requirements:
   1. Divisions 02 through 33 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
   1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products where available, in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
   1. Identification: On each copy, provide an applied label with the following information:
      a. Name of Project.
      b. Name and address of videographer.
      c. Name of Architect.
      d. Name of Contractor.
      e. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Laboratory's use prepared and bound in format matching operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 01 40 00 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Laboratory's operations. Adjust schedule as required to minimize disrupting Laboratory's operations and to ensure availability of Laboratory's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.
2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
   m. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.

f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operations and Maintenance Data."

B. Set up instructional equipment at instruction location.

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Laboratory for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Laboratory's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
   1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
   2. Laboratory will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
   1. Schedule training with Laboratory, through Architect, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess each participant's mastery of module by use of an oral, demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION

SECTION 01 81 13

SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements and procedures for compliance with certain USGBC LEED prerequisites and credits needed for Project to obtain LEED Gold certification based on LEED-NC, Version 2.2.
   1. Other LEED prerequisites and credits needed to obtain LEED certification depend on material selections and may not be specifically identified as LEED requirements. Compliance with requirements needed to obtain LEED prerequisites and credits may be used as one criterion to evaluate substitution requests and comparable product requests.
   2. Additional LEED prerequisites and credits needed to obtain the indicated LEED certification depend on Architect's design and other aspects of Project that are not part of the Work of the Contract.

B. Related Sections:
   1. Divisions 01 through 33 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.2 DEFINITIONS

A. LEED: Leadership in Energy & Environmental Design.

B. Rapidly Renewable Materials: Materials made from plants that are typically harvested within a 10-year or shorter cycle. Rapidly renewable materials include products made from bamboo, cotton, flax, jute, straw, sunflower seed hulls, vegetable oils, or wool.

C. Regional Materials: Materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

D. Regionally Manufactured Materials: Materials that are manufactured within a radius of 500 miles from Project site. Manufacturing refers to the final assembly of components into the building product that is installed at Project site.

E. Regionally Extracted and Manufactured Materials: Regionally manufactured materials made from raw materials that are extracted, harvested, or recovered within a radius of 500 miles from Project site.

F. Recycled Content: The recycled content value of a material assembly shall be determined by weight. The recycled fraction of the assembly is then multiplied by the cost of assembly to determine the recycled content value.
   1. "Post-consumer" material is defined as waste material generated by households or by commercial, industrial, and institutional facilities in their role as end users of the product, which can no longer be used for its intended purpose.
   2. "Pre-consumer" material is defined as material diverted from the waste stream during the manufacturing process. Excluded is reutilization of materials such as rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it.

1.3 SUBMITTALS

A. General: Submit additional LEED submittals required by other Specification Sections.

B. LEED submittals are in addition to other submittals. If submitted item is identical to that submitted to comply with other requirements, submit duplicate copies as a separate submittal to verify compliance with indicated LEED requirements.

C. Project Materials Cost Data: Provide statement indicating total cost for materials used for Project. Costs exclude labor, overhead, and profit. Include breakout of costs for the following categories of items:
   1. Plumbing.
   2. Mechanical.
   3. Electrical.
   4. Specialty items such as elevators and equipment.
   5. Wood-based construction materials.

D. LEED Action Plans: Provide preliminary submittals within 30 days of date established for the Notice to Proceed indicating how the following requirements will be met:
   1. Credit MR 2.1 and Credit MR 2.2: Waste management plan complying with Division 01 Section "Construction Waste Management and Disposal."
   2. Credit MR 3.1 and Credit MR 3.2: List of proposed salvaged and refurbished materials. Identify each material that will be salvaged or refurbished, including its source, cost, and replacement cost if the item was to be purchased new.
   3. Credit MR 4.1 and Credit MR 4.2: List of proposed materials with recycled content. Indicate cost, post-consumer recycled content, and pre-consumer recycled content for each product having recycled content.
   4. Credit MR 5.1 and Credit MR 5.2: List of proposed regional materials. Identify each regional material, including its source, cost, and the fraction by weight that is considered regional.
   5. Credit MR 7: List of proposed certified wood products. Indicate each product containing certified wood, including its source and cost of certified wood products.
   6. Credit EQ 3.1: Construction indoor-air-quality management plan.

E. LEED Documentation Notebook:
   1. The Contractor shall prepare a comprehensive notebook documenting compliance for each LEED credit for those construction credits for which they are responsible. LEED Documentation Notebook shall be formatted to match LEED numbering system for each credit and prerequisite. The original, or an electronic version on CD/DVD of the notebook, shall be submitted at project closeout.
   2. Notebook shall include LEED Credit Checklist or other approved checklist, applicable product data of material selection, final calculations, certifications for construction practices, procurement data, cumulative calculations and other items as identified in the approved LEED Action Plan. Notebook must contain all required data supporting full compliance with the indicated LEED construction credits.

F. LEED Progress Reports: Concurrent with each Application for Payment, submit reports comparing actual construction and purchasing activities with LEED action plans for the following:
   1. Credit MR 2.1 and Credit MR 2.2: Waste reduction progress reports complying with Division 01 Section "Construction Waste Management and Disposal."
   2. Credit MR 3: Salvaged and refurbished materials.
   3. Credit MR 3.1 and Credit MR 3.2: Salvaged and refurbished materials.
   4. Credit MR 4.1 and Credit MR 4.2: Recycled content.
   5. Credit MR 5.1 and Credit MR 5.2: Regional materials.
   6. Credit MR 7: Certified wood products.

G. LEED Documentation Submittals:
   1. Credit EA 5: Product data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy-consumption performance over time.
   2. Credit MR 2.1 and Credit MR 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."
   3. Credit MR 3.1 and Credit MR 3.2: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs for salvaged and refurbished materials.
   4. Credit MR 4.1 and Credit MR 4.2: Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.
   5. Credit MR 5.1 and Credit MR 5.2: Product data for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   6. Credit MR 7: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
   7. Credit EQ 3.1:
      a. Construction indoor-air-quality management plan.
      b. Product data for temporary filtration media.
      c. Product data for filtration media used during occupancy.
      d. Construction Documentation: Six photographs at three different times during the construction period, along with a brief description of the SMACNA approach employed, documenting implementation of the indoor-air-quality management measures, such as protection of ducts and on-site stored or installed absorptive materials.
   8. Credit EQ 3.2:
      a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
      b. Product data for filtration media used during flush-out and during occupancy.
      c. Report from testing and inspecting agency indicating results of indoor-air-quality testing and documentation showing compliance with indoor-air-quality testing procedures and requirements.
   9. Credit EQ 4.1: Product data for adhesives and sealants used inside the weatherproofing system indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D.
   10. Credit EQ 4.4: Product data for products containing composite wood or agrifiber products or wood glues indicating that they do not contain urea-formaldehyde resin.

1.4 QUALITY ASSURANCE

A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.

PART 2 - PRODUCTS

2.1 SALVAGED AND REFURBISHED MATERIALS

A. Credit MR 3.: Provide salvaged or refurbished materials for a minimum of 1 percent of building materials (by cost).

B. Credit MR 3.1 and Credit MR 3.2: Provide salvaged or refurbished materials for a minimum of 10 percent of building materials (by cost).

2.2 RECYCLED CONTENT OF MATERIALS

A. Credit MR 4.1 and Credit MR 4.2: Provide building materials with recycled content such that post-consumer recycled content plus one-half of pre-consumer recycled content constitutes a minimum of 20 percent of cost of materials used for Project.
   1. Cost of post-consumer recycled content of an item shall be determined by dividing weight of post-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
   2. Cost of pre-consumer recycled content of an item shall be determined by dividing weight of pre-consumer recycled content in the item by total weight of the item and multiplying by cost of the item.
   3. Do not include mechanical and electrical components, and specialty items such as elevators and equipment in the calculation.

2.3 REGIONAL MATERIALS

A. Credit MR 5.1 and Credit MR 5.2: Provide a minimum of 20 percent of building materials (by cost) that are regional materials.

B. Credit MR 5.1: Provide a minimum of 20 percent of materials (by cost) that are regionally manufactured materials.

C. Credit MR 5.2: Provide a minimum of 10 percent of materials (by cost) that are regionally extracted and manufactured materials.

2.4 CERTIFIED WOOD

A. Credit MR 7: Provide a minimum of 50 percent (by cost) of wood-based materials that are produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
   1. Wood-based materials include, but are not limited to, the following materials when made from wood, engineered wood products, or wood-based panel products:
      a. Rough carpentry.
      b. Miscellaneous carpentry.
      c. Finish carpentry.
      d. Architectural woodwork.
      e. Wood veneer wall covering.
      f. Wood flooring.
      g. Wood cabinets.

2.5 LOW-EMITTING MATERIALS

A. Credit EQ 4.1: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D:
   1. Wood Glues: 30 g/L.
   2. Metal to Metal Adhesives: 30 g/L.
   3. Adhesives for Porous Materials (Except Wood): 50 g/L.
   4. Subfloor Adhesives: 50 g/L.
   5. Plastic Foam Adhesives: 50 g/L.
   6. Carpet Adhesives: 50 g/L.
   7. Carpet Pad Adhesives: 50 g/L.
   8. VCT and Asphalt Tile Adhesives: 50 g/L.
   9. Cove Base Adhesives: 50 g/L.

10. Gypsum Board and Panel Adhesives: 50 g/L.
11. Rubber Floor Adhesives: 60 g/L.
12. Ceramic Tile Adhesives: 65 g/L.
13. Multipurpose Construction Adhesives: 70 g/L.
14. Fiberglass Adhesives: 80 g/L.
15. Contact Adhesive: 80 g/L.
16. Structural Glazing Adhesives: 100 g/L.
17. Wood Flooring Adhesive: 100 g/L.
18. Structural Wood Member Adhesive: 140 g/L.
19. Special Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, Teflon, ultra-high molecular weight polyethylene, rubber or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.
20. Top and Trim Adhesive: 250 g/L.
21. Plastic Cement Welding Compounds: 250 g/L.
22. ABS Welding Compounds: 325 g/L.
23. CPVC Welding Compounds: 490 g/L.
24. PVC Welding Compounds: 510 g/L.
25. Adhesive Primer for Plastic: 550 g/L.
26. Sheet Applied Rubber Lining Adhesive: 850 g/L.
27. Aerosol Adhesive, General Purpose Mist Spray: 65 percent by weight.
28. Aerosol Adhesive, General Purpose Web Spray: 55 percent by weight.
29. Special Purpose Aerosol Adhesive (All Types): 70 percent by weight.
30. Other Adhesives: 250 g/L.
31. Architectural Sealants: 250 g/L.
32. Nonmembrane Roof Sealants: 300 g/L.
33. Single-Ply Roof Membrane Sealants: 450 g/L.
34. Other Sealants: 420 g/L.
35. Sealant Primers for Nonporous Substrates: 250 g/L.
36. Sealant Primers for Porous Substrates: 775 g/L.
37. Modified Bituminous Sealant Primers: 500 g/L.
38. Other Sealant Primers: 750 g/L.

B. Credit EQ 4.2: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D and the following chemical restrictions:
1. Flat Paints, Coatings, and Primers: VOC not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC not more than 150 g/L.
3. Anticorrosive and Antirust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Clear Wood Finishes, Varnishes: VOC not more than 350 g/L.
5. Clear Wood Finishes, Lacquers: VOC not more than 550 g/L.
6. Floor Coatings: VOC not more than 100 g/L.
7. Shellacs, Clear: VOC not more than 730 g/L.
8. Shellacs, Pigmented: VOC not more than 550 g/L.
9. Stains: VOC not more than 250 g/L.
10. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
11. Restricted Components: Paints and coatings shall not contain any of the following:
    a. Acrolein.
    b. Acrylonitrile.
    c. Antimony.
    d. Benzene.
    e. Butyl benzyl phthalate.
    f. Cadmium.
    g. Di (2-ethylhexyl) phthalate.
    h. Di-n-butyl phthalate.

i. Di-n-octyl phthalate.
j. 1,2-dichlorobenzene.
k. Diethyl phthalate.
l. Dimethyl phthalate.
m. Ethylbenzene.
n. Formaldehyde.
o. Hexavalent chromium.
p. Isophorone.
q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

C. Credit EQ 4.4: Do not use composite wood or agrifiber products or adhesives that contain urea-formaldehyde resin.

PART 3 - EXECUTION

3.1 MEASUREMENT AND VERIFICATION

A. Credit EA 5: Implement measurement and verification plan consistent with Option B: Energy Conservation Measure Isolation in the EVO's "International Performance Measurement and Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction," and as further defined by the following:

B. If not already in place, install metering equipment to measure energy usage. Monitor, record, and trend log measurements.

C. Evaluate energy performance and efficiency by comparing actual to predicted performance.

D. Measurement and verification period shall cover at least one year of postconstruction occupancy.

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Credit MR 2.1 and Credit MR 2.2: Comply with Division 01 Section "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Credit EQ 3.1: Comply with SMACNA's "SMACNA IAQ Guideline for Occupied Buildings under Construction."
1. If Laboratory authorizes use of permanent heating, cooling, and ventilating systems during construction period as specified in Division 01 Section "Temporary Facilities and Controls," install filter media having a MERV 8 according to ASHRAE 52.2 at each return-air inlet for the air-handling system used during construction.
2. Replace all air filters immediately prior to occupancy.

B. Credit EQ 3.2: Comply with one of the following requirements:
   1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14000 cu. ft. of outdoor air per sq. ft. of floor area while maintaining an internal temperature of at least 60 deg F and a relative humidity no higher than 60 percent.
   2. Air-Quality Testing:
      a. Conduct baseline indoor-air-quality testing, after construction ends and prior to occupancy, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air," and as additionally detailed in the USGBC's "LEED-NC: Reference Guide."
      b. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
         1) Formaldehyde: 50 ppb.
         2) Particulates (PM10): 50 micrograms/cu. m.
         3) Total Volatile Organic Compounds (TVOC): 500 micrograms/cu. m.
         4) 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
         5) Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
      c. For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with outside air and retest the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from same locations as in the first test.
      d. Air-sample testing shall be conducted as follows:
         1) All measurements shall be conducted prior to occupancy but during normal occupied hours, and with building ventilation system starting at the normal daily start time and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
         2) Building shall have all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Nonfixed furnishings such as workstations and partitions are encouraged, but not required, to be in place for the testing.
         3) Number of sampling locations will vary depending on the size of building and number of ventilation systems. For each portion of building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft. or for each contiguous floor area, whichever is larger, and shall include areas with the least ventilation and greatest presumed source strength.
         4) Air samples shall be collected between 3 and 6 feet from the floor to represent the breathing zone of occupants, and over a minimum four-hour period.

END OF SECTION

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LEED for New Construction v 2.2
Registered Project Checklist

Project Name: Argonne Crystallization Facility

Project Address: 9700 South Cass Avenue

Yes	?	No		
39	5	3	Project Totals (Pre-Certification Estimates)	69 Points
GOLD			**Certified**: 26-32 points **Silver**: 33-38 points **Gold**: 39-51 points **Platinum**: 52-69 points	

Yes	?	No			
8	1	1	Sustainable Sites		14 Points
Yes			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
		0	Credit 2	**Development Density & Community Connectivity**	1
		0	Credit 3	**Brownfield Redevelopment**	1
		0	Credit 4.1	**Alternative Transportation**, Public Transportation	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
1			Credit 4.3	**Alternative Transportation**, Low-Emitting & Fuel Efficient Vehicles	1
		0	Credit 4.4	**Alternative Transportation**, Parking Capacity	1
0		1	Credit 5.1	**Site Development**, Protect or Restore Habitat	1
1	0		Credit 5.2	**Site Development**, Maximize Open Space	1
1			Credit 6.1	**Stormwater Design**, Quantity Control	1
1	0		Credit 6.2	**Stormwater Design**, Quality Control	1
	1		Credit 7.1	**Heat Island Effect**, Non-Roof	1
1			Credit 7.2	**Heat Island Effect**, Roof	1
1			Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
4		0	Water Efficiency		5 Points
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		0	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No			
5	2	2	Energy & Atmosphere		17 Points
Yes			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Yes			Prereq 1	**Minimum Energy Performance**	Required
Yes			Prereq 1	**Fundamental Refrigerant Management**	Required

***Note for EAc1:** All LEED for New Construction projects registered after June 26, 2007 are required to achieve at least two (2) points.

2	2	2	Credit 1	**Optimize Energy Performance**	1 to 10
			Credit 1.1	10.5% New Buildings / 3.5% Existing Building Renovations	1
			--> Credit 1.2	14% New Buildings / 7% Existing Building Renovations	2
			Credit 1.3	17.5% New Buildings / 10.5% Existing Building Renovations	3
			Credit 1.4	21% New Buildings / 14% Existing Building Renovations	4
			Credit 1.5	24.5% New Buildings / 17.5% Existing Building Renovations	5
			Credit 1.6	28% New Buildings / 21% Existing Building Renovations	6
			Credit 1.7	31.5% New Buildings / 24.5% Existing Building Renovations	7
			Credit 1.8	35% New Buildings / 28% Existing Building Renovations	8
			Credit 1.9	38.5% New Buildings / 31.5% Existing Building Renovations	9
			Credit 1.10	42% New Buildings / 35% Existing Building Renovations	10
		0	Credit 2	**On-Site Renewable Energy**	1 to 3
			Credit 2.1	2.5% Renewable Energy	1
			Credit 2.2	7.5% Renewable Energy	2
			Credit 2.3	12.5% Renewable Energy	3
1	0		Credit 3	**Enhanced Commissioning**	1
1		0	Credit 4	**Enhanced Refrigerant Management**	1
1	0		Credit 5	**Measurement & Verification**	1
		0	Credit 6	**Green Power**	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No			
6	1	0	**Materials & Resources**		**13 Points**
Yes			Prereq 1	**Storage & Collection of Recyclables**	Required
		0	Credit 1.1	**Building Reuse,** Maintain 75% of Existing Walls, Floors & Roof	1
		0	Credit 1.2	**Building Reuse,** Maintain 95% of Existing Walls, Floors & Roof	1
		0	Credit 1.3	**Building Reuse,** Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
1	0		Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
		0	Credit 3.1	**Materials Reuse**, 5%	1
		0	Credit 3.2	**Materials Reuse**, 10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)	1
1	0		Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)	1
1			Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured	1
	1		Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured	1
		0	Credit 6	**Rapidly Renewable Materials**	1
1			Credit 7	**Certified Wood**	1

Yes	?	No			
11	1	0	**Indoor Environmental Quality**		**15 Points**
Yes			Prereq 1	**Minimum IAQ Performance**	Required
Yes			Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
1			Credit 1	**Outdoor Air Delivery Monitoring**	1
	1		Credit 2	**Increased Ventilation**	1
1			Credit 3.1	**Construction IAQ Management Plan,** During Construction	1
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
1			Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
1		0	Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
0	0		Credit 7.1	**Thermal Comfort,** Design	1
1			Credit 7.2	**Thermal Comfort,** Verification	1
		0	Credit 8.1	**Daylight & Views,** Daylight 75% of Spaces	1
		0	Credit 8.2	**Daylight & Views,** Views for 90% of Spaces	1

LEED for New Construction v 2.2
Registered Project Checklist

Yes	?	No			
5			Innovation & Design Process		5 Points
1			Credit 1.1	**Innovation in Design:** Water Use Reduction	1
1			Credit 1.2	**Innovation in Design:** TBD	1
1			Credit 1.3	**Innovation in Design:** TBD	1
1			Credit 1.4	**Innovation in Design:** TBD	1
1			Credit 2	**LEED® Accredited Professional**	1

SECTION 01 91 00

COMMISSIONING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Description
B. Coordination
C. Commissioning Process
D. Related Work
E. Responsibilities
F. Definitions
G. Systems to be Commissioned
H. Test Equipment
I. Meetings
J. Reporting
K. Submittals
L. Startup, Prefunctional Checklists and Initial Checkout
M. Functional Performance Testing
N. Documentation, Non-Conformance and Approval of Tests
O. Operation and Maintenance (O & M) Manuals
P. Training of Laboratory Personnel
Q. Deferred Testing
R. Written Work Products

1.2 DESCRIPTION

A. Commissioning. Commissioning is a systematic process of ensuring that all building systems perform interactively according to the design intent and the Laboratory's operational needs. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training.

B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:

1. Verify applicable equipment and systems are installed according to the manufacturer's recommendations and to industry accepted minimum standards and receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Verify O&M documentation left on site is complete.
4. Verify the Laboratory's operating personnel are adequately trained.

C. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

D. Abbreviations. The following are common abbreviations used in the *Specifications* and in the *Commissioning Plan.*

A/E	Architect and Design Engineers	GC	General Contractor (prime)
CxA	Commissioning Authority	MC	Mechanical Contractor
CC	Controls Contractor	PFC	Prefunctional Checklist
Cx	Commissioning	PM	Project Manager (of the Laboratory)
Cx Plan	Commissioning Plan Document	Subs	Subcontractors to General
EC	Electrical Contractor	TAB	Test and Balance Contractor
FPT	Functional Performance Test		

1.3 COORDINATION

A. Commissioning Team. The members of the commissioning team consist of the Commissioning authority (CxA), the Project Manager (PM), the General Contractor (GC or Contractor), the Architect and Design Engineers, the Mechanical Contractor (MC), the Electrical Contractor (EC), the TAB representative, the Controls Contractor (CC), any other installing subcontractors or suppliers of equipment. If known, the Laboratory's building or plant Operator/Engineer is also a member of the commissioning team.

B. Scheduling. The CxA will work with the GC to establish protocols to schedule the commissioning activities. The CxA will provide sufficient notice to the GC for scheduling commissioning activities. The GC will integrate all commissioning activities into the master schedule. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the commissioning process.

1. The CxA will provide the initial schedule of primary commissioning events at the commissioning scoping meeting. The *Commissioning Plan—Construction Phase* provides a format for this schedule. As construction progresses, more detailed schedules are developed by the CxA. The Commissioning Plan also provides a format for detailed schedules.

1.4 COMMISSIONING PROCESS

A. Commissioning Plan. The commissioning plan provides guidance in the execution of the commissioning process. The CxA will issue a preliminary Cx Plan, prior to the initial commissioning scoping meeting. After the initial commissioning scoping meeting, the CxA will update the plan, which is then considered the "final" plan, though it may continue to evolve and expand as the project progresses. The *Specifications* take precedence over the *Commissioning Plan*.

B. Commissioning Process. The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a scoping meeting conducted by the CxA to review the commissioning process with the commissioning team members.

2. Additional meetings will be required throughout construction, scheduled by the CxA with necessary parties attending, to plan, scope, coordinate, schedule future activities and resolve problems.

3. Equipment documentation is submitted to the CxA during normal submittals, including detailed start-up procedures.

4. The CxA works with the Subs in developing startup plans and startup documentation formats, including providing the Subs with prefunctional checklists to be completed, during the startup process.

5. In general, the checkout and performance verification proceeds from simple to complex; from component level to equipment to systems and intersystem levels with prefunctional checklists being completed before functional testing.

6. The Subs, under their own direction, execute and document the prefunctional checklists and perform startup and initial checkout. The CxA documents that the checklists and startup were completed according to the approved plans. This may include the CxA witnessing start-up of selected equipment.

7. The CxA develops specific equipment and system functional performance test procedures. The Subs review the procedures.

8. The Subs execute the procedures, under the direction of, and documented by the CxA.

9. Items of non-compliance in material, installation or setup are corrected at the Subs' expense and the system retested.

10. The CxA reviews the O&M documentation for completeness.

11. Commissioning is completed before Substantial Completion.

12. The CxA reviews, pre-approves and coordinates the training provided by the Subs and verifies it was completed.

13. Deferred testing is conducted, as specified or required.

1.5 RELATED WORK

A. Specific commissioning requirements are given in the following sections of these specifications. All of the following sections apply to the Work of this section.

1. Section 20 00 00 – Mechanical General: Alerts the mechanical contractor to Cx responsibilities in 22 90 00 and 23 90 00.

2. Section 22 90 00 and 23 90 00 – Mechanical Cx: Describes the Cx responsibilities of the mechanical, plumbing, controls and TAB contractors, and the prefunctional testing and startup responsibilities of each.

3. Section 26 00 00 – Electrical General: Alerts the Electrical Contractor of Cx responsibilities in 26 90 00.

4. Section 26 90 00 – Electrical Cx: Describes the Cx responsibilities of the Electrical Contractor.

1.6 RESPONSIBILITIES

A. The responsibilities of various parties in the commissioning process are provided in this section. The responsibilities of the Mechanical Contractor, TAB and Controls Contractor

are in Division 22 and 23, and those of the Electrical Contractor in Division 26. Note that the services for the Project Manager, Architect, Mechanical and Electrical Engineers, and Commissioning Authority are not provided for in this contract. That is, the Contractor is not responsible for providing their services. Their responsibilities are listed here to clarify the commissioning process.

B. All Parties:

1. Follow the Commissioning Plan.
2. Attend commissioning scoping meeting and additional meetings, as necessary.

C. Architect:

1. Attend the commissioning scoping meeting and selected commissioning team meetings.
2. Perform normal submittal review, construction observation, record drawing preparation, O&M manual preparation, etc., as contracted.
3. Provide any design narrative documentation requested by the CxA.
4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
5. Review and approve the O&M manuals.

D. Mechanical and Electrical Engineers:

1. Perform normal submittal review, construction observation, record drawing preparation, etc., as contracted.
2. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist (along with the contractors) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Attend commissioning scoping meetings and other selected commissioning team meetings.
4. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.
5. Review and approve the O&M manuals.

E. Commissioning Authority (CxA):

1. The primary role of the CxA is to develop and coordinate the execution of a testing plan, observe and document performance—that systems are functioning in accordance with the design intent and in accordance with the Contract Documents. The CxA may assist with problem-solving non-conformance or deficiencies, but ultimately that responsibility resides with the General Contractor and the A/E. The Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems.

2. Construction and Acceptance Phase:

a. Coordinates and directs the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized

documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

b. Coordinate the commissioning work with the GC to ensure commissioning activities are being scheduled into the master schedule.

c. Develop a *Commissioning Plan.*

d. Plan and conduct a commissioning scoping meeting and other commissioning meetings.

e. Request and review additional information required to perform commissioning tasks, including O&M materials, Contractor start-up and checkout procedures.

f. Before startup, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

g. Review and approve normal Contractor submittals applicable to systems being commissioned for compliance with commissioning needs, concurrent with the A/E reviews.

h. Write and distribute prefunctional checklists.

i. Review and comment on the Subs enhanced start-up and initial systems checkout plan.

j. In coordination with the Subs, develop and implement an IAQ management plan for the building construction and pre-occupancy phases to reduce indoor air quality problems. The plan when implemented shall satisfy the requirements of LEED EQ Credits 3.1 and 3.2

k. Approve prefunctional tests and checklist completion by reviewing prefunctional checklist reports and by selected site observation and spot checking.

l. Approve systems startup by reviewing start-up reports and by selected site observation.

m. Perform limited witness or spot checking of air and water systems balancing. Review completed reports.

n. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include energy management control system trending or manual functional testing.

o. Analyze any functional performance trend logs and monitoring data to verify performance.

p. Coordinate, witness and approve manual functional performance tests performed by installing contractors. Witness performance of functional test procedures, executed by the contractors. Complete one retest or back-check verification of issues identified during functional testing. Additional retesting or back-check (beyond one) deemed necessary by the Laboratory will be at additional expense to the Contractor.

q. Maintain a master deficiency and resolution log and a separate testing record.

r. Oversee and approve the training of the Laboratory's operating personnel.

s. Compile and maintain a commissioning record and building systems book(s).

t. Review and approve the preparation of the O&M manuals.
u. Provide a final commissioning report.
v. Update USGBC on-line templates to document the status of LEED EA Functional and Enhanced commissioning activities.

3. Warranty Period:

a. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.
b. Return to the site within 10-12 months into the warranty period and review with facility staff the current building operation and condition of outstanding issues related to the original and seasonal commissioning. Also interview facility staff and identify problems or concerns they have operating the building as originally intended. Make suggestions for improvements and for recording these changes in the O&M manuals. Identify areas that may come under warranty or under the original construction contract.
c. Develop a thermal comfort survey of the building occupants within 6-18 months of occupancy. The survey shall be in accordance with ASHRAE 55 guidelines and requirements of LEED EQc7.2 Thermal Comfort Verification.

F. Laboratory's Project Manager (PM):

1. Construction and Acceptance Phase:

a. Manage the contract of the A/E, CxA and the GC.
b. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the *Commissioning Plan.*
c. Provide final approval for the completion of the commissioning work.

2. Warranty Period

a. Ensure any seasonal or deferred testing and any deficiency issues are addressed.

G. General Contractor (GC):

1. Construction and Acceptance Phase:

a. Facilitate the coordination of the commissioning work by the CxA and ensure commissioning activities are scheduled into the master schedule.
b. Include the cost of commissioning in the total contract price.
c. In each purchase order or subcontract written, include requirements for submittal data, O&M data, commissioning tasks and training.
d. Ensure all Subs execute their commissioning responsibilities according to the Contract Documents and schedule.
e. When necessary, observe and witness prefunctional checklists, startup and functional testing of selected equipment.
f. Review commissioning progress and deficiency reports.

g. Coordinate the resolution of non-compliance identified in all phases of commissioning. The General Contractor shall withhold payments to subcontractors as required to ensure all deficiencies are corrected.
h. A representative shall attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.
i. Coordinate the training of Laboratory personnel.
j. Prepare O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

2. Warranty Period:

a. Ensure that Subs execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.
b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

H. Equipment Suppliers:

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Laboratory to keep warranties in force.
2. Assist in equipment testing per agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor.
4. Through the contractors they supply products to, analyze specified products and verify that the designer has specified the newest, most updated equipment reasonable for this project's scope and budget.
5. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.

1.7 DEFINITIONS

A. Acceptance Phase - Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Approval - Acceptance that a piece of equipment or system is properly installed and functioning in the tested modes according to the Contract Documents.

C. Architect/Engineer (A/E) - The prime consultant (Architect) and sub-consultants who comprise the design team, generally the Mechanical Engineer and the Electrical Engineer.

D. Basis of Design - The basis of design is the primary thought processes and assumptions behind design decisions made to meet the design intent.

E. Commissioning Authority (CxA) - The CxA directs and coordinates the day-to-day commissioning activities.

F. Commissioning Plan - An overall plan, developed after bidding, which provides the structure, schedule and coordination planning for the commissioning process.

G. Contract Documents - The documents binding on parties involved in the construction of this project (drawings, specifications, change orders, amendments, contracts, Cx Plan, etc.).

H. Contractor - The General Contractor or authorized representative.

I. Control system - The central building energy management control system.

J. Deferred Functional Tests - FPTs that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

K. Deficiency - A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

L. Factory Testing - Testing of equipment on-site or at the factory, by factory personnel with an Laboratory's representative present.

M. Functional Performance Test (FPT) - Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems (rather than just components) under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint). Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing, in the commissioning sense of the word. TABs primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The commissioning authority develops the functional test procedures in a sequential written form, coordinates, oversees and documents the actual testing, which is usually performed by the installing contractor or vendor. FPTs are performed after prefunctional checklists and startup are complete.

N. General Contractor (GC) - The Prime Contractor for this project. Generally refers to all the GC's subcontractors as well. Also referred to as the Contractor, in some contexts.

O. Indirect Indicators - Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

P. Manual Test - Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

Q. Monitoring - The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of control systems.

R. Non-Compliance - see Deficiency.

S. Non-Conformance - see Deficiency.

T. Over-written Value - Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50°F to 75°F to verify economizer operation). See also "Simulated Signal."

U. Prefunctional Checklist (PC) - A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by the CxA to the Sub. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operation (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.). However, some prefunctional checklist items entail simple testing of the function of a component, a piece of equipment or system (such as measuring the voltage imbalance on a three-phase pump motor of a chiller system). The word prefunctional refers to before functional testing. Prefunctional checklists augment and are combined with the manufacturer's start-up checklist. Even without a commissioning process, contractors typically perform some, if not many, of the prefunctional checklist items a commissioning authority will recommend. However, few contractors document in writing the execution of these checklist items. Therefore, for most equipment, the contractors execute the checklists on their own. The commissioning authority only requires the procedures be documented in writing, and does not witness much of the prefunctional checklisting, except for larger or more critical pieces of equipment.

V. Project Manager (PM) - The contracting and managing authority for the Laboratory over the design and/or construction of the project; a staff position.

W. Sampling - Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

X. Seasonal Performance Tests – FPTs that are deferred until the system(s) will experience conditions closer to their design conditions.

Y. Simulated Condition - Condition that is created for the purpose of testing the response of a system (e.g., applying a hair blower to a space sensor to see the response in a VAV box).

Z. Simulated Signal - Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

AA. Specifications - The construction specifications of the Contract Documents.

BB. Startup - The initial starting or activating of dynamic equipment, including executing prefunctional checklists.

CC. Subs - The subcontractors to the GC who provide and install building components and systems.

DD. Test Procedures - The step-by-step process that must be executed to fulfill the test requirements. The test procedures are developed by the CxA.

EE. Test Requirements - Requirements specifying what modes and functions, etc., shall be tested. The test requirements are not the detailed test procedures.

FF. Trending - Monitoring using the building control system.

GG. Vendor - Supplier of equipment.

HH. Warranty Period - Warranty period for entire project, including equipment components. Warranty begins at Substantial Completion and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.8 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned in this project. For systems tested randomly the Laboratory or Laboratory's designated representative reserves the right to select the locations and/or equipment to be tested.

1. Mechanical Systems:

a. Air handling units (and all integral components, supply and exhaust fans, heating and cooling coils, energy recovery equipment, humidifiers, filters, etc.)
b. Hot water system (including pumps and heat recovery exchangers HX-1,2,3)
c. Chilled water system (including pumps)
d. Chilled beams (random 10%)
e. Oxygen depletion/CO2 monitoring
f. Fan coil units (random 10%)
g. Exhaust fans (Lab and R.I. Fume Hood exhaust)
h. Pumps
i. Air Terminal Devices (VAV reheat) (random 10%)
j. Lab air terminal devices/ pressure controls / fume hood exhaust
k. Fire / smoke dampers
l. Unit heaters/cabinet unit heaters (random 10%)
m. Testing, adjusting, and balancing (random spot checking)
n. Building automation system
o. Variable speed drives

2. Plumbing Systems:

a. Domestic Hot Water System

3. Electrical Systems:

a. Switchboards
b. Generator and generator controls
c. Automatic transfer switches
d. Power monitors (random 10%)
e. Life / Safety interface (random 10% of signal interface)
f. Lighting controls, including daylighting controls

4. Special Systems:

a. Security Access (Random 10%)

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup and initial checkout, and required functional performance testing shall be provided by the Division Contractor for the equipment being tested. For example, the Mechanical Contractor of Division 22 and 23 shall ultimately be responsible for all standard testing equipment for the HVAC and Plumbing system and controls system in Division 22 and 23, except for equipment specific to and used by TAB in their commissioning responsibilities. Two-way radios shall be provided by the respective Division 22, 23, or 26 Subcontractor.

B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents, shall be included in the base bid price to the Contractor and left on site.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the *Specifications.* If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and replaced when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 MEETINGS

A. Scoping Meeting. The CxA will schedule, plan and conduct a commissioning scoping meeting with the entire commissioning team in attendance. Meeting minutes will be distributed to all parties by the CxA.

B. Miscellaneous Meetings. Other meetings will be planned and conducted by the CxA as construction progresses. These meetings will cover coordination, deficiency resolution and planning issues with particular Subs. The CxA will plan these meetings and will minimize unnecessary time being spent by Subs. Meetings may be held monthly, until the final three months of construction, when they may be held as frequently as one per week.

3.2 REPORTING

A. The CxA will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

B. Testing or review approvals and non-conformance and deficiency reports are made regularly with the review and testing as described in later sections.

3.3 SUBMITTALS

A. The CxA will provide appropriate contractors with a specific request for the type of submittal documentation the CxA requires to facilitate the commissioning work. These requests will be integrated into the normal submittal process and protocol of the construction team. At a minimum, the submittals should include the manufacturer and model number, the manufacturer's printed installation and detailed start-up procedures, full sequences of operation, O&M data, performance data, any performance test procedures, control drawings and details of Laboratory-contracted tests. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority. All documentation requested by the CxA will be included by the Subs in their O&M manual contributions.

B. The Commissioning Authority will review submittals related to the commissioned equipment for conformance to the Contract Documents as it relates to the commissioning process, to the functional performance of the equipment and adequacy for developing test procedures. This review is intended primarily to aid in the development of functional testing procedures and only secondarily to verify compliance with equipment specifications.

C. The CxA may request additional design narrative from the Controls Contractor, depending on the completeness of the design intent documentation and sequences provided with the Specifications.

D. These submittals to the CxA do not constitute compliance for O&M manual documentation. The O&M manuals are the responsibility of the Contractor, though the CxA will review and approve them.

3.4 START-UP, PREFUNCTIONAL CHECKLISTS AND INITIAL CHECKOUT

A. The following procedures apply to all equipment to be commissioned. Some systems that are not comprised so much of actual dynamic machinery, e.g., electrical system power quality, may have very simplified PCs and startup.

B. General. Prefunctional checklists are important to ensure that the equipment and systems are hooked up and operational. It ensures that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full prefunctional checkout. No sampling strategies are used. The prefunctional testing for a given system must be successfully completed prior to formal functional performance testing of equipment or subsystems of the given system.

C. Start-up and Initial Checkout Plan. The CxA shall assist the commissioning team members responsible for startup of any equipment in developing detailed start-up plans for all equipment. The primary role of the CxA in this process is to ensure that there is written documentation that each of the manufacturer-recommended procedures have been completed. Parties responsible for prefunctional checklists and startup are identified in the commissioning scoping meeting and in the checklist forms.

1. These checklists and tests are provided by the CxA to the Contractor. The Contractor determines which trade is responsible for executing and documenting each of the line item tasks and notes that trade on the form. Each form will have more than one trade responsible for its execution.

2. The Subcontractor responsible for the purchase of the equipment develops the full start-up plan by combining (or adding to) the CxAs checklists with the manufacturer's detailed start-up and checkout procedures from the O&M manual and the normally used field checkout sheets. The Subcontractor may also include his own checkout sheets (for instance, a hydraulic test report for the system piping). The plan will include checklists and procedures with specific boxes or lines for recording and documenting the checking and inspections of each procedure and a summary statement with a signature block at the end of the plan.

   a. The full start-up plan could consist of something as simple as:

      1) The CxAs prefunctional checklists.
      2) The manufacturer's standard written start-up procedures copied from the installation manuals with check boxes by each procedure and a signature block added by hand at the end.
      3) The manufacturers (and Subs) normally used field checkout sheets.

3. The Subcontractor submits the full startup plan to the CxA for review and approval.

4. The CxA reviews and approves the procedures and the format for documenting them, noting any procedures that need to be added.

D. Sensor and Actuator Calibration:

1. All field-installed temperature, relative humidity, CO, CO_2 and pressure sensors and gages, and all actuators (dampers and valves) on all equipment shall be calibrated using the methods described below. Alternate methods may be used, if approved by the Laboratory beforehand. All test instruments shall have had a certified calibration within the last 12 months. Sensors installed *in* the unit at the factory with calibration certification provided, need not be field calibrated.

2. All procedures used shall be fully documented on the prefunctional checklists or other suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.

E. Sensor Calibration Methods:

1. <u>All Sensors.</u> Verify that all sensor locations are appropriate and away from causes of erratic operation. Verify that sensors with shielded cable are grounded only at one end. For sensor pairs that are used to determine a temperature or pressure difference, make sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other, for pressure. Tolerances for critical applications may be tighter.

2. <u>Sensors Without Transmitters</u> - Standard Application. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify that the sensor

reading (via the permanent thermostat, gage or building automation system (BAS) is within the tolerances in the table below of the instrument-measured value. If not, install offset in BAS, calibrate or replace sensor.

3. Sensors With Transmitters - Standard Application. Disconnect sensor. Connect a signal generator in place of sensor. Connect ammeter in series between transmitter and BAS control panel. Using manufacturer's resistance-temperature data, simulate minimum desired temperature. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the BAS. Record all values and recalibrate controller as necessary to conform with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction. Reconnect sensor. Make a reading with a calibrated test instrument within 6 inches of the site sensor. Verify the sensor reading (via the permanent thermostat, gage or building automation system (BAS) is within the tolerances in the table below of the instrument-measured value. If not, replace sensor and repeat. For pressure sensors, perform a similar process with a suitable signal generator.

Tolerances, Standard Applications

Sensor	Required Tolerance (±)	Sensor	Required Tolerance (±)
Hydronic water temps	0.4°F	Flow rates, air	10% of design
Outside air, space air, duct air temps	0.4°F	Flow rates, water	4% of design
		Relative humidity	4% of design
Watt hour, voltage & amperage	1% of design	Barometric pressure	0.1 in. of Hg
Pressures, air, water and gas	3% of design		

F. Valve and Damper Stroke Setup and Check:

1. EMS Readout. For all valve and damper actuator positions checked, verify the actual position against the BAS readout.

2. Set pumps or fans to normal operating mode. Command valve or damper closed, visually verify valve or damper is closed and adjust output zero signal as required. Command valve or damper open, verify position is full open and adjust output signal as required. Command valve or damper to a few intermediate positions. If actual valve or damper position doesn't reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3. Closure of Isolation Control Valves (NC): Command the valve closed. Observe the valve close. Remove power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Command the valve open. Observe valve open. Restore to normal.

4. Closure of Isolation Control Valves (NO): Command the valve open. Observe the valve open. Remove power from the valve and verify that the valve stem and actuator position do not change. Restore to normal. Command the valve closed. Observe valve closed. Restore to normal.

G. Execution of Prefunctional Checklists and Startup:

1. Four weeks prior to startup, the Subs and vendors schedule startup and checkout with the GC and CxA. The performance of the prefunctional checklists, startup and checkout are directed and executed by the Sub or vendor. When checking off prefunctional checklists, signatures may be required of other Subs for verification of completion of their work.

2. The Subs and vendors shall execute startup and provide the CxA with a signed and dated copy of the completed start-up and prefunctional tests and checklists.

3. Only individuals that have direct knowledge and witnessed a line item task on the prefunctional checklist was actually performed shall initial or check that item off. It is not acceptable for witnessing supervisors to fill out these forms.

H. Deficiencies, Non-Conformance and Approval in Checklists and Startup:

1. The Subs shall clearly list any outstanding items of the initial start-up and prefunctional procedures not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies are provided to the CxA within two days of test completion.

2. The CxA reviews the report for approval. The CxA shall work with the Subs and vendors to correct and retest deficiencies or uncompleted items. The CxA will involve the GC and others as necessary. The installing Subs or vendors shall correct all areas that are deficient or incomplete in the checklists and tests in a timely manner, and shall notify the CxA as soon as outstanding items have been corrected and resubmit an updated start-up report and a Statement of Correction on the original non-compliance report. When satisfactorily completed, the CxA recommends approval of the execution of the checklists and startup of each system to the GC.

3.5 FUNCTIONAL PERFORMANCE TESTING

A. This sub-section applies to all commissioning functional testing for all divisions.

B. Objectives and Scope. The objective of functional performance testing is to demonstrate that each system is operating according to the documented design intent and Contract Documents. Functional testing facilitates bringing the systems from a state of substantial completion to full dynamic operation. Additionally, during the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

1. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze condition, low oil pressure, no flow, equipment failure, etc., shall also be tested.

C. Development of Test Procedures. Before test procedures are written, the CxA shall obtain all requested documentation and a current list of change orders affecting equipment or systems,

including an updated points lists, program code, control sequences and parameters. The CxA shall develop specific test procedures and forms to verify and document proper operation of each piece of equipment and system. Each Sub or vendor responsible to execute a test shall provide limited assistance to the CxA in developing the procedures review (answering questions about equipment, operation, sequences, etc.). Prior to execution, the CxA shall provide a copy of the test procedures to the Sub(s) who shall review the tests for feasibility, safety, equipment and warranty protection.

1. The purpose of any given specific test is to verify and document compliance with the stated criteria of acceptance given on the test form.
2. Representative test formats and examples (not designed for this facility) are found in the Design Phase issued Commissioning Plan. The test procedure forms developed by the CxA shall include (but not be limited to) the following information:
3. System and equipment or component name(s)
4. Equipment location and ID number
5. Unique test ID number and reference to unique prefunctional checklist and start-up documentation ID numbers for the piece of equipment
6. Date
7. Project name
8. Participating parties
9. A copy of (or reference to) the specification section describing the test requirements
10. A copy of (or reference to) the specific sequence of operations or other specified parameters being verified
11. Formulas used in any calculations
12. Required pre-test field measurements
13. Instructions for setting up the test.
14. Special cautions, alarm limits, etc.
15. Specific step-by-step procedures to execute the test, in a clear, sequential and repeatable format
16. Acceptance criteria of proper performance with a Yes/No check box to allow for clearly marking whether or not proper performance of each part of the test was achieved.
17. A section for comments
18. Required trends for important variables required to be submitted by the contractors before test can be noted as complete.
19. Signatures and date block for the CxA

D. Testing Requirements:

1. To facilitate field testing, the controls contractor must be able to provide functional access to the control system via the graphical user interface from a laptop. The laptop will be operated by the controls contractor, and should be able to roam throughout the project site while maintaining connectivity. Coordination with the building wired or wireless network, or the provision of temporary wireless access points, will be required. The intent of this requirement is for the controls contractor to be proximate to equipment being tested.

E. Test Methods:

1. Functional performance testing and verification may be achieved by manual testing (persons manipulate the equipment and observe performance) or by monitoring the

performance and analyzing the results using the control system's trend log capabilities or by stand-alone dataloggers. The CxA will determine which method is most appropriate for tests that do not have a method specified.

2. Simulated Conditions. Simulating conditions (not by an overwritten value) shall be allowed, though timing the testing to experience actual conditions is encouraged wherever practical.

3. Overwritten Values. Overwriting sensor values to simulate a condition, such as overwriting the outside air temperature reading in a control system to be something other than it really is, is allowed, but shall be used with caution and avoided when possible. Such testing methods often can only test a part of a system, as the interactions and responses of other systems will be erroneous or not applicable. Simulating a condition is preferable. e.g., for the above case, by heating the outside air sensor with a hair blower rather than overwriting the value or by altering the appropriate setpoint to see the desired response. Before simulating conditions or overwriting values, sensors, transducers and devices shall have been calibrated.

4. Simulated Signals. Using a signal generator that creates a simulated signal to test and calibrate transducers and DDC constants is generally recommended over using the sensor to act as the signal generator via simulated conditions or overwritten values.

5. Altering Setpoints. Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test a sequence is acceptable. For example, to see the AC compressor lockout work at an outside air temperature below 55°F, when the outside air temperature is above 55°F, temporarily change the lockout setpoint to be 2°F above the current outside air temperature.

6. Indirect Indicators. Relying on indirect indicators for responses or performance shall be allowed only after visually and directly verifying and documenting, over the range of the tested parameters, that the indirect readings through the control system represent actual conditions and responses. Much of this verification is completed during prefunctional testing.

7. Setup. Each function and test shall be performed under conditions that simulate actual conditions as close as is practically possible. The Sub executing the test shall provide all necessary materials, system modifications, etc., to produce the necessary flows, pressures, temperatures, etc., necessary to execute the test according to the specified conditions. At completion of the test, the Sub shall return all affected building equipment and systems, due to these temporary modifications, to their pre-test condition.

8. Sampling. Multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using a sampling strategy. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity. A small size or capacity difference alone does not constitute a difference. It is noted that no sampling by Subs is allowed in prefunctional checklist execution.

a. A common sampling strategy referenced in the *Specifications* as the "xx% Sampling—yy% Failure Rule" is defined by the following example.
b. xx = the percent of the group of identical equipment to be included in each sample.
c. yy = the percent of the sample that if failing, will require another sample to be tested.

9. The example below describes a 10% Sampling—10% Failure Rule.

a. Randomly test at least 10% (xx) of each group of identical equipment. In no case test less than three units in each group. This 10%, or three, constitute the "first sample."
b. If 10% (yy) of the units in the first sample fail the functional performance tests, test another 10% of the group (the second sample).
c. If 10% of the units in the second sample fail, test all remaining units in the whole group.
d. If at any point, frequent failures are occurring and testing is becoming more troubleshooting than verification, the CxA may stop the testing and require the responsible Sub to perform and document a checkout of the remaining units prior to continuing with functionally testing the remaining units.

10. Trending – To verify performance of selected commissioned systems. Provide trend data in an organized way to permit concurrent review of multiple variables at defined time intervals. For example, a space temperature trend might show the following data every 15 minutes: VAV box airflow, discharge air temperature, reheat valve position, zone temperature and zone temperature setpoint. These five points would be tabulated in one trend report. Define units of measure for points in the trend. It is not acceptable to submit separate trend data for each point. Graphs of data are required for data sets containing more than 100 time intervals. Trend requirements vary with testing results and issues identified. A trend for each major system may be requested by the CxA (e.g., selected air handling, heating, cooling and other major systems).

F. Coordination and Scheduling. The Subs shall provide sufficient notice to the CxA regarding their completion schedule for the prefunctional checklists and startup of all equipment and systems. The CxA will schedule functional tests through the CM, GC and affected Subs. The CxA shall direct, witness and document the functional testing of all equipment and systems. The Subs shall execute the tests.

1. In general, functional testing is conducted after prefunctional testing and startup has been satisfactorily completed. The control system is sufficiently tested and approved by the CxA before it is used for TAB or to verify performance of other components or systems. The air balancing and water balancing is completed and debugged before functional testing of air-related or water-related equipment or systems. Testing proceeds from components to subsystems to systems. When the proper performance of all interacting individual systems has been achieved, the interface or coordinated responses between systems is checked.

3.6 DOCUMENTATION, NON-CONFORMANCE AND APPROVAL OF TESTS

A. Documentation. The CxA shall witness and document the results of all functional performance tests using the specific procedural forms developed for that purpose. Prior to testing, these forms are provided to the GC and Subs for review. The CxA will include the filled out forms in the O&M manuals.

B. Non-Conformance:

1. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted and reported on a standard non-compliance form.

2. Corrections of minor deficiencies identified may be made during the tests at the discretion of the CxA. In such cases, the deficiency and resolution will be documented on the procedure form.

3. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures. However, the CxA will not be pressured into overlooking deficient work or loosening acceptance criteria to satisfy scheduling or cost issues, unless there is an overriding reason to do so at the request of the Laboratory.

4. As tests progress and a deficiency is identified, the CxA discusses the issue with the executing contractor.

a. When there is no dispute on the deficiency and the Sub accepts responsibility to correct it:

1) The CxA documents the deficiency and the Subs' response and intentions and they go on to another test or sequence. The Sub corrects the deficiency, signs the statement of correction at the bottom of the non-compliance form certifying that the equipment is ready to be retested and sends it back to the CxA.

2) The CxA reschedules the test and the test is repeated. Additional retesting or back-check (beyond one) deemed necessary by the Laboratory will be at additional expense to the Contractor.

b. If there is a dispute about a deficiency, regarding whether it is a deficiency or who is responsible:

1) The deficiency shall be documented on the non-compliance form with the Sub's response and a copy given to the GC and to the Sub representative assumed to be responsible.
2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Project Manager.
3) The CxA documents the resolution process.

4) Once the interpretation and resolution have been decided, the appropriate party corrects the deficiency, signs the statement of correction on the non-compliance form and provides it to the CxA. The CxA reschedules the test and the test is repeated until satisfactory performance is achieved. Additional retesting or back-check (beyond one) deemed necessary by the Laboratory will be at additional expense to the Contractor.

5. The Contractor shall respond in writing to the CxA and GC at least as often as commissioning meetings are being scheduled concerning the status of each apparent outstanding discrepancy identified during commissioning. Discussion shall cover explanations of any disagreements and proposals for their resolution.

6. The CxA retains the original non-conformance forms until the end of the project.

C. Failure Due to Manufacturer Defect. If 10%, or three, whichever is greater, of identical pieces (size alone does not constitute a difference) of equipment fail to perform to the Contract Documents (mechanically or substantively) due to manufacturing defect, not allowing it to meet its submitted performance spec, all identical units may be considered unacceptable by the GC or PM. In such case, the Contractor shall provide the Laboratory with the following:

1. Within one week of notification from the GC or PM, the Contractor or manufacturer's representative shall examine all other identical units making a record of the findings. The findings shall be provided to the GC or PM within two weeks of the original notice.

2. Within two weeks of the original notification, the Contractor or manufacturer shall provide a signed and dated, written explanation of the problem, cause of failures, etc. and all proposed solutions, which shall include full equipment submittals. The proposed solutions shall not significantly exceed the specification requirements of the original installation.

3. The GC or PM will determine whether a replacement of all identical units or a repair is acceptable.

4. Two examples of the proposed solution will be installed by the Contractor and the GC will be allowed to test the installations for up to one week, upon which the GC or PM will decide whether to accept the solution.

5. Upon acceptance, the Contractor and/or manufacturer shall replace or repair all identical items, at their expense and extend the warranty accordingly, if the original equipment warranty had begun. The replacement/repair work shall proceed with reasonable speed beginning within one week from when parts can be obtained.

D. Approval. The CxA notes each satisfactorily demonstrated function on the test form.

3.7 OPERATION AND MAINTENANCE MANUALS

A. Standard O&M Manuals:

1. The specific content and format requirements for the standard O&M manuals are detailed in Section 0178 23 and 01 78 39.

2. CxA Review and Approval. Prior to substantial completion, the CxA shall review the O&M manuals, documentation and redline as-builts *for commissioned systems* and to verify compliance with the *Specifications.* The CxA will communicate deficiencies in the manuals to the GC, PM or A/E, as requested. Upon a successful review of the corrections, the CxA recommends approval and acceptance of these sections of the O&M manuals to the GC, PM or A/E. The CxA also reviews each equipment warranty and verifies requirements to keep the warranty valid are clearly stated.

3.8 TRAINING OF LABORATORY PERSONNEL

A. The GC shall be responsible for training coordination and scheduling, and ultimately for ensuring that training is completed.

B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Laboratory personnel for commissioned equipment or systems.

1. The CxA shall interview the facility manager and lead engineer to determine the special needs and areas where training will be most valuable. The Laboratory and CxA shall decide how rigorous the training should be for each piece of commissioned equipment. The CxA shall communicate the results to the Subs and vendors who have training responsibilities.

2. In addition to these general requirements, the specific training requirements of Laboratory personnel by Subs and vendors is specified in Section 01 79 00 and Divisions 20, 22 23 and 26.

3. Each Sub and vendor responsible for training will submit a written training plan to the CxA for review and approval prior to training. The plan will cover the following elements:

a. Equipment (included in training)
b. Intended audience
c. Location of training
d. Objectives
e. Subjects covered (description, duration of discussion, special methods, etc.)
f. Duration of training on each subject
g. Instructor for each subject
h. Methods (classroom lecture, video, site walk-through, actual operational demonstrations, written handouts, etc.)
i. Instructor and qualifications

4. For the primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

5. The CxA develops an overall training plan and coordinates and schedules with the GC, the overall training for the commissioned systems. The CxA develops criteria for determining that the training was satisfactorily completed, including attending some of the training, etc.

3.9 DEFERRED TESTING

A. Unforeseen Deferred Tests. If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the PM. These tests will be conducted in the same manner as the seasonal tests as soon as possible. Services of necessary parties will be negotiated.

B. Seasonal Testing. During the warranty period, seasonal testing (tests delayed until weather conditions are closer to the system's design) shall be completed as part of this contract. The CxA shall coordinate this activity. Tests will be executed, documented and deficiencies corrected by the appropriate Subs, with facilities staff and the CxA witnessing. Any final adjustments to the O&M manuals and as-builts due to the testing will be made.

3.10 WRITTEN WORK PRODUCTS

A. The commissioning process generates a number of written work products described in various parts of the *Specifications*. The *Commissioning Plan*, lists all the formal written work products, describes briefly their contents, who is responsible to create them, their due dates, who receives and approves them and the location of the specification to create them. In summary, the written products are:

Product	Developed By
1. Final commissioning plan	CxA
2. Meeting minutes	CxA
3. Commissioning schedules	CxA with GC
4. Equipment documentation submittals	Subs
5. Sequence clarifications	Subs and A/E as needed
6. Prefunctional checklists	CxA
7. Startup and initial checkout plan	Subs and CxA (compilation of existing documents)
8. Startup and initial checkout forms filled out	Subs
9. Final TAB report	TAB
10. Issues log (deficiencies)	CxA
11. Commissioning progress record	CxA
12. Deficiency reports	CxA
13. Functional test forms	CxA
14. Filled out functional tests	CxA
15. O&M manuals	Subs
16. Commissioning record book	CxA
17. Overall training plan	CxA and GC

Product	Developed By
18. Specific training agendas	Subs
19. Final commissioning report	CxA

END OF SECTION

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SECTION 02 41 00
DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.01. SUMMARY

A. General: Contract Work under this Section is subject to the requirements of the Documents, including the Supplementary Conditions.

B. Description: Provide all labor, materials and equipment required for all demolition, removal, and disposal of items indicated on the drawings and as specified, including but not limited to the following:
1. All existing foundations, asphalt paving, concrete pads and associated base material within proposed improvement areas.
2. Abandoned underground sewer pipe, water mains, conduits and duct banks interfering with the new construction.
3. Lighting, power poles, wiring, other utilities as shown and directed by Architect.
4. All other demolition work shown or noted on drawings, or as required, to facilitate new construction work.
5. Debris

1.02. RELATED DOCUMENTS

A. 31 20 00 –Earthwork
B. 31 25 13 – Erosion and Sedimentation Control

1.03. SUBMITTALS

A. Prior to mobilizing, submit photo documentation of adjacent areas and structures to be protected.

1.04. SPECIAL REQUIREMENTS

A. The Contractor shall be held responsible to have visited the site and fully determined to his own satisfaction all physical conditions; site characteristics; means of egress and access from and to the site; or any other peculiarities of access from and to the existing site which may influence or effect the cost of the work in any way.

B. The Contractor shall be responsible for and shall protect adjoining properties and existing thoroughfares from damage to his operations. The Contractor shall provide and maintain all barricades, lights, and all other protective devices necessary to fulfill the intent of this work, including requirements of all Federal, State or Municipal laws or ordinances. Barricades, lights and other protective devices shall be relocated as construction work progresses, and removed upon completion and acceptance of the work, or when so directed by the Architect.

C. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct

streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.

D. Protection of Existing Improvements: Provide protection necessary to prevent damage to existing improvements indicated to remain in place.
   1. Protect improvements on adjoining properties and on Laboratory's property.
   2. Restore damaged improvements to their original condition, as acceptable to Laboratory.

E. Utilities and Services:
   1. The Contractor shall carefully examine all public records and data available regarding public utilities and services and confer where necessary with the respective departments of the local agencies having jurisdiction. Contractor shall contact Laboratory for existing utility locations at least 72 hours prior to the start of demolition and construction operations.

PART 2 - PRODUCTS-NOT USED

PART 3 - EXECUTION

3.01. GENERAL

A. No demolition shall be commenced until a program of operations schedule has been coordinated with the Architect, except that preparatory work may be started if specifically approached by and coordinated with the Architect.

B. Demolition work shall be done in such manner as to avoid hazards to persons and property and interference with the use of adjacent areas or interruption of free passage to and from such areas. Care shall be taken to prevent the spread of dust and flying particles.

C. Demolition and removal work shall be executed in careful and orderly manner. Accumulation of rubbish will not be permitted.

D. After work is started it shall be continued to completion at a rate that will allow the balance of the work to be completed within the time specified. If extra shifts are necessary beyond regular working hours, the work shall proceed with a minimum of nuisance to surrounding facilities.

E. Exact extent of demolition to be done may not be fully indicated by the drawings. The Contractor shall determine the nature and extent of demolition that will be necessary by comparing the drawings with the existing field conditions. It is expressly understood that this Contract includes all work of a demolition nature that may be required or necessary for a full and complete execution of the work, whether particularly referred to herein or not.

F. Portions of existing sidewalk which interfere with new construction work shall be removed as shown on the plans, or as directed by the Architect. In removing sidewalk, provisions shall be made for satisfactory transition between replacement sand the portion remaining in place. The Contractor shall saw cut to full depth with a concrete sawing machine to

prevent the surface from spalling when the concrete is broken out. This work shall be done in such a manner that a straight joint will be ensured.

G. Portions of existing concrete curb, gutter, combination curb and gutter which interfere with new construction work shall be removed as shown on the plans, or as directed by the Architect. In removing concrete curb, gutter, combinations curb and gutter, provisions shall be made for satisfactory transition between replacements and the portion remaining in place. The Contractor shall saw cut to full depth with a concrete sawing machine to prevent the surface from spalling when the concrete is broken out. This work shall be done in a manner that a straight joint will be ensured.

3.02. DISPOSAL

A. The Contractor is responsible for disposal in conformance with all applicable regulations and as directed by Laboratory unless otherwise provided for in the contract documents.

B. All salvageable materials resulting from the demolition work shall be provided to Laboratory. Coordinate with Laboratory construction project manager for stockpiling and relocation of salvageable material.

C. Remove all wrecked materials, debris and rubbish from the site. Under no circumstances shall debris or rubbish be allowed to accumulate on the premises.

3.03. REMOVAL

A. On completion of the demolition and removal, clean the areas affected, including areas outside the limits of the Contractor's work area where permission to work has been granted. Remove surplus construction material or debris resulting from the demolition work and dispose of legally off the site.

B. Access routes to and from the site shall be kept clean of debris resulting from the work.

C. Burning of rubbish or debris on or near the premises will not be permitted.

END OF SECTION

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SECTION 03 10 00

CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Reinforcement and Embedded Assemblies	Section 03 20 00
Cast-in-Place Concrete	Section 03 30 00
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

2. ACI 301 – Standard Specification for Structural Concrete.

3. ACI 318 – Building Code Requirements for Reinforced Concrete.

4. ACI 347 – Guide to Formwork for Concrete.

5. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings

C. Definitions:

1. The term "Contract Documents" in this specification is defined as the design drawings and the specifications.

2. The term "SER" in this specification is defined as the Structural Engineer of Record for the structure in its final condition.

3. The term "Design Professionals" in this specification is defined as Laboratory's Architect and SER.

4. The term "Contractor" in this specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.

5. The term "Testing Agency" in this specification is defined as an independent testing and inspection service engaged by Laboratory for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.

6. The terms "for record" and "submit for record" in this specification are defined as Contractor submittals that do not require a response from the Design Professionals.

7. Working Days: Monday through Friday, excluding federal or state holidays.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company which specializes in the type of concrete formwork required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.

B. Contractor's Testing Laboratory Services: Required as specified in Division 1, and herein.

C. Materials and installed work may require testing and retesting at anytime during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

A. Where the SUBMITTALS section of this specification is in conflict with Section 01 33 00 Submittals, the more stringent requirements for the Contractor apply. Do not submit items not requested.

1. Submittal Schedule: See Section 03 30 00.

2. Formwork Shop Drawings:

   a. Submit for Record: Formwork shop drawings sealed and signed by a registered design professional licensed to practice as a Structural Engineer in the state where the project is located. Shop drawings shall clearly indicate but not be limited to the following:

      i. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)

      ii. Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents

      iii. Location and pattern of form tie placement, and other items that affect the appearance of concrete that will remain exposed to view.

      iv. Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.

      v. Comprehensive (a single drawing per area/element) layout drawings showing openings in structural members, including floor slabs, walls and shearwalls. Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor. Submit with or prior to reinforcement submittal for same element/area.

   b. Submit for Review

      i. Location of proposed construction joints in slab on grade, walls and sheawalls per specification Section 03 30 00.

3. Product Data - Submit copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.

4. Samples - At request of Architect, submit samples of form ties and spreaders

5. Compatibility Certification - Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.

6. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by Laboratory, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

7.

8. LEED Submittals
   a. See Division 1 Section 01 35 36 “LEED Requirements” for additional LEED requirements.
   b. LEED Submittal Credit Credit EQ 4.2: VOC

i. Submit Product Data and material safety data sheets stating compliance with VOC limits. Refer to Section 01 35 36 "LEED Requirements" for additional requirements.

B. Submittal Process: See Section 01 33 00 and Section 03 30 00

C. SER Submittal Review: See Section Section 01 33 00 and Section 03 30 00

D. Substitution Request: See Section 01 63 20

E. Request for Information (RFI): See Division 1 and Section 03 30 00

1.7 FORMWORK DESIGN

A. Design of Formwork and its removal is the Contractor's responsibility.

B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.

C. Design Requirements:

1. Forms shall be designed for fabrication and erection in accordance with Design Professionals' requirements and recommendations of ACI 301, 318 and 347.
2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
3. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency, ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.
4. The use of flowing concrete (8" to 10" slump) or Self Consolodating Concrete requires a review of the formwork design based on the rate of placement and setting time of the mix.

1.8 DELIVERY, HANDLING, STORAGE

A. Comply with General Conditions and Division 1, including the following:

1. Store forms and form materials clear of ground and protect from damage.

1.9 WARRANTY

A. Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:

1. Discoloration of concrete scheduled to remain exposed to view.
2. Damage of concrete finishes caused by forms.
3. Damage of concrete caused by form stripping.
4. Non-compliance with form finishes required for designated architectural finishes.
5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Products of the manufacturers specified in this section establish the minimum functional, aesthetic and quality standards required for work of this section.

B. Substitutions: Comply with General Conditions using form in Division 1.

2.2 FORMWORK REQUIREMENTS

A. General Requirements:

1. Formwork shall meet construction safety regulations for locality in which this Project is located.
2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
3. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations, unless noted otherwise).
   a. Class B – Coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
   b. Class C – General Standard for permanently exposed surfaces where other finishes are not specified. Use Class C for Safe Room Concrete Walls.
   c. Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.

4. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings, using form materials with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.

5. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

B. Form Finishes for Exposed Surfaces:

1. Type: Straight, smooth, free of cement paste leaks at butt-joints, surface imperfections and other irregularities detrimental to appearance of finished concrete, fully coordinated with requirements for required finish material.

2. Form exposed areas of columns, beams, ledges, balcony fascias to achieve true alignment and level soffit of spandrel beams and concrete edges. All such areas must be sharp, straight and true to line and level. Spandrel beams and concrete canopies and ledges must have adequate shoring to prevent any visible amount of sag and sufficient bracing to prevent any lateral movement during construction.

2.3 FORM MATERIALS

A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.

1. Provide materials with sufficient strength to prevent warping.

B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" thick, complying with U.S. Product Standard PS-1.

1. Other Acceptable Sheet Materials: 14 gauge sheet steel or fibrous glass reinforced resin.

C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.

1. Use only where entire width can be covered with one board 11-1/4" or less in width.

D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.

1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Chamfer for Form Corners:

1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" size, maximum possible lengths.

2. Required for all exposed corners of beam, walls and column forms.

F. Form Ties:

1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Ties used for architecturally exposed concrete shall be galvanized.
3. Ties shall not leave metal closer than 1-1/2" to exposed surface.
4. When removed, ties shall not leave holes larger than 1" diameter in concrete surface.
5. Removable Ties: Use type with tapered cones, 1" outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
7. Wire Ties: Not acceptable.

G. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:

1. Type: Of size, strength and quality to meet the required quality of formwork.

H. Form Release Agent:

1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.

2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).

3. [In compliance with LEED Credit EQ 4.2, acceptable products include but are not limited to:
   a. "Bio-Form," Leahy-Wolf Company, Franklin, IL
   b. "Enviroform," Conspec Marketing and Manufacturing Co., Inc., Kansas City, KS
   c. "Soy Form Away," Natural Soy Products, Watkins, IA
   d. "Soy Form Away," Midwest Biologicals, Inc., Woodburn, IN]

4. For Steel Forms: Non-staining rust-preventative type.

I. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

Coordinate with materials as specified in Section 03 20 00/Concrete Reinforcement and Embedded Assemblies.

PART 3 - EXECUTION

3.1 FORMWORK

A. General:

1. Inspect areas to receive formwork.
   a. Immediately report to Laboratory's Testing Agency and Design Professionals in writing the conditions that will adversely affect the Work.
2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
12. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.

14. Where specifically shown on the Contract Documents as monolithic, upturned beams, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.

B. Concrete Accessories and Embedded Items:

1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.

   a. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.

2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.

3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.

4. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.

5. Coordinate with Section 03 20 00/Concrete Reinforcement and Embedded Assemblies.

6. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.

C. Temporary Openings:

1. Locate temporary openings in forms at inconspicuous locations.

2. For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.

3. For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.

4. Securely brace temporary openings and set tightly in forms to prevent loss of concrete.

5. Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.

D. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.

1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.

2. Accurately place and securely support items built into forms.

E. Cleaning:

1. Normal Conditions

   a. Thoroughly clean forms and adjacent surfaces to receive concrete.

b. Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.

c. Flush with water or use compressed air to remove remaining foreign matter.

d. Verify that water and debris can drain from forms through clean-out ports.

2. During Cold Weather:

a. Remove ice and snow from within forms.

b. Do not use de-icing salts.

c. Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.

d. Use compressed air or other means to remove foreign matter.

F. Form Release Agents

1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.

2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.

a. Coat steel forms with nonstaining, rust-preventative material.

3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

G. Before Placing Concrete:

1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.

a. Make necessary corrections or adjustment to formwork to meet tolerance requirements.

2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.

3. Notify Laboratory’s Testing Laboratory sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

H. During Concrete Placement:

1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.

2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.

I. Camber:

1. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.

2. Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

J. Surface Defects:

1. Install forms substantially free of surface defects.

K. Formwork Loads on Grade

1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

L. Footings and Grade Beams:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.

2. When trench forms are used, provide an additional 1” of concrete on each side of the minimum design profiles and dimensions indicated.

M. For slabs-on-grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.2 REMOVING FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, shearwalls and similar parts of the work, may be removed after cumulatively curing at not less than 50°F for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.

B. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.

C. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

D. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 03 30 00.

E. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.

F. Form tie holes shall be filled as per approved samples submitted to the Architect and Engineer.

G. The Contractor shall assume responsibility for all damage due to removal of the forms.

3.3 RE-USING FORMS

A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.

1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
2. Apply new form release agent on re-used forms.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets.

C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

3.4 FIELD QUALITY CONTROL

A. General: Laboratory's Testing Laboratory shall inspect concrete formwork as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered, nor shall it obligate Design Professionals for final acceptance.

B. Testing Laboratory shall provide qualified personnel at site to inspect formwork using the latest Contract Documents and approved shop drawings as follows:

1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect suitability of concrete placement and tolerances stated herein.
2. Inspect forms for location, configuration, compliance with specified tolerances, block outs, camber, shoring ties, seal of form joints and compliance with Contract Documents.
3. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
4. Verify proper use/application of form release agents.

5. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.

C. Submit inspection, observation, and/or test reports to the Design Professionals and provide an evaluation statement in each report stating whether or not concrete formwork conforms to the requirements of Specifications and Drawings. Specifically note deviations.

D. Immediately report deficiencies to the Contractor. Contractor shall correct the deficiency at no cost to Laboratory.

END OF SECTION

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SECTION 03 20 00

CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Formwork	Section 03 10 00
Cast-in-Place Concrete	Section 03 30 00
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

2. ACI 301 – Standard Specification for Structural Concrete.

3. ACI 315 – Details and Detailing of Concrete Reinforcement.

4. ACI 318 – Building Code Requirements for Reinforced Concrete.

5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.

6. AWS D1.1 – Structural Welding Code-Steel.

7. AWS D1.4 – Structural Welding Code-Reinforcing Steel.

8. AWS D12.1 – Recommended Practices for Welding Reinforcing Steel Metal Inserts, and Connections in Reinforced Concrete Construction.

9. CRD C 572 – Specification for Polyvinylchloride Waterstops.

10. Concrete Reinforcing Steel Institute ”Manual of Standard Practice”

11. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

C. Definitions:

1. The term “Contract Documents” in this specification is defined as the design drawings and the specifications.

2. The term “SER” in this specification is defined as the Structural Engineer of Record for the structure in its final condition.

3. The term “Design Professionals” in this specification is defined as Laboratory’s Architect and SER.

4. The term “Contractor” in this specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.

5. The term “Testing Agency” in this specification is defined as an independent testing and inspection service engaged by Laboratory for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.

6. The terms “for record” and “submit for record” in this specification are defined as Contractor submittals that do not require a response from the Design Professionals.

7. Working Days: Monday through Friday, excluding federal or state holidays.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a fabricator specializing in reinforcing steel fabrication of type for cast-in-place concrete work required for this Project, with a minimum of 10 years of documented successful experience, and have the facilities capable of meeting all requirements of Contract Documents.

1. Welders shall be qualified in accordance with AWS D1.1, within 12 months before starting the work.

    a. Make qualification records available to the Design Professionals upon request.

B. Manufacturers shall specialize in manufacturing the types of concrete accessories required for cast-in-place concrete work, with a minimum of 10 years of documented successful experience and shall have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of accessory.

1.6 SUBMITTALS

A. Where the SUBMITTALS section of this specification is in conflict with Section 01 33 00 Submittals, the more stringent requirements for the Contractor apply. Do not submit items not requested.

1. Submittal Schedule: See Section 03 30 00.

2. Shop Drawings: Submit shop drawings that shall clearly indicate, but not be limited to:

    a. All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.

    b. Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.

    c. Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.

    d. Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.

        i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.

        ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.

    e. Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.

    f. Each type of supporting and spacing devices, including miscellaneous accessories.

    g. Construction joint type, details and locations. Contractor shall coordinate with concrete pour schedule and submit for action by the Design Professionals.

    h. Submit comprehensive (a single drawing per area/element) layout/placement drawings. Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor. Submit with or prior to reinforcement submittal for same element/area. Drawings shall include:

i. Concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement.)

ii. Opening in structural members, including floor slab, shearwalls, and grade beams.

i. Reproduction of structural drawings is not permitted.

3. Product Data – Submit for record for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.

4. Mill Reports: Submit for record.

5. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by Laboratory, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

6. LEED Submittals

a. Credit MR 4.1, 4.2: Recycled Content – Reinforcement Steel, Reinforcing Wire Fabric, Supports for Reinforcement:

i. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

ii. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

b. Credit MR 5.1, 5.2 Local/Regional Materials – Reinforcement Steel:

i. Extraction, processing and manufacturing (fabrication) facilities location(s): Indicate location of extraction, processing and manufacturing (fabrication) facility; indicate distance between manufacturing facility and the project site.

ii. Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

iii. Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

B. Submittal Process: See Section 01 33 00 and Section 03 30 00

C. SER Submittal Review: See Section 01 33 00 and Section 03 30 00

D. Substitution Request: See Section 01 63 20

E. Request for Information (RFI): See Division 1 and Section 03 30 00

1.7 DELIVERY, HANDLING, STORAGE

A. Comply with General Conditions and Division 1, including the following:

1. Deliver reinforcing steel to Project site bundled, tagged and marked.

a. Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.

2. Deliver welded wire fabric in sheets. Do not deliver in rolls.

3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.

4. Deliver and store welding electrodes in accordance with AWS D1.4.

5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.

6. Store reinforcing steel above ground so that it remains clean.

a. Maintain steel surfaces free from materials and coatings that might impair bond.

b. Keep covered.

c. Protect against corrosion or deterioration of any kind.

1.8 WARRANTY

A. Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:

1. Bars with kinks or bends not indicated on drawings or on approved shop drawings.

2. Bars damaged due to bending, straightening or cutting.

3. Bars heated for bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 as indicated on drawings.

2. Size: As indicated on structural drawings.

3. Where indicated on drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
   a. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Epoxy-Coated: ASTM A 775 where indicated on drawings.
5. Weldable reinforcement: ASTM A 706 where indicated on drawings.

B. Welded Wire Reinforcement:

1. Type: steel wire, plain finish, ASTM A 82.
2. Type: steel wire, deformed, ASTM A 496.
3. Size: As indicated on structural drawings.
4. Where indicated on drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
   a. Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
5. Plain Steel Welded Wire Reinforcement: ASTM A 185.
6. Deformed Steel Welded Wire Reinforcement: ASTM A 497.
7. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

2.2 ACCESSORIES

A. Tie Wire:

1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 82.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:

1. Mechanical tension and compression splicing systems shall be used where indicated on drawings.
2. Acceptable Products: Lenton Cadweld by Erico, Solon, OH or Bar-Lock by Dayton Superior, Dayton, OH, TX, Grip-Twist by Bar Splice, Dayton, OH or Lenton Couplers by Erico, Solon, OH. Splices shall be installed in compliance with manufacturer's requirements.
3. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
4. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Mechanical Bar Terminators:

1. For bar sizes #11 or smaller where specifically detailed on drawings, mechanical bar terminators shall be used.

2. Acceptable Products: Lenton Terminator by Erico, Solon, OH or Grip-Twist Doughnut by Bar-Splice, Dayton, OH.

D. Supports for Reinforcement:

1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, hot-dip galvanized after fabrication, in accordance with ASTM A 123, or epoxy coated to match supported reinforcement.

2. For Contact with Forms: Use types with not less than 3/32" of plastic between metal and concrete surface.

   a. Plastic tips shall extend not less than ½" on metal legs.

3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound load without damage or permanent distortion.

4. Unless otherwise indicated on drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.

5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.

E. Deformed Bar Anchors:

1. Type: Automatic end welded, ASTM A 496 quality.

2. Size and Grade: As indicated on structural drawings by Nelson Stud Welding.

F. Anchor rods and dowels:

1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.

2. Adhesive Anchors for anchor rods and dowels in existing concrete:

   a. HIT-RE 500-SD by Hilti, Inc., Tulsa, OK

   b. PE 1000+ by Powers Fasteners, Inc., Brewster, NY

   c. Epcon A7 by ITW Red Head, Addison, IL

   d. SET-XP by Simpson Strong-Tie Co., Pleasanton, CA

G. Prefabricated Bent-In Dowel Keyway System:

1. Type, Size and Grade as indicated on drawings.
2. Acceptable Products: Lenton Form Savers by Erico, Solon, OH or Stabox by Meadow Burke, Tampa, FL.
3. Installation: Per Manufacturer's instructions.

2.3 ANCHORAGE ACCESSORIES

A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:

1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi, minimum tensile strength of 60,000 psi.
2. Anchor Rods: ASTM F1554, Grade as noted on drawings.
3. Threaded Inserts: Manufactured by Dayton/Richmond Screw Anchor Co. or Powers Fasteners, Inc.
4. Adhesive Anchors:
   a. HIT-RE 500-SD by Hilti, Inc., Tulsa, OK
   b. PE 1000+ by Powers Fasteners, Inc., Brewster, NY
   c. Epcon A7 by ITW Red Head, Addison, IL
   d. SET-XP by Simpson Strong-Tie Co., Pleasanton, CA
5. Expansion Anchors:
   a. Kwik Bolt TZ or Kwik Bolt 3 by Hilti, Inc., Tulsa, OK
   b. Power Stud+ SD1 or SD2 by Powers Fasteners, Inc., Brewster, NY
   c. Trubolt or Trubolt+ by ITW Red Head, Addison, IL
   d. Strong-Bolt by Simpson Strong-Tie Co., Pleasanton, CA
6. Threaded Anchors:
   a. HUS-H by Hilti, Inc., Tulsa, OK
   b. Wedge Bolt+ by Powers Fasteners, Inc., Brewster, NY
   c. Tapcon by ITW Red Head, Addison, IL
   d. Titan HD by Simpson Strong-Tie Co., Pleasanton, CA
7. Inserts and Coil Rods: Yield strength 65,000 psi, ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior, Dayton, OH.
8. Welding Electrodes: AWS 5.5, Series E70.
9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.

B. Dovetail Anchor Slots:

1. Type: Formed 22 gauge (0.85mm) galvanized steel manufactured by Heckmann Building Products/Chicago, Illinois or Hohmann and Barnard/Hauppauge, New York.
2. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.
3. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
4. Finish: Hot-dip galvanized or zinc-plated steel.
5. Stainless steel anchors are acceptable.

2.4 JOINT FILLERS

A. Permanent Compressible Joint Filler:

1. Type: W. R. Meadows: "Ceramar" closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants.
2. Location of Use: Slabs and curbs as indicated on drawings or required.
3. Thickness: As indicated on drawings or required.

B. Temporary Compressible Joint Filler:

1. Type: White molded polystyrene beadboard.
2. Location of Use:
   a. In slabs, curbs, and walls which must be removed prior to joint sealant installation.
   b. Vertically to isolate walls from columns or other walls.

C. Noncompressible Joint Filler:

1. Type: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi compressive strength, ASTM C 578, Type IV.
2. Thickness: As indicated on drawings.
3. Location of Use: As indicated on drawings or required.

D. Asphalt-Impregnated Joint Filler:

1. Type: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994.
2. Thickness: ½" maximum, as indicated on drawings or required.
3. Location of Use: Sidewalks at foundation walls and as indicated on drawings or required.

E. Asphalt-impregnated fiberboard expansion joint filler for interior work:

1. Type: ASTM D1751.

F. Self-expanding cork board expansion joint filler for exterior work:

1. Type: ASTM D1752.

G. Construction Joints:

1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" on center to receive dowelling, complete with anchorage.

H. Isolation joint at crystallization lab, warm room and cold room

1. Expansion – joint filler: Polyethylene closed-cell backing for sealants

a. BASF Expansion – Joint filler, BASF construction Chemicals, LLC-Building Systems, Shakopee, MN.

2.5 WATERSTOPS

A. Preformed Bentonite Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.

1. Acceptable Products:

a. Volclay Waterstop RX by CETCO Building Materials Group, Hoffman Estates, IL

b. Adcor ES by W. R. Grace & Co., Cambridge, MA

2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).

3. Location of Use: Concrete cold joints at footings, walls and slab joints.

4. Comply with manufacturer product application and installation instructions.

B. Polyvinyl Chloride Waterstops:

1. Type: “PVC Waterstops” by Bometals, Inc. Carrollton, GA, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.

2.6 LEED REQUIREMENTS

1. LEED Credit MR 5.1, 5.2: Reinforcing steel extraction, processing and manufacturing (fabrication) facilities (as applicable) should be within 500 miles of project site.

2. LEED Credit MR 4.1, 4.2: Recycled content: Minimum 25 percent post-consumer recycled content.

PART 3 - EXECUTION

3.1 FABRICATION

A. Reinforcing Steel Fabrication:

1. Fabricate in accordance with approved shop drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.
   a. Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
   b. Bends or kinks not indicated on Drawings or final shop drawings.
   c. Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:

1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:

1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:

1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries.
3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Owner's Testing Laboratory.
4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.
5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

3.2 INSTALLATION OF REINFORCEMENT

A. General:

1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by Owner's Testing Laboratory.
5. Reinforcement steel is not permitted to be "floated into position".
6. Bend bars cold.
   a. Do not heat or flame cut bars.
   b. No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Independent Testing Laboratory for cracks.
7. Weld only as indicated.
   a. Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
   b. See structural drawings for additional requirements.
8. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:

1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.
   a. Place reinforcement bars within tolerances specified in ACI 117.
   b. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.
3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
   a. Repair damages before placing concrete.

5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:

1. Install in lengths as long as practicable.
2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
3. Overlap the wire reinforcement 6" or one panel width + 2", whichever is larger.
   a. Securely tie together with wire.
4. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural drawings.

D. At Construction Joints:

1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.

E. At Expansion Joints:

1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on drawings.

F. Splicing:

1. Unless otherwise indicated on drawings provide lap splices for bar sizes #11 and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on drawings.
2. At all #14 and #18 bars and where mechanical splices are specifically indicated on drawings, comply with requirements specified in this Specification section under "Mechanical Splicing Systems".
3. Do not splice reinforcement except as indicated on structural drawings.
4. Tension couplers may be used and installed per manufacturer's specifications where indicated on drawings or as approved by Engineer.

G. Dowels in Existing Concrete:

1. Install dowels and dowel adhesive in accordance with supplier's recommendations.
2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

3.3 INSTALLATION OF ACCESSORIES

A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.

1. Set and secure embedments, including embedded plates, bearing plates, and anchor bolts, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
2. Inspect locations to receive concrete accessories.
3. Immediately report to the Design Professionals in writing of conditions that will adversely affect the Work or fails to meet Contract Document requirements.
4. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Owner's Testing Laboratory.

B. Construction and Contraction (Control) Joints:

1. Construction and contraction (control) joints indicated on drawings are mandatory and must not be omitted.
   a. Provide construction joints in accordance with ACI 318.
   b. Provide 1-1/2" deep key type construction joints at end of each placement for slabs, beams, walls and footings.
      i. Bevel forms for easy removal.
2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
3. Install waterstops to form continuous diaphragm in each joint.
4. Support and protect exposed waterstops during progress of Work.
5. Field-fabricate joints in waterstops according to manufacturer's printed instructions.

C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

3.4 FIELD QUALITY CONTROL

A. General: Laboratory's Testing Laboratory shall test and inspect concrete reinforcement and embedded assemblies as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professionals for final acceptance.

B. Laboratory's Testing Laboratory shall provide qualified personnel at site to inspect reinforcement and embeds using the latest Drawings and reviewed shop drawings, as follows:

1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.

2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.

3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.

C. Laboratory's Testing Laboratory shall submit inspection, observation, and/or test reports to the Design Professionals as required herein and shall provide an evaluation statement in each report stating whether or not concrete reinforcement and embedded assemblies conforms to requirements of Specifications and Drawings and shall specifically note deviations there from.

D. Immediately report deficiencies to the Contractor. Contractor shall prepare proposed remedy for deficiency. Contractor shall present proposal to the Design Professionals for approval. After an approved proposal is accepted by the Design Professionals, the Contractor shall correct the deficiency at no cost to Laboratory.

END OF SECTION

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Concrete Formwork	Section 03 10 00
Concrete Reinforcement and Embedded Assemblies	Section 03 20 00
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.

2. ACI 301 – Standard Specifications for Structural Concrete.

3. ACI 318 – Building Code Requirements for Structural Concrete.

4. American Concrete Institute "Manual of Concrete Practice", various committee reports as referenced herein, latest edition.

5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.

6. ASTM C1202 – Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration

7. ICC-500 Chapter 8 - Standard for the Design and Construction of Storm Shelters - 2008

C. Definitions:

1. The term "Contract Documents" in this specification is defined as the design drawings and the specifications.

2. The term "SER" in this specification is defined as the Structural Engineer of Record for the structure in its final condition.

3. The term "Design Professionals" in this specification is defined as Laboratory's Architect and SER.

4. The term "Contractor" in this specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.

5. The term "Testing Agency" in this specification is defined as an independent testing and inspection service engaged by Laboratory for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.

6. The terms "for record" and "submit for record" in this specification are defined as Contractor submittals that do not require a response from the Design Professionals.

1.5 CONCRETE CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company which specializes in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

B. Contractor's Testing Laboratory Services: Required as specified in Division 1, and herein.

C. Materials and installed work may require testing and retesting at anytime during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

A. Where the SUBMITTALS section of this specification is in conflict with Section 01 33 00 Submittals, the more stringent requirements for the Contractor apply. Do not submit items not requested.

1. **Submittal Schedule**: The contractor shall submit for approval a schedule at least twenty (20) working days prior to commencing submittals.

   a. This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for approval at least twenty (20) working days before the modification or addition is proposed to take place.

   b. If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.

2. **Mix Designs:** Submit concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.

   a. Mix designs shall be prepared or reviewed by an approved independent testing laboratory retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, signed by a registered design professional licensed to practice as a Professional Engineer in the state where the project is located**,** and shall be coordinated with design requirements and Contract Documents.

   b. Before submitting to Laboratory's Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.

   c. Provide a completed "Concrete Mix Design Submittal Form" (attached to the end of this Specification Section) for each proposed concrete mix.

   d. Data shall be from the same production facility that will be used for this Project.

   e. Mix Design data shall include but not be limited to the following:

      i) Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.

      ii) Design Compressive Strength: As indicated on the Drawings.

iii) Proportions: ACI 301 and ACI 318.

iv) Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.

v) Water/cementitious material ratio.

vi) Evaluate and classify fly ash in accordance with ASTM D 5759.

vii) Report chemical analysis of fly ash in accordance with ASTM C 311.

viii) Classify blast furnace slag in accordance with ASTM C 989.

ix) Slump: ASTM C 143.

x) Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218.

xi) Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.

xii) Unit Weight of Concrete: ASTM C 138.

xiii) Design strength at 28, 56 or 90 days, as indicated on contract documents: ASTM C 39.

a) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by Water-Cement Ratio is not permitted.

b) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength.

c) If early concrete strengths are required, contractor shall submit trial mixture results as required.

xiv) Test records to support proposed mixtures shall be no more than 12 months old and use current cement and aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.

xv) Manufacturer's product data for each type of admixture.

xvi) Manufacturer’s certification that all admixtures used are compatible with each other.

xvii) All information indicating compliance with Contract Documents including method of placement and method of curing.

xviii) Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.

xix) Lightweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.

xx) Certification from a qualified testing agency indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity in accordance with ASTM C 33

3. **Hot and Cold Weather Procedures**: Submit for record to Design Professional's written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this specification.

4. **Product Data**: Submit product data clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility and limitations for each of the following:

   a. Bonding agents.

   b. Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.

   c. Absorptive covers and moisture retaining covers.

   d. Vapor Retarder: See Division 7, Thermal and Moisture Protection.

   e. Self-leveling concrete topping.

   f. Grout: Submittal of Grout not by manufacturers listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.

   g. Other products proposed by contractor

5. **Concrete Joint Locations:** Submit plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.

   Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.

6. **Preconstruction Survey**: Submit for record. Where interface with existing construction occurs (at LOM), before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.

7. **Survey of As-built Floor Conditions**: Submit for Record. Survey and report flatness (F_F), levelness (F_L), and final elevations of finished floor.

8. **Structural Repairs**: Submit procedures and product information.

9. **Patching Defective Concrete Finishes**: Submit procedures and product information.

10. **Hazardous Materials Notification:** Submit for Record. In the event no product or material is available that does not contain hazardous materials as determined by Laboratory, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation. Submit for Record.

11. **Conduit and pipes embedded in concrete:** Submit for approval layout of embedded conduit and pipes, as follows:

    a. In concrete slab or wall when requirements do NOT conform to requirements of ACI 318, Chapter 6.
    b. Conduits and pipes in concrete slabs on steel deck.

12. **LEED Requirements**

    a. See Division 1 Section "LEED Requirements" for additional LEED requirements.
    b. LEED Submittals
        i) Credit EQ 4: Product data for curing compound and sealers that confirm VOC limits are not exceeded.
        ii) Credit MR 5.1, 5.2: Local/Regional Materials – aggregates:
            a) Sourcing location(s): Indicate location of extraction and processing facilities; indicate distance between extraction and processing facilites and the project site.
            b) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
            c) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
            d) Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.
        iii) Credit MR 5.1, 5.2: Local/Regional Materials – water:
            a) Sourcing location(s): Indicate location of extraction and processing facilities; indicate distance between extraction and processing facilities (as applicable) and the project site.
            b) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.
            c) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.
        iv) Credit MR 5.1, 5.2: Local/Regional Materials – cement:

a) Sourcing location(s): Indicate location of extraction and processing facilities; indicate distance between extraction and processing facilities and the project site.

b) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

c) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

v) Credit MR 5.1, 5.2: Local/Regional Materials – supplementary cementitious materials (SCM).

a) Sourcing location(s): Indicate location of extraction and processing and facilities (as applicable); indicate distance between extraction and processing facilities and the project site.

b) Manufacturing location(s): Indicate location of manufacturing facility; indicate distance between manufacturing facility and the project site.

c) Product Value: Contractor to indicate dollar value of product containing local/regional materials; include materials cost only.

vi) Credit MR 4.1, MR 4.2: Fly ash – recycled content:

a) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

b) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

vii) Credit MR 4.1, MR 4.2:Ground Granulated Blast-furnace Slag:

a) Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

b) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

viii) Credit EQ 4.1, 4.2: VOC

a) Submit Product Data and material safety data sheets stating compliance with VOC limits for Curing and Sealing Compounds. Refer to Division 1/LEED Requirements for additional requirements.

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.

2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.

3. The Contractor shall submit to the Design Professionals two (2) black line prints and one (1) electronic copy for shop drawing review. If the Contractor and Design Team agree to process shop drawings electronically, Contractor shall submit one hardcopy and one electronic copy to the SER. The naming convention of each drawing must follow the submittal numbering system and include the submittal number, specification number, revision number and drawing number in the prefix of the drawing name.

4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.

5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:

   a. Failure to specifically cloud modifications

   b. Unapproved revisions to previous submittals

   c. Unapproved departure from Contract Documents

6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.

7. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

   a. Conforming to the Contract Documents.

   b. Coordination with other trades.

   c. Responsibility for all required detailing and proper fitting of construction work.

d. The necessity of furnishing material and workmanship required by drawings and specifications which may not be indicated on the shop drawings.

e. Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 Stamp - For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require the following actions:

a. APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

b. APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.

c. REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

d. NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

3. TYPE 2 Stamp - For submittals for building elements which are not designed by the SER but are performance specified, for items that do not form part of the completed structural system but impose loads on the structure, and for construction items or activities which have an effect on the final structure, a second stamp will be used. The responses on the stamp used by the SER require the following actions:

a. NO EXCEPTION TAKEN indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

b. EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.

c. REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.

2. All substitutions must be requested using the Request for Substitution form included in Division 1. Structural acceptance using the substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The substitution request form, even if accepted, does not constitute a change order.

1.7 STORAGE, HANDLING AND DELIVERY

A. Comply with General Conditions and Division 1.

B. Storage:

1. Store materials in accordance with ACI 304R.

2. Store cement in weathertight buildings, bins or silos that will exclude moisture and contaminates.

3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.

4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.

5.

C. Handling:

1. Handle fine and coarse aggregates as separate ingredients.

2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.

3. Do not use frozen or partially frozen aggregates.

4. Allow sand to drain until it has reached relatively uniform moisture content before use.

5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-INSTALLATION CONFERENCE

A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the approvedd concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:

1. Contractor.
2. Laboratory’s Testing Agency representative
3. Concrete Subcontractor.
4. Ready-mix concrete producer.
5. Admixture manufacturer(s).

B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:

1. Design Professionals.
2. Laboratory's Representative.

C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these specifications.

1.9 QUALITY ASSURANCE BY LABORATORY’S TESTING AGENCY

A. Quality assurance is testing and inspection to assist Laboratory in evaluating the Contractor's performance.

B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by Laboratory.

C. Coordination with Laboratory’s Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the testing agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The

Contractor shall cooperate fully with Laboratory's Testing Agency in the performance of their work and shall provide the following:

1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work

2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job.

3. Full and ample means of assistance for testing and inspection of material

4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field

D. Duties of Laboratory's Testing Agency:

1. Reports: The Testing Agency shall prepare daily reports of the concrete work including progress and description/area of work, tests made and results. The daily reports shall be collected and delivered to the Design Professionals and Laboratory weekly.

2. Rejection: Laboratory's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall report deficiencies to Laboratory, Design Professionals, and Contractor immediately.

3. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Laboratory on a weekly basis.

4. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Laboratory that the installation is in accordance with the design and specification requirements.

E. Field Quality Assurance

1. General: Laboratory's Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professional for final acceptance.

2. Laboratory's Testing Agency is responsible for monitoring concrete placement as follows:

   a. Laboratory's Testing Agency shall provide qualified personnel at site to monitor concreting operations as follows:

      i) Verify use of required design mix

ii) Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.

iii) Record temperature of concrete at time of placement.

iv) Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.

v) Record types and amounts of admixtures added to concrete batches, including that added after departure of concrete trucks from batch plant at the project site.

vi) Record amounts of and monitor dosing of high-range water-reducing admixtures added at site for site-added admixtures and redosing for plant-added admixtures.

vii) Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.

viii) Monitor consistency and uniformity of concrete.

ix) Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:

a) Concrete curing.

b) Hot weather concreting operations.

c) Cold weather concreting operations.

3. Laboratory's Testing Agency shall conduct tests of concrete as follows:

a. Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 100 cu.yd. of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by Laboratory's Testing Agency and Design Professionals. Sample all columns, regardless of other frequencies listed above.

b. Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.

c. Determine air content of normal weight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173.

d. Determine unit weight of normal weight concrete in accordance with ASTM C 138 and lightweight concrete in accordance with ASTM C 567.

e. Conduct one test for air content for each strength test required or for every 50 cubic yards of fly ash concrete placed, whichever is less. Test in accordance with ASTM C 173 or ASTM C 231.

f. The water content of freshly mixed concrete will be tested on a random basis, a minimum of once per 100 cubic yards or every 5000 square feet of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:

   i) Architecturally exposed hard troweled slabs

   ii) Slab to receive a bonded finish floor material

g. Conduct slump tests in accordance with ASTM C 143.

h. Conduct slump tests for concrete enhanced with high-range water-reducing admixtures as follows:

   i) Concrete with plant added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site. Batches delivered to site with slumps in excess of the range defined in the mix design submittal or with excessive segregation as defined in the ACI Manual of Standard Practice Part I shall be rejected.

   ii) Concrete with site added high-range water-reducing admixtures shall be sampled immediately upon arrival at job site and after addition of high-range water-reducing admixtures for conformance to initial water slump and final slump requirements.

   iii) Concrete shall also be sampled at point of initial discharge for conformance to slump and/or slump-flow requirements. Visually observe slump-flow at point of concrete placement. If slump loss is visually observed to exceed the range specified for mix design, perform additional slump test at point of discharge from concrete pump hose.

i. Conduct strength tests of concrete as follows:

   i) Secure sample sets in accordance with ASTM C 172.

   ii) Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch diameter x 8 inches long. If 6 inch diameter by 12 inch long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f'c.

   iii) Test cylinders in accordance with ASTM C 39.

   iv) For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.

   v) For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.

   vi) When high early strength concrete is required by contractor, additional cylinders shall be made and tested as required at Contractor's expense.

vii) If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.

4. Laboratory's Testing Agency shall evaluate concrete for conformance with Specifications as follows:

   a. Slump:

      i) Laboratory's Testing Agency shall maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.

   b. Strength test:

      i) Laboratory's Testing Agency shall maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in Work.

      ii) Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi.

      iii) If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein.

   c. Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.

      i) Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.

      ii) Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.

      iii) Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.

   d. Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.

5. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Laboratory's Testing Agency, and prior to the removal of shores and forms.

F. Laboratory's Testing Agency shall submit inspection, observation, and/or test reports to Laboratory and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete placement conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.

G. Immediately report deficiencies to the Contractor, Laboratory and Design Professionals.

1.10 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. Laboratory's general review during construction and activities of Laboratory' Testing Agency are undertaken to inform Laboratory of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

C. The Contractor shall immediately report to the Design Professionals any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Laboratory, the Contractor shall correct the deficiency at no cost to Laboratory.

1.11 WARRANTY

A. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:

1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
3. Areas which show surface failure or defects.
4. Areas which puddle water.
5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have Laboratory's Testing Agency perform appropriate tests for bond and discoloration.
6. Patches that become crazed, cracked or sound hollow when tapped.
7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS & PRODUCTION

A. Portland Cement:

1. ASTM C150, Type I or Type II
2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of Structural Engineer. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
3. Provide the same brand of Portland Cement produced in the United States from a single source throughout the project, as required to meet Design Professionals' requirements.

B. Aggregates for Normalweight Concrete:

1. ASTM C 33
2. Coarse Aggregates: Crushed stone or gravel with a total water-soluble chloride ion content below 0.02%.
3. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
4. Combined Aggregate Gradation: Combined aggregate gradation for slabs and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100.
5. Do not use fine or coarse aggregates that contain substances that cause spalling.
6. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:.

   Size no. 57 for footings, drilled piers and caissons and mass concrete

   Size no. 67 for all other locations

   Size no. 467 or 457 for non-reinforced concrete at locations noted on drawings.
7. Contractor shall furnish concrete with maximum 3/8" aggregate at no additional cost to Laboratory if areas of high reinforcement density require it for placement and consolidation.

C. Aggregates for Lightweight Concrete:

1. ASTM C 330.
2. Classification of Aggregates: As required to meet Design Professional's requirements.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.

D. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed ¾".

E. Water: ASTM C 94. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.

F. Supplementary Cementitious Material

1. Fly Ash:

   a. ASTM C 618, Class C or Class F.
   b. Shall not be used unless part of an approved mix design.
   c. Limit Loss on Ignition to 2.5%

2. Ground Granulated Blast-furnace Slag (GGBFS)

   a. ASTM C 989.
   b. Shall not be used unless part of an approved mix design.

3. Silica Fume (Microsilica):

   a. ASTM C 1240
   b. Acceptable Product: W. R. Grace "Force 10,000"
   c. Acceptable Product: Euclid Chemical Company "Eucon MSA"
   d. Acceptable Product: BASF "Rheomac SF 100"
   e. Acceptable Product: Sika Corporation "Sikacrete 950 DP"

4. Limit the maximum content of supplementary cementitious materials for concrete exposed to deicing chemicals to values shown in ACI 318, Table 4.2.3

5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.

6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with specifications.

7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.

G. Ready Mixed Concrete:

1. Shall be batch-mixed and transported in accordance with ASTM C 94.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:

1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):

1. Shall be as indicated on the Structural Drawings

C. Air Entrainment

1. For concrete exposed to freeze/thaw cycles or deicing chemicals, and concrete intended to be watertight, provide entrained air content of 6% ± 1.5%, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
   a. Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams and foundation walls.
   b. Concrete in parking garages.
   c. Ramps and loading docks.
2. For lightweight concrete less than 120 pcf density, air content may be up to 7% regardless of exposure condition.
3. Entrained air content noted above shall occur at point of delivery.
4. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.
5. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete

1. Unless lower limits are stated in the contract documents, all concrete exposed to freezing and thawing in moist condition and/or required to be watertight shall have a maximum W/cm ratio of 0.45.
2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources shall have a maximum W/cm ratio of 0.40.
3. Absent the above conditions, all concrete with required strength of 4000 psi or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump

1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in Laboratory's testing agency responsibilities:

   a. Concrete with high range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" for normal weight concrete and 4" for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" unless otherwise approved by the SER.

F. Chloride Ion Content

1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 4.4 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.

2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to Laboratory.

2.3 ADMIXTURES

A. General:

1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:

1. ASTM C 260
2. Acceptable Product: BASF "MICRO-AIR" or "MB-AE-90"
3. Acceptable Product: W. R. Grace "Darex Series" or "Daravair Series"
4. Acceptable Product: Euclid Chemical Company "AEA –92 or Air 40"
5. Acceptable Product: Sika Corporation "Sika Air Series" or "Sika AEA Series"

C. Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Product: BASF' "POZZOLITH 220-N"
3. Acceptable Product: Euclid Chemical Company "EUCON NW" or "EUCON WR 91"
4. Acceptable Product: W. R. Grace "WRDA' Series or "Mira" Series
5. Acceptable Product: Sika Corporation "Plastocrete Series"

D. Retarding Admixture:

1. ASTM C 494, Type B
2. Acceptable Product: BASF POZZOLITH 100-XR"
3. Acceptable Product: Euclid Chemical Company “EUCON RETARDER 100”
4. Acceptable Product: W. R. Grace “Daratard 17”
5. Acceptable Product: Sika Corporation “Plastiment Series”

E. Non Corrosive Accelerating Admixture:

1. ASTM C 494, Type C
2. Acceptable Product: BASF "POZZUTEC 20
3. Acceptable Product: Euclid Chemical Company “ACCELGUARD 80”, “ACCELGUARD NCA” or “ACCELGUARD 90”
4. Acceptable Product: W. R. Grace “Daraset” Series, “Polarset”, or “DCI”
5. Acceptable Product: Sika Corporation “Sikaset NC” or “Plastocrete 161 FL” or “Sika Rapid-1”

F. Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type D
2. Acceptable Product: BASF "POZZOLITH 100-XR"
3. Acceptable Product: Euclid Chemical Company “EUCON RETARDER 75” or “EUCON DS”
4. Acceptable Product: W. R. Grace “Daratard 17”
5. Acceptable Product: Sika Corporation “Plastiment Series”

G. Water-Reducing and Accelerating Admixture:

1. ASTM C 494, Type E
2. Acceptable Product: BASF "POZZUTEC 20
3. Acceptable Product: Euclid Chemical Company “ACCELGUARD 80” or “ACCELGUARD 90”
4. Acceptable Product: W. R. Grace “Libricon NCA”
5. Acceptable Product: Sika Corporation “Sikaset NC” or “Plastocrete 161 FL”

H. Mid-Range Water-Reducing Admixture:

1. ASTM C 494, Type A
2. Acceptable Product: W. R. Grace “Daracem”
3. Acceptable Product: Sika Corporation “Sikaplast Series”
4. Acceptable Product: Euclid Chemical Company: “Eucon MR” or “Eucon MRX”

I. High-Range Water-Reducing Admixture:

1. ASTM C 494, Type F
2. Acceptable Product: BASF "RHEOBUILD 1000" or “GLENIUM SERIES”
3. Acceptable Product: Euclid Chemical Company“EUCON 37” or “PLASTOL SERIES”

4. Acceptable Product: W. R. Grace “Daracem” or “ADVA” Series
5. Acceptable Product: Sika Corporation “Viscocrete Series” or “Sikament Series”

J. High-Range Water-Reducing and Retarding Admixture:

1. ASTM C 494, Type G
2. Acceptable Product: Euclid Chemical Company “EUCON 537”
3. Acceptable Product: W. R. Grace “Daracem 100”

K. Corrosion Inhibiting Admixtures:

1. ASTM C 494, Type C, 30% $\pm$ 2% solution of Calcium Nitrite
2. Acceptable Product: W.R. Grace “DCI or DCI-S’
3. Acceptable Product: Euclid Chemical Company “EUCON CIA”
4. Acceptable Product: Sika Corporation “Sika CNI”

L. Shrinkage Reducing Admixtures:

1. ASTM C 157
2. Acceptable Product: W.R. Grace “Eclipse 4500”, or “Eclipse Floor”
3. Acceptable Product: Euclid Chemical Company “EUCON SRA” or “Conex”
4. Acceptable Product: Sika Corporation “Sika Control 40”

2.4 ADHESIVES

A. Bonding Agent for Cured Concrete:

1. ASTM C 881 Type I and IV, Grade 3, Class B and C.
2. Acceptable Product: BASF "CONCRESIVE PASTE (LPL)", Class C Only
3. Acceptable Product: Euclid Chemical Company “EUCO #452 Epoxy Sysyem”
4. Acceptable Product: Euclid Chemical Company “DURALCRETE Series”
5. Acceptable Product: Sika Corporation “Sikadur 31 Hi-Mod Gel (1:1 Mix Ratio)

B. Bonding Agent for Uncured Concrete:

1. ASTM C 881, Type II and V, Grade 2, Class B and C.
2. Acceptable Product: BASF "CONCRESIVE LIQUID (LPL)", Class C Only
3. Acceptable Product: Euclid Chemical Company “FLEXOCRETE System”
4. Acceptable Product: Euclid Chemical Company “DURALCRETE System”
5. Acceptable Product: Sika Corporation “Sikadur 32 Hi-Mod”

C. Anti-Corrosive Epoxy Cementitious Bonding Compound:

This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).

1. Acceptable Products: Euclid Chemical Company “DURALPREP AC”
2. Acceptable Products: Sika Corporation “ARMATEC 110"

2.5 CURING COMPOUNDS AND SEALERS

A. Interaction with finishes:

1. See architectural drawings for finish material applied over concrete.
2. Use only curing and sealer compounds that are compatible with finish material.
3. Manufacturer's certification is required.
4. Where finish material is liquid rubberized asphalt, use only strippable type curing compound.

B. Curing and Sealing Compound (VOC Compliant, 350 g/l) :

1. ASTM C1315, Type I, Class A and ASTM C 309, Type I, Class A or B
2. Acceptable Product: Euclid Chemical Company "Super Diamond Clear VOX"
3. Acceptable Product: Euclid Chemical Company "Super Aqua Clear VOX"
4. Acceptable Product: Symons “Kure 1315”
5. Acceptable Product: Sonneborn “Cure & Seal 1515 UV”
6. Liquid type membrane-forming curing compound, clear styrene acrylate type.

C. Curing Compound (Strippable):

1. ASTM C 309, Type I, Class A or B
2. Acceptable Product: Euclid Chemical Company “Kurez DR VOX” or “Kurez RC Off”.

2.6 SEALERS

A. Surface Sealer:

1. ASTM C 309, Type I, Class A or B
2. Acceptable Product: Euclid Chemical Company “DIAMOND CLEAR VOX”
3. Acceptable Product: Sonneborn “Kure-N-Seal W”
4. Acceptable Product: Symons “Spec-Cure C309”

B. Liquid Densifier/Sealer:

1. The liquid densifier compound shall be a siliconate based sealer which penetrates concrete surfaces, increases abrasion resistance and provides a “low-sheen” surface that is easy to clean and eases the problem of tire mark removal. The compound must contain a minimum solids content of 20% of which 50% is siliconate.
2. Acceptable Product: Euclid Chemical Company “Euco Diamond Hard”
3. Acceptable Product: Sonneborn “Kure-N-Harden”

2.7 DRY SHAKE HARDENERS

A. Mineral Aggregate Hardener:

1. The specified mineral aggregate hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The

hardener shall be a factory-blended mixture of specially processed graded mineral aggregate, selected Portland cement and necessary plasticizing agents

2. Acceptable Product: Euclid Chemical Company, "Surflex"
3. Acceptable Product: BASF, "Mastercron"
4. Curing Compound: Euclid Chemical Company “Kurez DR VOX” (for use with “Surflex”)
5. Curing Compound: BASF, “Masterkure 200W” (for use with “Mastercron”)

B. Non-Oxidizing Metallic Hardener:

1. The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer’s owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected Portland Cement and necessary plasticizing agents.
2. Acceptable Product: Euclid Chemical Company, “Diamond-Plate”
3. Acceptable Product: BASF “Lumiplate”
4. Curing Compound: Euclid Chemical Company, “Kurez DR VOX” (for use with “Diamond-Plate”)
5. Curing Compound: BASF “Masterkure 200 W” (for use with “Lumiplate”)

2.8 MISCELLANEOUS CONCRETE PRODUCTS

A. Nonshrink Grout

1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:
   a. See General Notes for grout minimum compressive strength.
   b. Grout shall conform to ASTM C 1107

2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F (7°C) and 90°F (32°C) limits when testing is initiated.
3. Acceptable Product: BASF "MASTERFLOW 928"
4. Acceptable Product: Euclid Chemical Company “HI-FLOW GROUT”
5. Acceptable Product: Five Star Products “Five Star Grout”
6. Acceptable Product: Sika Corporation “Sikagrout 328”

B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:

1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" (25mm) thickness without aggregate in one pour. If greater than 1" (25mm) thickness is required, aggregate shall be used in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
2. Acceptable Product: Ardex Engineered Cements "ARDEX K-15"
3. Acceptable Product: Euclid Chemical Company “Flo-Top or Super Flo-Top”
4. Acceptable Product: Sika Corporation “Sika Level Series”

2.9 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:

1. Acceptable Product: BASF "CONFILM"
2. Acceptable Product: Euclid Chemical Company“Eucobar”
3. Acceptable Product: Sika Corporation “Sika Film”

B. Moisture-Retaining Covers:

Conforming to ASTM C171. A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.

1. Hydracure S-16 by PNA Construction Technologies, Inc., Matthews, NC

2. Transguard 4000 by Reef Industries (Armorlon Division), Incorporated, Houston TX

C. Sand Cushion: Clean, manufactured or natural sand.

D. Structural Polystyrene used as Typical Fill
1. Material: Rigid cellular polystrene thermal insulation with closed cells formed by expansion of polystrene base resin in an extrusion process.
2. Comply with the requirements of ASTM C 578, Type VII.
3. Compressive strength, 40 psi (280 kPa), ASTM D 1621.
4. Compressive modulus, min 2200 psi (15MPa), ASTM D 1621.
5. Flexural strength, 75 psi (520kPa), ASTM C 203.
6. Thickness as indicated on drawings.
7. Acceptable product: STYROFOAM Highload 60, The Dow Chemical Company
8. Acceptable product: FOAMULAR 600, Owens Corning.

E. Structural Polystyrene used as Fill for Wheel Load Applications
1. Material: Rigid cellular polystrene thermal insulation with closed cells formed by expansion of polystrene base resin in an extrusion process.
2. Comply with the requirements of ASTM C 578, Type V.
3. Compressive strength, 100 psi (700kPa), ASTM D 1621.
4. Compressive modulus, min 3700 psi (25.5 MPa), ASTM D 1621.
5. Flexural strength, 100 psi (700 kPa), ASTM C 203.
6. Thickness as indicated on drawings.
7. Acceptable product: STYROFOAM Highload 100, The Dow Chemical Company
8. Acceptable product: FOAMULAR 1000, Owens Corning.

F. Non-Slip Aggregate:
1. Abrasive aggregate shall be composed of an aluminum oxide abrasive bonded by a vitreous ceramic material. Use hard, homogeneous, non-glazing, rustproof aggregate which is unaffected by moisture or cleaning compounds.
2. Acceptable Product: Euclid Chemical Company “NON-SLIP AGGREGATE”

3. Acceptable Product: North Company "Alundum"
4. Acceptable Product: Anti-Hydro International "A-H A-2 Emery Shake-On"
5. Acceptable Product: Anti-Hydro International "A-H Alox"

G. Semi Rigid Joint Filler:

1. Acceptable Product: Euclid Chemical Company "Euco 700" or "Euco QWIKjoint 200"
2. Acceptable Product: Sika Corporation "Sikadur 51 SL"

2.10 CONCRETE REPAIR MATERIALS

A. Polymer Repair Mortar
1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Acceptable Products (Horizontal Repairs): Euclid Chemical Company "Thin Top Supreme or Tammspatch II" (for 1/16" to 3/8" thickness), or "Concrete Top Supreme" (for 3/8" to 2" thickness).
3. Acceptable Products (Horizontal Repairs): Sika Corporation "Sikatop 121 Plus" or "Sikatop 122 Plus".
4. Acceptable Products (Vertical and Overhead Repairs): Euclid Chemical Company "Verticoat", "Verticoat Supreme", or "Duraltop Gel"
5. Acceptable Products (Vertical and Overhead Repairs): Sika Corporation, "Sikatop 123 Plus".
6. Acceptable Products: Degussa, "EMACO R" Series"

B. High Strength Flowing Repair Mortar
1. For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8" aggregate.
2. The product shall achieve 9000 psi @ 28-days at a 9-inch slump.
3. Prior approval by the Design Professionals is required for cold weather applications
4. Acceptable Product: Euclid Chemical Company "Eucocrete"
5. Acceptable Product: Degussa "EMACO S" Series
6. Acceptable Product: Sika Corporation "Sika Repair 211 SCC Plus"

C. Repair Topping
1. Latex and microsilica modified cementitious mortar topping, which meets or exceeds the bond strength requirements of ASTM C 1059.
2. Acceptable Products: Euclid Chemical Company, "Thin-Top Supreme or Tammspatch II"
3. Acceptable Product: Sika Corporation "Sika Repair 211 SC Plus"

2.11 LEED REQUIREMENTS

A. LEED Credit MR 5.1, 5.2: Extraction, processing and fabrication facilities (as applicable) for all aggregates and water shall be within 500 miles of project site.

B. LEED Credit MR 4.1, 4.2: Weight of fly ash or slag is limited to a maximum of 25% of the total cementitious material content for foundations, walls and columns.

C. Sealers: Products must meet VOC requirements of LEED Credit EQ 4.2. See Division 1, LEED Requirements for additional requirements.

D. Curing Compounds: Products must meet VOC requirements of LEED Credit EQ 4.2. See Division 1, LEED Requirements for additional requirements.

E. See Division 1 Section "LEED Requirements" for additional LEED requirements.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade:

1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
   a. Omit when subgrade is already damp.
2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
3. Do not place concrete on frozen ground.

B. Forms:

1. Coordinate with Section 03 10 00 Concrete Formwork.
2. Remove dirt, sawdust, nails and other foreign material from formed space.
3. Dampen wood forms by sprinkling immediately before placing.
4. Cool metal forms by sprinkling immediately before placing.

C. Concrete Accessories:

1. Coordinate with Section 03 10 00 Concrete Formwork.

D. Dewatering:

1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.

3.2 JOINTS IN CONCRETE

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.

1. Do not use contraction joints in framed floors or composite slabs.
2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.
   a. Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.
4. Maximum joint spacing is as indicated on Drawings (typical details).

B. Construction Joints:

1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.

2. Horizontal Joints: Horizontal construction joints other than those shown on the drawings will not be permitted unless approved by the Architect.

3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material. The joints shall be dampened and the specified bonding compound applied. New concrete shall be placed while the bonding grout or epoxy adhesive is still tacky. The anti-corrosive epoxy cementitious adhesive has a 20-hour open time.

C. Isolation Joints:

1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction Joints in Floor Slabs-on-Grade:

1. Maximum slab area controlled by jointing is 400 square feet
2. Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
3. Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.
4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. The Soff-Cut saw shall be used to a depth of ¼ of slab thickness immediately after final finishing. Conventional saw shall be used ass soon as possible after final finish without raveling to a depth as indicated on the drawings.
5. Where contraction joints coincide with construction joints, detail joint as indicated on drawings.

E. Joint Fillers: Coordinate with Section 03 20 00 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

F. Install in accordance with Manufacturer's recommendations.

3.3 MIXING

A. Measurement of Materials: Conforming to ASTM C 94

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:

1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of Laboratory's Testing Agency.
3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.

1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.

D. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

3.4 CONCRETE PLACEMENT

A. Prior to Concrete Placement:

1. Mechanical vibrators are required and must be available for placing concrete.
2. Remove debris from space to be occupied with concrete.
3. Notify Design Professionals and Laboratory's Testing Agency 48 hours prior to starting concrete placement.
4. Approved mix designs must be maintained on file in Contractor's Field Office.
5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 03 20 00 and Drawings.
6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
7. Do not place concrete having a slump outside of allowable slump range.
8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills. Placement upon soft mud or dry earth is not permitted.

9. Unless adequate protection is provided, concrete shall not be placed during rain.
10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
11. Do not use aluminum equipment in placing and finishing concrete.
12. Keep subgrade moisture uniform without puddles or dry areas.
13. Place vapor retarder directly below slabs on grade as specified in contract documents.

B. For Conduits and Pipes Embedded in Concrete:

1. For concrete slab, wall, beam or column, conform to requirements of ACI 318, Chapter 6. For variations from these requirements, submit a written request for Design Professionals' review and response.
2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
3. Provide sleeves for pipes passing vertically through concrete.
4. Do not embed aluminum materials.
5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

D. Placing Concrete in Forms:

1. Clean and prepare forms as specified in Section 03 1000/Concrete Formwork.
2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
3. Deposit concrete in forms in horizontal layers no deeper than 24” and in a manner to avoid inclined construction joints.
4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
   a. Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
8. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer.
9. Do not insert vibrators into lower layers of concrete that have begun to set.
10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

E. Placing Concrete Slabs:

1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
   a. Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.

2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
4. Bring slab surfaces to correct level with a straightedge and strike off.
   a. Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
   b. Do not disturb slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing in proper position on chairs during concrete placement.
6. Do not place materials on slabs or impose loads during period of setting.

F. Placing Concrete on Steel Decks

1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.

G. Placing Concrete at Construction Joints:

1. To secure full bond at construction joints, horizontal surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic.
2. Before new concrete is placed in contact, horizontal surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. Dampen hardened concrete at joints with water where no bonding agents are used. Leave no standing water.
4. Apply specified bonding agent per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

H. Floor Topping Slabs:

1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2".
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. At topping slabs placed directly against base slab, remove deleterious material and dampen base slab with water immediately before placing concrete. Leave no standing water.
6. Unless noted as a "bonded" topping slab on the drawings, topping slabs thinner than 4" should be placed directly against dampend base slab with no bonding agent. Topping slabs 4" (or thicker should be placed on bond breaker consisting of two sheets of plastic film.
7. Where noted on drawings as a "bonded" topping slab, broom/vacuum clean unsealed surfaces or wire brush sealed or troweled surfaces to expose bare rough surface. Then place approved bonding grout or epoxy adhesive on the base slab per manufacturer's instructions.
8. The topping mix shall have a maximum water/cement ratio of 0.45.

9. The topping mix shall have a maximum shrinkage of 0.04% in 28 days.
10. The topping mix shall contain a minimum of 5 lbs. per cubic yard of macro synthetic fibers and achieve an Average Residual Strength (ARS) of 200 psi unless a higher dosage or ARS is noted on the plans.
11. The topping slab shall be moist cured for a minimum of 36 hours after placement.
12. The topping slab shall have contraction joints located to match any joints in the base slab, to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet.

I. Cold-Weather Placement:

1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.
2. When air temperature has fallen to or is expected to fall below 40°F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F, and not more than 80°F, at point of placement.
3. Do not use frozen materials or materials containing ice or snow.
   a. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.

J. Hot-Weather Placement:

1. Hot weather is defined as air temperature which exceeds 90°F or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F.
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.

3.5 CONCRETE FINISHES

A. General:

1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. For shored floor or slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than 72hours of concrete placement by Laboratory's Testing Agency.
4. See architectural drawings for locations of the various finishes listed below.
5. Comply with slab F_F and F_L values specified below:
   a. If an individual test section measures less than either of the specified minimum local F_F/ F_L numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
   b. If the composite value of the test surface measures less than either of the specified overall F_F/ F_L numbers, then the entire slab may be rejected and remedial measures may be required.
   c. F_L numbers shall not apply to unshored slabs or shored slabs with camber.

B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural drawings:

1. Scratch Finish.
   a. Finish surface to overall value of F_F=20 and F_L=15 and minimum local value of F_F = 14 and F_L=10 measured according to ASTM E 1155.
   b. Slope surfaces uniformly to drains where required.
   c. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural drawings:

1. Float Finish.
   a. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
   b. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.
   c. Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
   d. Finish surfaces to overall value of F_F=20 and F_L=15 and minimum local value of F_F=14 and F_L=10 measured according to ASTM E 1155.
   e. Cut down high spots and fill low spots.
   f. Uniformly slope surfaces to drains.
   g. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural drawings:

1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
3. Finish surface to overall value of F_F=20 and F_L=15 and minimum local value of F_F = 14 and F_L=10 measured according to ASTM E 1155.
4. Texture shall be approved by the Design Professionals from sample panels.

E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile on thick-set mortar, paint or another thin film-finish coating system, as indicated on architectural drawings:

1. Trowel Finish.
   a. After floating, begin first trowel-finish operation using a power-driven trowel.
   b. Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
   c. The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
   d. Grind smooth any surface defects that would telegraph through applied floor covering system.
2. Finish surface to overall value of F_F=25 and F_L=20 and minimum local value of F_F=17 and F_L=14 measured according to ASTM E 1155.
3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
7. Dry Cement: Shall not be used during finishing.

F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural drawings:

1. Trowel and Fine Broom Finish:
   a. Apply a trowel finish as specified.
   b. Immediately follow by slightly scarifying the surface with a fine broom.
2. Finish surface to overall value of F_F=30 and F_L=20 and minimum local value of F_F = 20 and F_L=14 measured according to ASTM E 1155.

G. Finishes for Parking Garage Deck, Ramps, Loading Docks:

1. Highway straight edge immediately after screeding concrete.
2. Finish surface to overall values of F_F=20 and F_L=15 and minimum local value of F_F = 14 and F_L=10 measured according to ASTM E 1155.

3. For Slabs Not Receiving Deck Coating: Medium broom finish with ridges not to exceed 1/8" in height. Texture shall be as approved by the Design Professionals from sample panels.
4. For Slabs Scheduled to Receive Deck Coating: Smooth floated finish which must be verified with coating manufacturer before finishing the slab.
   a. Coordinate with deck coating specified in Division 7.
5. Auto Ramps: Rough texture applied perpendicular to direction of traffic. Texture shall be as approved by the Design Professionals from sample panels.

H. Tolerances at Slab Discontinuities

Within 2 ft of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the contract documents, the following equivalent straightedge tolerances shall apply:

Specified local $F_F = 14$, use ¼" over 4 ft, no offset greater than 1/16"

Specified local $F_F = 20$, use 1/8" over 4 ft, no offset greater than 1/32"

I. Dry Shake Finish:
1. Non-slip aggregate where indicated on drawings.
2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. and in other locations so noted on the drawings.
3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. where noted on the drawings.
4. Final finish type, method and tolerance as applicable by location and use.
5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.

J. Rough Formed Finish:

1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4" (6mm) in height rubber down or chipped off.

K. Smooth Formed Finish:

1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural drawings:
2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

L. Smooth Rubbed Finish:

1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
   a. Do not apply cement grout other than that created by the rubbing process.

M. Grout-Cleaned Finish:

1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

N. Unformed Surfaces:

1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.6 CURING AND PROTECTION

A. Normal Conditions:

1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. Concrete shall be kept continuously moist and above 50° F (10°C) for seven days. High early strength concrete usage shall be maintained over 50° F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
   a. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
      i) Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).

ii) Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
iii) Recoat areas subjected to heavy rainfall within 3 hours after initial application.
iv) Maintain continuity of coating and repair damage during curing period.
v) Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
vi) Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent.
vii) Hand-brooming and sweeping is not sufficient.
viii) Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.

b. Provide moist curing by the following methods:
i) Keep concrete surface continuously wet by covering with water.
ii) Use continuous water-fog spray.
iii) Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4” (100mm) lap over adjacent absorptive covers.

c. Provide moisture-retaining cover curing as follows:
i) Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” (75mm) and sealed by waterproof tape or adhesive.
a) Immediately repair any holes or tears during curing period using cover material and waterproof tape

6. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
7. Cure surfaces exposed to deicing salts, brackish water, etc, such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed.
a. If forms are removed, continue curing by methods specified above, as applicable.

B. Cold-Weather Protection:
1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:

1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
a. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.

2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.

D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.7 CONCRETE REPAIRS

A. Perform patching and repairs in accordance with ACI 301.

B. Contractor shall submit patching and repair methods and materials for review by Design Professionals.

C. When complete, all patches and repairs shall match color and texture of adjoining surfaces.

D. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by design professionals to verify repair color and texture match before proceeding with repair.

E. Apply all patching and repair materials in accordance with manufacturer's specifications.

F. Repairing Formed Surfaces:

1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.
   a. Surface defects, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   b. Chip away defective areas, honeycomb, rock pockets, voids over 1/4" in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" and saw-cut edges to prevent feather edging of fill material.
5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" wide all around steel to allow proper bond.

G. Repairing Unformed Surfaces:

1. Depressed and high areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
   a. Correct high areas by grinding after concrete has cured at least 14 days. Surface defects include crazing and cracks in excess of 0.01" wide or that penetrate to the

reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.

b. Correct low areas by applying leveling material. Finish leveling material as specified in this section.

2. Repair surfaces containing defects that affect durability of concrete.
   a. Surface defects include crazing and cracks in excess of 0.01" wide or that penetrate to the reinforcement or completely through nonreinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Repair defective areas, except random cracks and single holes not exceeding 1" in diameter, by cutting out and replacing with fresh concrete.
   a. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4clearance all around.

4. Contractor shall be responsible for repairing all cracks wider than 0.02and all cracks wider than 0.01” that occur in a group of at least three cracks within twelve inches, in concrete slabs by epoxy injection or routing and sealing as required by Design Professionals. Use epoxy adhesive, Eucopoxy Injection Resin by Euclid Chemical Company or Sikadur 35, LV, LPL by Sika Corporation according to manufacturer’s recommendations.

H. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.8 EVALUATION AND ACCEPTANCE OF CONCRETE

A. In accordance with ACI 301, except where otherwise specified.

B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.9 COORDINATION & CORRECTIVE MEASURES

A. Conflicts: The contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

END OF SECTION

CONCRETE MIX DESIGN SUBMITTAL FORM

Project: _____

City: _____

General Contractor: _____

Concrete Contractor: _____

Concrete Strength: _____

Use/Location on Job: _____

Supplier's Mix Designation: _____

Design Mix Information	**(Please check one):**	*Refer to ACI 301 for requirements of data used to substantiate strength calculations.*
Field Experience (Based on Standard Deviation Analysis):	_____	
Trial Mixture Test Data:	_____	

Design Characteristics:

Density:	_____	Pcf (kg/m^3)
Strength:	_____	Psi (MPa) (28 day)
Air:	_____	% (specified)

Materials:	**Type/Source**	**Specific Gravity**	**Weight (lb)**	**Absolute Vol. (cu. ft.) (cu. m)**
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft. (1.0 m^3)
Water/Cementitious Material Ratio (lbs. (kg) water / lbs. (kg) cementitious material) =				%

Admixtures:	**Manufacturer**	**ASTM**	**Dosage (oz/cwt)**

Water Reducer:			
Air Entraining Agent:			
High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches (mm)
Slump after HRWR: _____ Inches (mm)

Standard Deviation Analysis (from experience records):

No. of Test Cylinders Evaluated: _____
Standard Deviation:

Required Average Strength f'cr
Average Strength by Tests
Equation Used (ACI Chapter 5)
(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	**Age (days)**	**Mix #1**	**Mix #2**	**Mix #3**
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	28 [56] [90]	psi (MPa)	psi (MPa)	psi (MPa)
	Average	psi (MPa)	psi (MPa)	psi (MPa)
Required Average Strength f'cr				
Average Strength by Tests				
Equation Used (ACI Chapter 5)				

REQUIRED ATTACHMENTS	***Please check***
Coarse Aggregate Gradation Report	
Fine Aggregrate Gradation Report	
Combined Aggregate Gradation Report: (8% - 18% for large top size aggregates (1½ in.) (40mm) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) (25mm or 20mm) retained on each sieve below the top size and above the No. 100) (See Section 2.3.B.)	
Fly Ash (or other Supplementary Cementitious Material) Certification	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatibility certification letters	
Chloride Ion Content Certification	
Alkali Aggregate Reactivity Certification	
Shrinkage Test Reports	

SUBMITTED BY:

Name: _____

Address: _____

_____

Phone no.: _____

Main Plant Location: _____

Miles from Project: _____

Secondary Plant Location: _____

Miles from Project: _____

_____

Date: _____

Certification by Concrete Supplier:
Signature: _____

1.

SECTION 03 40 00
SITE PRECAST CONCRETE

PART 1 -GENERAL

1.1 SUMMARY

A. Work includes:
   1. General Contractor Provide work as shown in the drawings and as specified herein: Custom precast architectural concrete seatwall systems as shown on drawings, shop drawings, setting material, grout, sealant, caulks, and installation of precast units.

1.2 RELATED SECTIONS

A.	Cast-In-Place Concrete	Section 03 30 00
B.	Concrete Unit Paving	Section 32 14 13
C.	Site Joint Sealants	Section 32 13 73

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each precast mixture, including color admixture mixture rate in gal./cu yd of concrete.

C. Shop Drawings:
   1. Seatwall: Include member locations, plans, elevations, dimensions, shapes and sections, and types of reinforcement. Detail fabrication and installation of custom precast units. Verify all measurements in field prior to preparation of Shop Drawings.

D. Samples:
   1. For each type of finish indicated on exposed surfaces of precast units with architectural finish, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by
      2 inches.
      a. Where other faces of precast seatwall unit are exposed, include Samples illustrating workmanship, color, and texture of backup mix as well as facing mix.
      b. For selection.

E. Delegated-Design Submittal: For precast indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the structural engineer licensed in the State of Illinois responsible for their preparation.

F. Performance Requirements:
   1. Compressive Strength 5000 p.s.i.
   2. Air Content 6-8%
   3. Water-Cement Ratio .45:1

4. Up to 10% mica for sparkle on exterior surfaces.

G. Qualification Data: For Installer and fabricator.

H. Welding certificates.

I. Material certificates. For certification attesting that materials meet specification requirements.

J. Material test reports.

K. Source quality-control reports.

L. Field quality-control and special inspection reports.

M. LEED Submittals
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

1.4 REFERENCES

A. American Society for Testing and Materials
1. ASTM C-150
2. ASTM C-33
3. ASTM C-260
4. ASTM C-494
5. ASTM C-128
6. ASTM C-31

B. Precast/Prestressed Concrete institute (PCI)

C. American Concrete institute (ACI)
1. ACI-318

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum 3 years experience in design and casting of projects comparable to this project. Responsibility includes preparation of Shop Drawings.
1. Participates in PCI's Plant Certification program and is designated a PCI-certified plant.

B. Design Standards: Comply with ACI 318 and design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast units indicated.

C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

D. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D.1.1M, "Structural Welding Code - Steel."

2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

E. Sample Panels: After sample approval and before fabricating precast units with architectural finish, produce a minimum of 2 sample panels approximately 1 sq. ft. in area for review by A/E.

F. Field Measurements: Verify measurements of concrete foundations to receive precast concrete wall and bench top, including locations of all expansion and construction joints. Include this information on Shop Drawing submittals.

G. Mockups: After sample panel approval but before production of precast concrete units with architectural finish, construct mockups to verify color and finish selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup to demonstrate jointing and setting conditions as shown in Drawings, if not indicated as directed by Laboratory including structural precast units with an architectural finish complete with anchors, connections, flashings, and joint fillers.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Laboratory specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Acceptance.

H. Preinstallation Conference: Conduct conference at the Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging and shipping: Precast concrete to be palletized and shrink wrapped, delivered in unopened packaging with legible manufacturer identification, including size, piece number, quantities, manufacture date and inspector's initials.

B. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.

C. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage. Protect from damage by other trades.

D. Lift and support units only at designated points shown on Shop Drawings.

1.7 WARRANTY

A. Manufacturer/General Contractor shall warrant installed system for a period of 2 years from date of substantial completion against failure of workmanship and materials.

PART 2 - PRODUCTS

1.8 ACCEPTABLE FABRICATORS

A. Wausau Tile Co., which is located at: P. O. Box 1520 9001 Bus Hwy. 51 ; Wausau, WI 54402-1520; Toll Free Tel: 800-388-8728; Tel: 715-359-3121; Email: request info (wtile@wausautile.com.); Web: www.wausautile.com

B. Approved equal.

1.9 FORM MATERIALS

A. Forms: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that will provide continuous and true precast surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
   1. Form-Release Agent: Commercially produced liquid-release agent that will not bond with, stain or adversely affect precast concrete surfaces and will not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration to match those used for precast with architectural finish. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect precast surfaces and will not impair subsequent surface or joint treatments of precast.

1.10 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

1.11 Concrete Materials

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
   1. Seatwall: For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source to achieve color required to match Architect’s sample.

B. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

C. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1.12 STEEL CONNECTION MATERIALS AND REINFORCEMENT

A. Reinforce precast with deformed rods or wire, or both, as recommended by precast concrete manufacturer.

B. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.

C. High-Strength Bolts and Nuts: ASTM A 325 or ASTM A 490, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.

D. Zinc-Coated Finish: For exterior steel items and steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.
   1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

E. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

F. Stainless Steel pins, sizes as indicated in drawings, for setting bench top.

1.13 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type M, and clean, natural sand, ASTM C 270.

1.14 MISCELLANEOUS MATERIALS

A. Shims for wall jointing shall be polycarbonate material and be removed completely prior to finish grouting and sealant installation.

B. Sealer: Colorless, pure acrylic water-repellent penetrating sealer. Sealer to maintain natural look of concrete surface with no glaze or gloss, darkening or color change.

1.15 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.
   1. Limit use of fly ash to 25 percent replacement of portland cement by weight and granulated blast-furnace slag to 40 percent of portland cement by weight; metakaolin and silica fume to 10 percent of portland cement by weight.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at structural precast fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C 1218/C 1218M.

D. Normal-Weight Concrete Mixtures: Proportion by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 6000 psi minimum.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 116.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

1.16 FORM FABRICATION

A. Forms: Accurately construct forms, mortar tight, of sufficient strength to withst and pressures due to concrete-placement operations and temperature changes. Coat contact surfaces of molds

with release agent before reinforcement is placed. Avoid contamination of reinforcement by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain forms to provide completed structural precast units of shapes, lines, and dimensions indicated in the Drawings, within fabrication tolerances specified.

1.17 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing structural precast units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in structural precast units as indicated on the Contract Drawings.

D. Cast-in openings larger than 6 inches in any dimension. Do not drill or cut openings without A/E approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

F. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 116.

I. Comply with ACI 306.1 procedures for cold-weather concrete placement.

J. Comply with PCI MNL 116 procedures for hot-weather concrete placement.

K. Identify pickup points of structural precast units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each structural precast unit on a surface that will not show in finished structure.

L. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

M. Discard and replace structural precast units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Architect's approval.

1.18 FABRICATION TOLERANCES

A. Fabricate structural precast units straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL 116 product dimension tolerances.

B. Units to conform to shop drawings, with a 1/8” tolerance in dimension.

1.19 FINISH

A. Provide finish as indicated on drawings.

B. Manufacture member faces free of joint marks, grain, and other obvious defects with corners, including false joints, uniform, straight, and sharp. Finish exposed-face surfaces of precast units to match approved sample panels and mockups.

1.20 SEALANT

A. Sealants shall be per section 32 13 73.

1.21 SOURCE QUALITY CONTROL

A. Testing: Test and inspect structural precast according to PCI MNL 116 requirements.

B. Defective Units: Discard and replace structural precast units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to A/E approval. A/E reserves the right to reject precast units that do not match approved samples, sample panels, and mockups.

2. EXECUTION

2.1 INSTALLATION SEATWALL

A. Install precast level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection.
   1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   2. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

B. Connect precast units in position by bolting, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

C. Field cutting of precast units is not permitted without approval of the A/E.

D. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

E. Grouting: Grout connections and joints. Retain grout in place until hard enough to support itself.

F. Rake all joints back ½" and install sealant.

G. Install and test lighting bar where indicated and as shown in details and specified in Electrical specifications.

H. Install acrylic or polycarbonate lens into wall unit as shown in details.

2.2 TOLERANCES

A. Erect seatwall precast units level, plumb, square, true, and in alignment.

2.3 FIELD QUALITY CONTROL

A. Repair or remove and replace work where inspections indicate that it does not comply with specified requirements.

2.4 CLEANING

A. Clean mortar and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after installation and completion of grouting to remove dirt and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.

B. Related Sections:
1. Division 03 "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Division 05 “Metal Fabrications “ for steel support angles

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
   3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
      b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   6. Joint reinforcement.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

D. Mockups: As indicated on the Drawings.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: CMUs shall be manufactured within 500 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Recycled Content of Masonry Products: Recycled content not less than 25 percent.

C. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

D. CMUs: ASTM C 90.

E. Density Classification: Normal weight.

F. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
1. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

G. Concrete Facing Brick: ASTM C 1634.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3750 psi.
2. Density Classification: Lightweight Normal weight.
3. Texture: Ground-face finish.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Regional Materials: Aggregate for mortar and grout[, cement, and lime] shall be extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Masonry Cement: ASTM C 91.

F. Mortar Cement: ASTM C 1329.

G. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.

K. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized, carbon steel.
   3. Wire Size for Side Rods: 0.187-inch diameter.
   4. Wire Size for Cross Rods: 0.187-inch diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
   1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 1 side rod at each wythe of masonry 4 inches wide or less.
   2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
   3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.[Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.]

2.6 MISCELLANEOUS ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.
   1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
   2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
   3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 EMBEDDED FLASHING MATERIALS

A. Application: Unless otherwise indicated, use the following:
   1. Where flashing is indicated only stainless steel flashing is allowed.
   2. Where flashing is indicated to receive counterflashing, use metal flashing
   3. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   4. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a sealant stop or flexible flashing with a metal sealant stop.
   5. Where flashing is fully concealed, use metal flashing or flexible flashing.

B. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from high-density polyethylene incorporating chemical stabilizers that prevent UV degradation. Cell flashing pans have integral weep spouts that are designed to be built into mortar bed joints and weep collected moisture to the exterior of CMU walls and that extend into the cell to prevent clogging with mortar.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

E. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

2.9 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.10 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
   3. For exterior masonry, use portland cement-lime or mortar cement mortar.
   4. For reinforced masonry, use portland cement-lime mortar.
   5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
   1. For masonry below grade or in contact with earth, use Type S.
   2. For reinforced masonry, use Type N.
   3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
   4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches s measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
   3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
   4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
   1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
   2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
   3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
   4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill

head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
   2. Install preformed control-joint gaskets designed to fit standard sash block.
   3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
   4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
   1. Build in compressible joint fillers where indicated.

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
   1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.8 LINTELS

A. Provide concrete lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

3.9 CMU FLASHING INSTALLATION

A. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

3.10 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches .

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Testing Prior to Construction: One set of tests.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.13 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

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SECTION 05 10 00

STRUCTURAL STEEL

PART 1 – GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete	Section 03 30 00
Steel Deck	Section 05 30 00
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards:

1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.

2. American Institute of Steel Construction (AISC 303-05), "Code of Standard Practice", March 18, 2005, shall apply except:

   a) The last sentence of the last paragraph of item 3.1.2 shall be revised from "…for

approval." to read "…for review; the Contractor's Engineer shall be professionally responsible for connections they design."

b) Item 3.6 shall be deleted.

c) Item 4.4 shall be deleted, and replaced with the requirements of the project specification.

d) The second paragraph of 7.10.3 shall be revised from "… Owner's Designated Representative for Design and Construction" to "Laboratory's Designated Representative for Construction or as indicated in the Contract Documents"

e) The last sentence of items 8.5.2 and 8.5.4 shall be deleted.

f) Item 8.5.3 shall be deleted. Where a conflict exists between the Code of Standard Practice and the Contract Documents, the Contract Documents shall govern.

3. American Welding Society, AWS D1.1-08, "Structural Welding Code".

4. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using ASTM A325 or A490 Bolts", (June 30, 2004).

5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.

6. The Society for Protective Coatings (formerly Steel Structures Painting Council, "SSPC") "Steel Structures Painting Manual", (2005).

C. Definitions:

1. The term "Contract Documents" in this specification is defined as the design drawings and the specifications.

2. The term "SER" in this specification is defined as the Structural Engineer of Record for the structure in its final condition.

3. The term "Design Professionals" in this specification is defined as Laboratory's Architect and SER.

4. The term "Contractor" in this specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Structural Steel Fabricator or Structural Steel Erector.

5. The term "Heavy Shapes" in this specification is defined to include hot rolled steel shapes with flanges exceeding 2 inches in thickness and built up cross sections with plates exceeding 2 inches in total thickness.

6. The term "High Restraint Weld" describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.

7. The term "Testing Agency" in this specification is defined as an independent testing

and inspection service engaged by Laboratory for quality assurance observation and testing of steel construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.

8. The terms "for record" and "submit for record" in this specification are defined as Contractor submittals that do not require a response from the Design Professionals.

1.5 STRUCTURAL STEEL CONTRACTOR QUALIFICATIONS

A. The term Structural Steel Contractor refers to any or all of the following parties, regardless of their contractual relationships: Structural Steel Fabricator, Structural Steel Detailer, Structural Steel Erector and Contractor's Engineer.

B. Qualification Data: Submit qualification data (personnel and firm resumes, and project lists with references) for the Structural Steel Fabricator ("Fabricator"), Structural Steel Detailer ("Detailer"), Contractor's Engineer(s) and Structural Steel Erector ("Erector").

C. The Fabricator shall have 10 years of comparable experience in installations of this type and shall employ labor and supervisory personnel familiar with the type of installation, experienced in fabrication and erection of structural steel for projects of similar size and complexity. At the time of bid the Fabricator shall be AISC certified to the Standard for Steel Building Structures (STD) and must submit proof of these qualifications. The Fabricator's qualifications shall be subject to review by the Design Professionals and Laboratory.

D. The Detailer shall have 10 years experience preparing detailed steel shop drawings and CNC downloads for structures of this type and complexity. The detailer's qualifications shall be subject to review by the Design Professionals and Laboratory. The Contractor's Engineer(s) shall be qualified to perform the type of work required by the project. The Engineer(s) shall be a Licensed Structural Engineer(s) in Illinois. The Contractor's Engineer(s) shall have 10 years of experience being in responsible charge of work of this nature. The proposed Engineer(s) shall be subject to approval of Design Professionals and Laboratory.

E. The Erector shall have 10 years of successful experience erecting structural steel for structures of this type and complexity in the region of the project. At the time of bid the Erector shall be an AISC Certified Steel Erector (CSE) and must submit documentation of this qualification. Welding: Qualify the welding procedures, shop welders, field welders, welding operators and tackers in accordance with AWS D1.1 and for the following periods of effectiveness of certification:

1. Certification and qualification, including period of effectiveness of welding personnel shall be as specified by AWS D1.1. Certification shall remain in effect for duration of work provided welders are continuously engaged in performing the type of welding for which they are certified, unless welders fail to perform acceptable welding, as determined by Laboratory's Testing Agency. Certification and re-certification of welding personnel is subject to verification by the Testing Agency. Re-testing for re-certification will be the Contractor's responsibility.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Calculations, Shop Drawings and Erection Drawings
(3) Submittal Letters
(4) Pre-construction Survey
(5) Quality Control Program
(6) Product Data
(7) Samples
(8) Welding Procedures Specification (WPS)
(9) Welder Certifications
(10) Mill Reports
(11) As-built surveys
(12) LEED Submittals

1. **Submittal Schedule**: The contractor shall submit for approval a typical connection design calculation and shop drawing submission schedule at least twenty (20) working days prior to commencing submission of connection design calculations and shop drawings.

   a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, including but not limited to the number of calculation sheets, erection drawings, and piece drawings, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for approval at least twenty (20) working days before the modification or addition is proposed to take place.

   b) If at any time the total number of connection design calculations, erection drawings and shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.

2. **Calculations, Shop Drawings and Erection Drawings** (including Field Work drawings): Submit required connection calculations, shop drawings and erection drawings for all structural steel indicated on the Contract Documents.

   a) Material shall not be fabricated or delivered before the shop and erection

drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.

b) Connection design calculations: Calculations are required for all details that are not indicated on the drawings as "Completely Designed." Each calculation package shall be signed and sealed by the Contractor's Engineer.

c) Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.

d) Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on contract documents, and shall not be scaled from contract documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pre-tensioned high strength bolts and identify surface preparation requirements at slip critical connections.

e) Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the SER. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.

f) Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.

g) Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items. All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size, type, number, location and any special installation requirements, and field weld size, type, length and location.

3. **Submittal Letters**: The Contractor shall submit for record letters from the Contractor's Engineer supervising the preparation of connection designs on shop and erection drawings.

a) A letter shall be submitted along with the first submission of Connection design calculations. It shall be signed and sealed by the Contractor's Engineer, and shall include the following:

"All Connection design calculations for this project have been developed, and all details and connections for this project <u>will be</u> designed, by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as

completely designed on the Contract Drawings."

b) Additional letters shall be submitted upon the satisfactory submission, review and/or approval of each distinct package of shop and erection drawings. It shall be signed and sealed by the Contractor's Engineer and include the following:

"All details and connections as shown on the listed shop and erection drawings for this project have been designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."

4. **Preconstruction Survey**: Submit for record. Where interface with existing construction occurs (at the LOM), before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals. For all steel construction, before steel erection commences, perform and submit to the Design Professionals a complete survey for position and alignment at all points where construction by other trades will support steel elements, including embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines, and elevations of bearing surfaces and tops of bolts relative to building Datum elevation.

5. **Quality Control Program**: Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.

6. **Product Data**: Submit manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.

7. **Samples**:

   a) Submit (2) samples each, (2) of shop painted products and (2) of field touch-up painted products.

   b) Exposed to View steel: Sample shall include surface preparation and finish paint system. Submit at least four weeks prior to fabrication.

      (1) Submit 12” long sample of HSS8x8 clerestory corridor columns. Sample shall include applied finish paint system.

      (2) Submit 12” long W21x44 clerestory corridor beam including end shear connection. Sample shall include applied finish paint system.

8. **Welding Procedures**: Submit for record written welding procedures for all AWS D1.1 prequalified joints, and qualification procedures for all joints not prequalified by Section 3 of AWS D1.1. Submit written welding procedures developed by Contractor’s welding consultant for heavy shapes and High Restraint Welds described in this specification. Use the forms in AWS D1.1, Annex E. Submit all

welding and qualification procedures to Laboratory's Testing Agency for approval before submitting to the Design Professionals.

9. **Welder Certification**: Submit for record certification that the welders have passed qualification tests using AWS procedures.

   a) A certification shall be submitted in standard AWS format.

   b) Each certification shall state that the welder has been doing satisfactory welding of the required type within the six-month period prior to the subject work.

   For any welder whose period of certification effectiveness has lapsed or whose workmanship is subject to question in the opinion of the Design Professionals or Testing Agency, immediate testing for recertification will be required. Tests, when required, shall be conducted at the sole expense of the Contractor.

10. **Mill Reports**: Submit for record certified copies of all mill reports, two (2) to the Design Professionals and one (1) to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this specification) for the project. Where required on the Contract Documents or by the AISC Code, reports shall include results of Charpy V-notch tests.

    a) Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.

    b) Prior to commencing steel erection, the contractor shall deliver certificates to Laboratory in number and form as may be required by the local Building Department or other local and State agencies having jurisdiction.

11. **As-Built Surveys**: Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each certified survey, performed by a professional surveyor employed by the Contractor, shall be submitted to the Contractor's Engineer for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, the Contractor shall present corrective measures to the Design Professionals within 48 hours of completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Design Professionals and Laboratory.

12. **LEED Submittals:**

    a) See Division 1 Section "LEED Requirements" for additional LEED requirements.

       1. Credit MR 4.1, 4.2 - Recycled Content:

          a) Indicate recycled content; indicate percentage of pre-consumer and post-

consumer recycled content per unit of product.

b) Indicate relative dollar value of recycled content product to total dollar value of product included in project.

2. Credit MR 5.1, 5.2 - Local/Regional Materials:

a) Extracting, processing and manufacturing (fabrication) location(s): Indicate location of extracting, processing and manufacturing (fabrication) facilities; indicate distance between each facility and the project site.

b) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

c) Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

3. Credit EQ 4.2: VOC

a) Submit Product Data and material safety data sheets stating compliance with VOC limits for field applied primers and paints. Refer to Section 01 35 36/LEED Requirements for additional requirements.

B. Submittal Process

1. Refer to Division 1

2. Connection design calculations: Calculations are required for all details that are not indicated on the drawings as “Completely Designed”, including thermal break details. The Contractor shall submit connection design calculations prior to submitting shop drawings related to those calculations. The shop drawings shall incorporate all comments provided on the calculations.

3. Shop and erection drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop and erection drawings shall be referenced on each shop and erection drawing to facilitate checking. Unless the piece marks are self indexing, furnish index sheets with the shop drawings, relating piece marks for all beam, girder and column details to the sheet numbers on which they are located.

4. The Contractor shall allow at least fifteen (15) working days between receipt and release by the SER for the review of connection design calculations.

5. All modifications or revisions to submittals, shop drawings, connection design calculations and erection drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been

approved by the Design Professionals:

a) Failure to specifically cloud modifications

b) Failure to submit calculations for the modifications

c) Unapproved revisions to previous submittals

d) Unapproved departure from Contract Documents

6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal.

C. SER Submittal Review

1. The review of connection design and the review and approval of shop and erection drawings and other submittals by the Design Professionals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

a) Responsibility for the adequacy of the design of the connections designed by the Contractor's Engineer.

b) Responsibility for all required detailing.

c) Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.

d) The necessity of furnishing material and workmanship required by contract drawings and specifications which may not be indicated on the shop and erection drawings.

e) Conforming to the Contract Documents.

f) Coordination with other trades.

g) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 Stamp - For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require the following actions:

a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

b) APPROVED AS NOTED indicates that the SER requires the shop or erection

drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.

c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.

3. TYPE 2 Stamp - For submittals for building elements which are not designed by the SER but are performance specified, for items that do not form part of the completed structural system but impose loads on the structure, and for construction items or activities which have an effect on the final structure, a second stamp will be used. The responses on the stamp used by the SER require the following actions:

a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.

b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.

c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request

1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.

2. All substitutions must be requested using the Request for Substitution form included in Division 1. Structural acceptance using the substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The substitution request form, even if accepted, does not constitute a change order.

1.7 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

A. The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor's Engineer.

1.8 STORAGE AND DELIVERY

A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by Laboratory at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.

B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.

C. Store fasteners in a protected place.

D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1.

1.9 CONNECTION DESIGN AND DETAILING MEETING

A. At least 20 working days prior to starting connection design and detailing, the Fabricator shall hold a meeting to verify all connection design assumptions and procedures and shop drawing preparation and submittal procedures.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the connection design and detailing to attend this meeting, including but not limited to:

1. General Contractor

2. Fabricator

3. Detailer

4. Connection Engineer

5. Design Professionals

6. Erector

C. The Fabricator shall prepare an agenda prior to the meeting, and shall distribute meeting minutes to all parties within 5 working days of the meeting.

1.10 DESIGN OF CONNECTIONS

A. The contractor is responsible to design all connections not completely designed on the Contract Documents. A Completely Designed connection is only one that is specifically designated as such by the statement “COMPLETELY DESIGNED” on the Contract Documents. All connections not indicated as “COMPLETELY DESIGNED” shall be designed for the forces and/or connection design criteria called for in the Contract Documents.

B. Connection concepts shown on the drawings that are not “COMPLETELY DESIGNED” show only the minimum requirements to convey design intent.

C. All connections and details shown on shop and erection drawings shall be prepared under the supervision of the Contractor's Engineer, in accordance with AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings."

D. The contractor shall design and provide any stiffener plates, doubler plates, reinforcing plates, etc. and their connections that may be required to develop and/or transfer the forces and/or connection design criteria called for in the Contract Documents.

E. Design connections to withstand the combined effects of shears, axial forces, moments and torques and as required by applicable code(s) and the contract documents.

F. All forces shown on the drawings are to be assumed reversible unless noted otherwise and must be checked for both directions. If no transfer/pass-through forces are shown on the Contract Documents, the most critical combinations of member forces and directions shall be assumed for the connection design.

G. Use types of shop and field connections shown on Contract Documents or, in absence of such indication, propose appropriate type for Design Professionals review.

H. All welded connection must utilize pre-qualified joints or joints that have been qualified by AWS D1.1, section 2.

I. Comply with all connection notes on drawings in conjunction with these specifications.

J. Refer to drawing S5.4.3 for specific connection requirements for Exposed to View members.

K. The connection design calculation submittals shall meet the following criteria:

a) Number each calculation in a logical and orderly system. Once submitted for review, calculations shall not be renumbered. Resubmitted calculations shall be indicated by using the same number with an “R” suffix. All changes must be

clouded.

b) Provide sketches for results of each calculation, with all pertinent dimensions relating to the calculations (including pitch, gage, edge distance, unbraced lengths, Whitmore lengths, etc.) clearly shown. Geometry must be shown accurately and to scale. Provide enough sketches to clearly document the full range of geometric conditions applicable to each connection design calculation proposed.

c) For repetitive connections provide a spreadsheet or computer program summary table for each specific location, and a standard calculation which shows how the spreadsheet or program calculation applies.

d) Provide drawings showing the overall locations of the connections that are keyed/referenced to each connection calculation.

e) Calculations shall be typed, or performed by spreadsheet, or by computer program, or by other method approved by the SER. All spreadsheet calculations shall show the input and results for every calculation step and include appropriate text and sketches explaining all calculation assumptions.

f) Provide calculation checks for all forces shown on the drawings. All AISC code requirements apply. Provide calculations for each check. “OK by inspection” is not permitted.

1.11 STRUCTURAL STEEL PRE-ERECTION CONFERENCE:

A. At least twenty (20) working days prior to the commencing of steel erection the Contractor shall hold a meeting to review the detailed requirements of the steel erection.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:

1. General Contractor/Construction Manager
2. Steel Erector / Steel Fabricator
3. Finish Painting Contractor
4. Erector’s Surveyor
5. Roof Deck Contractor
6. All Testing and Inspection Agencies
7. Design Professionals
8. Laboratory
9. Cladding Contractor

C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.

D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.

E. Notwithstanding any provision of the Specification, the SER shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

1.12 QUALITY ASSURANCE BY LABORATORY'S TESTING AGENCY

A. Quality assurance is testing and inspection to assist Laboratory in evaluating the Contractor's performance in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program (see the following section on quality control).

B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by Laboratory.

C. Laboratory has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to Laboratory.

D. Coordination with Laboratory's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the testing agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with Laboratory's testing agencies in the performance of their work and shall provide the following:

1. Information as to time and place of starting shop fabrication and a field construction and erection schedule, one week prior to the beginning of the work

2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office and the drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.

3. Representative sample pieces requested by the inspection agency for testing, if necessary

4. Full and ample means of assistance for testing and inspection of material

5. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.

E. Duties of Laboratory's Testing Agencies:

1. Reports: The Testing Agency shall prepare daily reports of the structural steel work

including progress and description/area of work, tests made and results. Reports of inspection of welding shall include deficiencies noted and corrections made, and other items pertinent to acceptance or rejection of the work. The reports shall state whether specimens comply with or deviate from contract requirements. The daily reports shall be collected and delivered to the Design Professionals and Laboratory weekly.

2. Rejection: Laboratory's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall report deficiencies to Laboratory, Design Professionals, and Contractor immediately.

3. Structural steel work and general testing requirements: The Testing Agency reserves the right to perform the following shop and field inspections in addition to any other inspections enumerated above or specified on the Contract Documents:

   a) Shop inspection of steel shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of heavy shapes as defined in this specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of heavy shapes, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the required percentage of tested cambers may be increased by the SER to 100% at no expense to Laboratory.

   b) Field inspection of steel shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up.

   c) Check qualifications of the following:

      (1) Shop welding procedures and personnel
      (2) Shop stud welding setup and operators
      (3) Shop bolting procedure and crew

   d) Where testing is required for less than 100% of locations, select test locations at random and throughout the project.

   e) Review mill certifications for compliance with the Contract Documents.

4. High Strength Bolting: The Testing Agency reserves the right to inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:

   a) Surface preparation and bolt type conforms to plans and specifications prior to start of bolting operations.

b) Proper bolt storage and handling procedures per codes and standards referenced by this specification are being followed.

c) Visually inspect all bolted connections.

d) For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.

e) For all bolted connections that are indicated as pre-tensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.

f) For all bolted connections that are indicated as pre-tensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pre-tensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.

(1) "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.

g) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.

5. Welding:

a) Review of submittals: Welding procedures including prequalification, qualifications test and, for heavy shapes and high restraint welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant.

b) Full penetration welds: Test all full penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired by the Contractor at the Contractor's expense.

c) Partial penetration welds: Test all partial penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired by the Contractor at the Contractor's expense.

d) Testing of welds at heavy shapes and high restraint welds shall be performed not less than 48 hours after the weld has been completed.

e) Fillet welds: Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds per connection using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.

f) Inspection and Testing by the Testing Agency of high restraint welds and where Heavy Shapes are to be joined by partial or full penetration welds in tension:

(1) Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.

(2) Test Full Penetration Welds in accordance to the requirements of this specification section, ultrasonically in accordance with AWS D1.1 procedures. On T or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.

(3) Test Partial Penetration Butt Joints in accordance with this specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex K-7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.

g) At heavy shapes and high restraint welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.

6. Headed Studs and Deformed Bar Anchors: Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).

a) Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition for each member with any defective studs, test an additional member.

b) Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.

7. Cleaning & Painting:

a) Prior to shop painting, examine all fabricated pieces to verify proper cleaning in accordance with the contract documents.

b) Examine all shop painting to verify conformance with this specification.

c) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.

8. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Laboratory on a weekly basis.

9. Safety tie backs: Inspect and test installed tiebacks in accordance with ANSI/IWCA I-14.1.

10. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Laboratory that the installation is in accordance with the design and specification requirements (including applicable codes).

1.13 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Contractor shall immediately report to the Design Professionals any deficiencies in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Laboratory, the Contractor shall correct the deficiency at no cost to Laboratory.

C. Laboratory's general review during construction and activities of Laboratory' Testing Agency are undertaken to inform Laboratory of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

1.14 WARRANTY

A. Warranty: Upon completion of all work to be performed under this Contract, the Contractor shall execute and deliver in a satisfactory form a warranty that all workmanship and materials used in the performance of this Contract shall remain free from defects for a period of one (1) year from the date of execution of the Warranty.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel shall conform to the requirements listed on the Structural General Notes.

B. “Heavy Shapes” as defined in this specification require minimum Charpy impact values per the Structural General Notes, in addition to any other members stated in the Notes.

C. Structural steel and accessories shall be produced in the United States.

2.2 SHOP COATINGS

A. Standard Primer: SSPC – Paint 25 or Paint 25 BCS, Type II zinc oxide raw linseed oil and alkyd primer. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient =0.50 min) requirements. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than 2.3 oz per square foot, with no individual thickness less than 2.0 oz per square foot.

D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other complying with SSPC-Paint 20.

E. Interior primer for Exposed to View steel as identified on drawing S0.0.6 – Modified Aromatic Polyurethane Primer. Refer to Division 9 for finish coat requirements.

F. Exterior primer for Exposed to weather steel as identified on drawing S0.0.6 – Aromatic Urethane, Zinc Rich - requires a primer compatible with field applied finish coat. Refer to Division 9 for finish coat requirements.

G. Members to receive intumescent fire-resistive coatings, as identified on drawing S0.0.6 – shop applied primer compatible with intumescent coating system as specified in Division 9 specification.

2.3 ACCESSORIES

A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specifications for Structural Joints using ASTM A325 or A490 Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.

B. All bolts shall be new, and not re-used.

C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.

D. Direct Tension Indicators: Meet requirements of ASTM F959.

E. Anchor Rods: Per structural General Notes.

F. Washers:

1. Round washers shall conform to American Standard B 27.2 type b

2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.

3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.

4. The diameter of the hole of square beveled washers shall be 1/16 inch greater than the bolt size for bolts smaller than one inch, and shall be 1/8 inch greater than the bolt size for bolts larger than one inch.

5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.

G. Welding Electrodes: Electrodes shall be low hydrogen and shall be selected from Table 4.1.1 of AWS D1.1. Comply with CVN requirements of the Structural General Notes.

1. Shielded Metal-Arc Welding: Welding electrodes for manual shielded metal-arc welding shall conform to the specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1 E70 or 80, or the specification for Low-Alloy Steel Covered Arc-Welding Electrode, AWS A5.5.

2. Submerged-Arc Welding: Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Gare Mild Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.

3. Where Charpy V-Notch values are required on the base metal, an electrode meeting the Charpy V-Notch requirements listed in the Structural General Notes shall be provided.

H. Headed Studs (shear connectors) shall be per Structural General Notes.

I. Deformed Bar Anchors shall be as specified in Structural General Notes.

J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.

K. Grout: Refer to General Notes.

L. Post-installed Anchors shall be per Structural General Notes.

M. Hex Cap (Acorn) Nuts: ASTM A563

N. Thermal Insulation Material for Thermal Break: ASTM D2863, ASTM D696, ASTM C177

1. Schock Isokorb type KST

2. Or equal.

O. Safety tiebacks

1. Attached to the structure per the manufacturers and code requirements.

2. Basis of Design: Probel

3. Comply with NAAMM "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.4 LEED Requirements

A. Structural Steel: LEED Credit MR 5.1, 5.2: Extraction, processing and manufacturing (fabrication) facilities should be within 500 miles of project site.

B. Structural Steel: LEED Credit MR 4.1, 4.2: Recycled content: Minimum 50 percent post-consumer recycled content

C. Bolts: LEED Credit MR 4.1, 4.2: Recycled content: Minimum 50 percent post-consumer recycled content.

D. Anchor Rods: LEED Credit MR 4.1, 4.2: Recycled content: Minimum 25 percent post-consumer recycled content.

E. Headed Studs (shear connectors): LEED Credit MR 4.1, 4.2: Recycled content: Minimum 50 percent post-consumer recycled content.

PART 3 – EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section and report any defects affecting installation to Design Professionals. Commencement of work will be construed as complete acceptance of preparatory work by others. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other trades.

B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, the Contractor shall ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete by others. The Contractor shall immediately bring to the attention of the Design Professionals any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

3.2 FABRICATION

A. Fabricate and assemble structural steel in the shop to the greatest extent possible. Refer to drawing S5.4.3 for specific detailing/fabrication requirements for Exposed to View steel members and connections.

B. Tolerances:

1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.

2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.

C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other trades. All holes shall be accurately drilled or punched at right angles to the surface of the metal in accordance with AISC Specifications. Holes shall not be made or enlarged by burning. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.

D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.

E. Cutting: Manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch from the finished dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth.

F. Cutting of Heavy Shapes: Where “Heavy Shapes” as defined in this specification are to be joined by partial or full penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F. Weld access holes and copes shall be ground to a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.

G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.

H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.

I. Bolts indicated as “finger tight” on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.

J. Installation of High Strength Bolts:

1. Except where "snug tight" installation is specifically permitted or required on design drawings (refer to Exposed to View Steel on S0.0.6 and details on S5.4.3), all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI)

Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts". Calibrated Wrench Pretensioning shall only be used where specifically approved by the SER.

2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.

3. All high strength bolt assemblies (including Tension Control bolts and DTI's) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.

K. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer. Welding of Structural Steel:

1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.

2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.

3. Each welder's work shall be traceable.

4. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.

L. Bearing:

1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column.

2. Finish bearing areas of base plates per AISC M2.8.

M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.

N. Seal weld open ends of hollow structural sections (HSS) with 3/8"minimum closure plates, uon. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where steel is Exposed to Weather. Refer to drawing S0.0.6 for Exposed to Weather steel.

O. Cleaning and Preparation of Steel Surfaces:

1. Clean all steel work in accordance with the Steel Structures Painting Council (SSPC). Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.

a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.

Interior, Exposed to View (see drawing S0.0.6) in the Finished Building: SSPC-SP-3, Power Tool Cleaning..

Interior, Exposed to View ALTERNATE No. A-6: SSPC-SP-6, Commercial Blast Cleaning.

b) Exterior (exposed to weather or in unconditioned space, see S0.0.6): SSPC-SP-6, Commercial Blast Cleaning.

c) Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.

d) Members receive intumescent paint (see drawing S0.0.6): for shop applied primer, SSPC-SP2 minimum, but not less than required by manufacturer.

P. Shop Coating:

1. Where painting is specified, paint all steel work in accordance with the Steel Structures Painting Council (SSPC) Method specified herein that corresponds to its location and exposure and in accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.

a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.

b) Interior, Exposed to View in the Finished Building: SSPC – See Division 9

c) Exterior (exposed to weather or in unconditioned space): SSPC – See Division 9

2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.

3. Do not paint:

a) Surfaces within six 6 inches of field welds

b) Surfaces to be encased in concrete or to receive cementitious fireproofing

c) Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the SER)

d) Surfaces required for testing and preheat, until all testing and preheat has been performed

e) Finished bearing surfaces (use removable rust-inhibiting coating)

f) Top flange of the beam where steel deck or headed studs are to be attached

4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.

5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.

6. Hot-dip galvanize the following steel members:

   a) All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles

   b) All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware

   c) Any other steel members indicated as “Galvanized” on the Contract Documents.

   d) All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

3.3 ERECTION

A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.

B. Bracing: Brace the frame during erection in accordance with the Contractor’s erection procedure.

C. Errors: Immediately report to the Design Professionals any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.

D. Exposed to View steel (shop primed):

1. Handle, lift and align pieces using paddled slings and/or other protection required to maintain appearance and shop applied finish of steel through the erection process.

2. Bolt Head Orientation: All bolts should be oriented as indicated on the contract documents. Where bolt-head alignment is specified, the orientation shall be noted for each connection on the erection drawings. Where not noted, the bolt head in a given connection shall be oriented to one side.

3. Removal of field connection aids: Run-out tabs, erection bolts and other steel members added to connections to allow for alignment, fit-up and welding in the field shall be removed from the structure. Welds at run-out tabs shall be removed to

match adjacent surfaces and ground smooth. Holes for erection bolts shall be plug welded and ground smooth.

E. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted.

F. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.

G. Bolting and Welding of Structural Steel: See Section on "Fabrication".

H. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.

I. Splices: Splices will be permitted only where indicated on the contract drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.

J. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the SER.

K. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.

L. Hammering: Hammering which may damage or distort the members will not be permitted.

M. Do not use cutting torches in the field without the specific approval of the SER for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.

N. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.

O. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.

P. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and

unpainted areas adjacent to field welds according to manufacturers recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.

Q. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.

R. Clean all steel members of mud and debris and construction residue prior to erection.

S. Headed Studs and Deformed Bar Anchors

1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.

2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.

3. Remove ceramic ferrules from studs and work after welding.

T. Safety tie backs

1. Install safety tiebacks per code requirements and manufacturer's recommendations at locations indicated on drawings.

3.4 LEED Requirements

A. Extraction, processing and manufacturing (fabrication) facility should be within 500 miles of project site.

B. Field applied Coating Product: must meet VOC requirements of LEED Credit EQ 4.2. See Section 01 35 36/LEED Requirements for additional requirements.

END OF SECTION

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SECTION 05 30 00

STEEL DECK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the design and installation of composite and non-composite structural steel floor deck systems, steel roof deck systems and related work with all attachments, flashings, metal closures, concrete stops, accessories and fittings as required for a complete installation in accordance with the drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS:

Submittals	Division 1
Concrete	Section 03 30 00
Structural Steel	Section 05 10 00
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Steel deck work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the drawings.

B. Standards and Definitions:

1. All steel floor and roof deck manufacturers shall be listed in the Underwriter's Laboratories "Fire Resistance Index of Companies".

2. American Iron and Steel Institute (AISI) “Specification for the Design of Cold-Formed Steel Structural Members”, latest edition.

3. American Welding Society AWS D1.3 , “Structural Welding Code – Sheet Steel.”

4. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein, latest edition.

5. Steel Deck Institute (SDI) "Design Manual for Composite Decks, Form Decks and Roof Decks", latest edition.

6. For definitions see Steel Specification, 05 10 00.

1.5 STEEL DECK MANUFACTURER AND CONTRACTOR QUALIFICATIONS

A. The Manufacturer and the Steel Deck Erector ("Erector") shall each demonstrate a minimum of ten (10) years of experience with the specified steel deck systems.

B. The Erector shall use prequalified welding processes in accordance with the AWS Structural Welding Code and shall provide certification that those welders to be employed in the Work are currently qualified for those processes and have satisfactorily passed the applicable AWS qualification tests.

C. Contractor's Engineer shall be qualified to perform the type of work required by the project. The Engineer shall be a Licensed Structural Engineer in state of the Illinois**.** The Contractor's Engineer shall have 10 years of experience in responsible charge of work of this nature, on steel deck installations similar to this Project in material, design, and extent, with a record of successful in-service performance. Proposed Contractor's Engineer shall be subject to approval of Design Professionals and Laboratory.

1.6 SUBMITTALS

A. Submittals shall be in compliance with requirements of Section 01 33 00, Section 05 10 00 and as stated below. Where the SUBMITTALS section of this specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements.

(1) Submittal Schedule
(2) Calculations, Shop Drawings and Erection Drawings
(3) Manufacturer's Certification
(4) Manufacturer's Installation Instructions
(5) Welder Certifications
(6) LEED Submittals

1. **Submittal Schedule:** The Steel Deck Contractor shall submit a schedule of drawing and calculation submissions at least twenty (20) working days prior to commencing submission of drawings and calculations. The schedule will indicate the number of drawings and calculations proposed to be submitted each week. Any modifications to the schedule shall be submitted for approval at least twenty (20) working days prior to modification is proposed to take place.

2. **Calculations, Shop Drawings and Erection Drawings (including Field Work Drawings):** Submit manufacturers standard load tables and calculations for items designed by the Contractor's Engineer. Submit shop drawings and erection drawings for all steel deck indicated on the contract documents.

a) Materials shall not be fabricated or delivered to the site before the shop drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.

b) Submit for record, prior to or with shop drawings, calculations for items designed by the Contractor's Engineer. Calculations shall address all design gravity, uplift, and in-plane diaphragm loads indicated. Each calculation package shall be signed and sealed by the Contractor's Engineer.

c) Shop Drawings shall clearly indicate:

(1) Deck types (profiles), steel gauges,and deck finishes.
(2) Deck layout, including panel locations , number of deck spans per panel, structural support locations and joint locations.
(3) Deck dimensions and sections keyed to layout plans, including side and end details and bearing requirements.
(4) Deck fastener types (welds, screws, pins, proprietary systems) and layout patterns at panel sides, ends and interior supports.
(5) Deck manufacturer, profiles, properties, vertical load capacity and in-plane diaphragm shear capacity for all as-detailed conditions.
(6) Details and locations of accessories including hardware, framing reinforcement anchorage, sump pans, cant strips, ridge plates, valley plates and closure plates.
(7) Fabrication necessary to incorporate steel deck into the job.
(8) Correlation with other requirements, openings and flashings.
(9) Fully dimensioned layout of field-installed headed studs (shear connectors).
(10) Contractor-coordinated openings for mechanical, electrical, plumbing, fire protection and other trades.

d) A letter shall be submitted along with the the shop drawings. It shall bear the registration number, seal, signature and address of the Structural Engineer who prepared or supervised the calculation and reviewed the shop drawing submittal and shall include the following: "The steel deck calculations have been developed,for this project and are designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the contracto Documents. I have reviewed the steel deck layout drawings and they comply with assumptions used to develop the steel deck calculation.".

e) The Contractor shall have reviewed and approved the shop drawings prior to submission to the Design Professionals for their review, representing that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog number and similar data with respect thereto and reviewed or coordinated each drawing and sample with the work of other trades and with the requirements of the project and the Contract Documents.

3. **Manufacturer's Certification:** Submit for record a letter of certification from the deck manufacturer stating that the design, the detailing and fabrication of the steel

deck to be installed under this Section are in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks.

4. **Manufacturer's Installation Instructions:** Submit for record Manufacturer's literature providing recommended installation instructions.

5. **Welder Certifications:** Submit for record welder certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

6. **LEED Submittals:**

   a) See Section 01 35 36 "LEED Requirements" for additional LEED requirements.

   b) Credit MR 4.1, 4.2 - Recycled Content – roof deck, composite deck:

      i. Indicate recycled content; indicate percentage of pre-consumer and post-consumer recycled content per unit of product.

      ii. Indicate relative dollar value of recycled content product to total dollar value of product included in project.

      iii. See Section 01 35 36 "LEED Requirements" for additional LEED requirements.

   c) Credit MR 5.1, 5.2 - Local/Regional Materials – roof deck, composite deck:

      (i) Extraction, processing and manufacturing (fabrication) facilities location(s): Indicate location of manufacturing (fabrication) facility; indicate distance between manufacturing facility and the project site.

      (ii) Product Value: Indicate dollar value of product containing local/regional materials; include materials cost only.

      (iii) Product Component(s) Value: Where product components are sourced or manufactured in separate locations, provide location information for each component. Indicate the percentage by weight of each component per unit of product.

   d) Credit EQ 4.2: VOC

      (i) Submit Product Data and material safety data sheets stating compliance with VOC limits for field applied primers and paints. Refer to Section 01 35 36 "LEED Requirements" for additional requirements.

B. Submittal Process: See Division 1 and Section 05 10 00

C. SER Submittal Review: See Division 1 and Section 05 10 00

D. Substitution Request: See Division 1

E. Request for Information (RFI): See Division 1

1.7 COORDINATION AND TEMPORARY SUPPORT

A. Consult and cooperate with Contractors for other trades whose work affects or is affected by work under this Section in order that all phases of the work are properly coordinated to avoid delays, errors, omissions, or damage to any part of the work.

B. Steel Deck Contractor shall inform General Contractor of any special support requirements such as shoring of deck for wet concrete loads.

C. General Contractor shall coordinate with Steel Deck Contractor regarding any construction loads on deck before concreting, and on completed deck in excess of the design loads shown. Such conditions may include both gravity and lateral loads.

1.8 STORAGE AND DELIVERY

A. Do not bend or mar decking.

B. Store off ground with one end elevated for drainage.

C. Cover decking with waterproof material, ventilated to avoid condensation.

D. Do not store deck bundles on framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

1.9 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

A. See Section 05 10 00

1.10 QUALITY ASSURANCE BY LABORATORY'S TESTING AGENCY

A. Laboratory's Testing & Inspection Agency ("Testing Agency"):

1. Reports: The Testing Agency shall include in the daily reports of the structural steel, steel deck progress and description/area of work, tests made and results.

2. Coordination: The Contractor shall have sole responsibility for coordinating his work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and/or Public Agencies, are properly provided. The Contractor shall cooperate fully with the Testing Agency in the performance of their work.

3. Cost: Except as specifically noted otherwise, the Testing Agency shall be engaged and paid by Laboratory.

B. Decking is subject to inspection and testing once connected in place:

1. Expense of removing and replacing any portion of decking for testing purposes will be borne by Laboratory if connections are found to be satisfactory.

2. Contractor shall remove work found to be defective and provide acceptable work at

no additional cost to Laboratory.

C. Field Inspection:

1. All steel deck shall be inspected after erection to ascertain the following relative to approved shop drawings:

   a) Deck profile, type (acoustic, cellular, vented), gage and finish

   b) Deck orientation, alignment, bearing and laps (if applicable)

   c) Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members

   d) Damage of members during transportation, storage and erection

   e) Installation for proper erection

   f) Connections (for quantity, size and spacing, and quality of welds) including continuous inspection of deck welding

2. Headed studs (shear connectors):

   a) At the start of each day's operations for attaching headed studs, the Contractor shall first weld a minimum of two studs to demonstrate proper welding set up for that day's typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.

   b) Should failure occur in the weld zone of either stud, Contractor shall adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.

   c) Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.

   d) Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.

   e) Failed test studs shall be removed and replaced by production studs.

   f) During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 05 10 00.

D. Testing Agency Reports & Certifications:

1. Indicate to the Contractor where remedial work must be performed. Track and retest all locations of remedial work.

2. Upon completion of work and resolution of remedial items, certify in a letter to the

Design Professionals and Laboratory that the installation is in accordance with the design and specification requirements (including applicable codes).

1.11 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Contractor shall immediately report to the Design Professionals any defects in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall submit proposed corrective actions and recommendations in writing for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Laboratory, the Contractor shall correct the deficiency at no cost to Laboratory.

C. Laboratory's general review during construction and activities of the Testing Agency is undertaken to inform Laboratory of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Review: The Design Professionals will observe the construction for general compliance with the provisions of the contract Documents during various phases of construction.

B. Should additional work and/or visits be required which are necessitated by failure of the Contractor to perform his work in accordance with the Contract Documents the Contractor shall bear the cost of such in accordance with the Division 1 Specifications and specification section 05 10 00.

1.13 WARRANTIES

A. Warranty: Upon completion of all work to be performed under this Contract, the Contractor shall execute and deliver in a satisfactory form a warranty that all workmanship and materials used in the performance of this Contract shall remain free from defects for a period of one (1) year from the date of execution of the Warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. The work specified herein is based on the products of Vulcraft, in order to establish design quality and function in the installed work. Products of other manufacturers shall be subject to the approval of the Design Professionals. All steel deck units shall be of the same depth and profile as shown on the drawings and the product of one manufacturer.

B. Steel deck and accessories shall be produced in the United States.

2.2 DESIGN

A. Section properties of the steel deck units shall be calculated in accordance with the AISI "Specification for the Design of Cold-Formed Steel Structural Members", latest edition. The minimum positive and negative section moduli so obtained shall be used in calculations involving positive and negative moments, respectively, in determining the required gauges of steel deck units.

B. Where indicated on drawings or Structural General Notes, the Contractor's Engineer shall design the steel deck using the load criteria shown on the drawings and the design criteria specified herein.

C. The Contractor's Engineer shall be responsible for determining the suitability of single, double and multiple span lengths of decking for analysis under service and construction conditions.

D. Design of steel deck not receiving concrete fill:

1. Resist design loads using bare steel deck properties. Consider both construction loads and specified loads.

2. Use three span continuous layouts wherever possible.

E. Design of steel deck to receive concrete fill

1. Manufacture to work compositely with the concrete fill, unless otherwise specifically noted in the Contract Documents as 'form deck.'

2. Assume deck acts with hardened concrete in a simple-span mode unless otherwise specifically noted on the Contract Documents.

3. Resist superimposed dead and live loads indicated on drawings, but not less than 150 psf superimposed load on composite slab.

4. Resist construction loads using bare steel deck properties.

5. Assume unshored construction unless shoring is specifically coordinated with the General Contractor prior to design.

6. Use three span continuous layouts wherever possible.

F. At spans where trenches cross steel deck, design the interrupted deck ends as noncomposite cantilevers capable of supporting a superimposed dead and live load of 150 psf excluding concrete fill, unless greater load capacity is required by the Contract Documents. Increased deck gauge may be necessary to satisfy this loading condition.

2.3 MATERIALS

A. Galvanized Steel: roof steel deck, floor galvanized steel deck and all closures and flashings shall be formed from steel sheets conforming to ASTM A653, Structural Quality Grade 33 (minimum) with minimum yield strength of 33 ksi. Before forming,

the steel sheet shall be coated with a zinc coating conforming to ASTM A653 Zinc coated per ASTM A653 G60. Exposed to view deck will be painted.

B. Floor decking shall be formed with integral locking lugs or embossments to provide a mechanical lock between the steel floor and the concrete slab sufficient to resist at least twice the design shear force. Minimum depth of embossments or locking lugs shall be .050".

C. All steel decking shall be roll formed for uniformity in dimension and strength.

D. Floor and roof decking shall be classified by Underwriters' Laboratories, Inc. Each unit or bundle shall be labeled and marked as required by UL, indicating manufacturer, testing, and inspection.

2.4 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter.

C. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated, but not less than the deck gauge.

D. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

E. Hanger Tabs: Manufacturer's standard UL rated piercing steel sheet hanger attachment devices for floor deck panels.

F. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch thick minimum, of same material as deck panels, with 1-1/2-inch minimum deep level recessed pans and 3-inch wide flanges. Cut holes for drains in the field.

G. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071" thick minimum units, of same material as deck panels.

H. Miscellaneous Roof Deck Accessories: Steel sheet ridge and valley plates, finish strips, and reinforcing channels, of same material and thickness as roof deck unless otherwise indicated.

I. Headed Studs (shear connectors) shall be per Structural General Notes.

J. Steel Sheet Accessories: ASTM A 653, galvanized to G 90 coating class.

K. Galvanizing Repair Paint: SSPC Paint 20 or MIL-P-21035, with dry film containing a minimum of 94% zinc dust by weight.

L. Flexible Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

2.5 SIDE JOINT HANGER SYSTEM FOR USE IN COMPOSITE STEEL FLOOR DECK ONLY

A. Provide hanger tabs along the side joints of units at 1'-0" (300mm) centers.

B. Side joint hanger tabs shall have a minimum allowable static load capacity of at least 100 lbs (45kg). and shall accommodate a flat bar hanger (no rod hangars).

C. All hangers, their installation, and tab activation shall be by trades requiring the tabs.

D. No plastered ceilings shall be hung from side joint hanger tabs.

E. No mechanical, electrical, plumbing or fire protection loads shall be hung from deck side joint hanger tabs.

2.6 MISCELLANEOUS MATERIALS

A. Arc-Welding Electrodes: AWS A5.1 E60XX or E70XX Series, as required for the conditions of use.

B. Touch Up Paint: use galvanized repair paint specified above.

C. Closure Tape as required to maintain cells clear of concrete at abutting panel ends.

2.7 LEED REQUIREMENTS

A. LEED Credit MR 5.1, 5.2: : Extraction, processing and manufacturing (fabrication) facilities (as applicable) should be within 500 miles of project site.

B. LEED Credit MR 4.1, 4.2: Recycled content: Minimum 50 percent post- consumer recycled content.

PART 3 - EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section, especially plan and elevation locations of supporting frames and walls. Report any defects affecting installation to Design Professionals. The Contractor alone shall be responsible for checking the dimensions and coordination of the steel deck work with other trades.

B. Do not place deck units on supports with debris or unapproved coatings that could affect full, level bearing and proper connections.

C. Do not place deck units on concrete supporting structures until concrete has cured and is dry.

D. Coordinate the location of decking bundles with a structural steel erector to prevent overloading of structural members.

3.2 ERECTION – PLACEMENT

A. Erect steel deck in accordance with the decking manufacturer's recommendations and the requirements of the drawings and these specifications.

B. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.

C. Place deck units flat, square, without warping or excessive deflections, in straight alignment for entire length of run of cells and with close alignment between the cells at ends of abutting units.

D. Abutting ends of deck panels shall occur over supports. End bearing shall be a minimum of 2 inches, or greater if required (web crippling) by deck manufacturer.

E. Where deck panels nest, laps shall be a minimum of 2" and shall occur over supports. Nesting is permitted only where profiles are designed to nest and are fabricated with offset ends.

F. Install slab edge closures and pour stops at the theoretical position with maximum tolerance of + 3/8"). Closures and pour stops shall have adequate adjustments to maintain this tolerance while accommodating the structural steel frame tolerances.

3.3 ERECTION - CONNECTIONS

A. Connect steel deck to the steel framework at ends of units and at intermediate supports as shown on the Contract Documents and approved shop drawings.

B. Deck to support welds shall be puddle welds of diameter and spacing shown on Contract Documents and/or approved shop drawings.

C. Where headed studs occur, if fused to deck for full weld perimeter each headed stud may be considered to replace one puddle weld

D. Fasten side laps and perimeter edges of panels between supports by button punching, side seam welding or screws, or as noted on construction drawings.

3.4 ERECTION – OPENINGS AND CLOSURES

A. Contractor to coordinate location of all openings with other trades (see Submittals).

B. Cut and install sleeves and holes through decking for openings indicated on the Architectural, Structural, and/or Mechanical-Electrical-Plumbing-Fire Protection Drawings. Cost shall be paid by the trade requiring such sleeves and holes. Sleeves will be furnished by the various trades requiring them. Provide and install reinforcement as required around sleeves. Where possible, leave deck intact and use block outs to hold back concrete at openings. Cut deck after concrete cures.

C. Provide miscellaneous headers and other steel reinforcing and supports welded to decking and structural steel as required at penetrations, around columns, etc. per typical

details and manufacturer's recommendations.

D. Field cutting parallel to flutes shall be done in the low flutes, taking care to leave sufficient horizontal material to permit satisfactory welding of deck to supporting steel.

E. Openings required for work of other trades and not indicated on Architectural, Structural, Mechanical / Electrical / Plumbing / Fire Protection / Telecom Drawings shall be permitted only upon approval of the Design Professionals as to size and location.

F. Furnish and install tight-fitting closures at locations including but not limited to

1. open ends of flutes and sides of decking (neoprene or sheet steel)
2. open ends of all flutes at columns, walls and openings shown on Contract Drawings
3. panel ends where panels change direction or abut (sheet steel or closure tape)
4. between deck units and columns (sheet steel)
5. between columns and exterior cladding (sheet steel)
6. welding hole cover, with friction fastening, to close excess holes when required (sheet steel).

3.5 WELDING

A. Welding of steel deck shall follow the technique outlined by the steel deck manufacturer.

B. Welding of headed studs shall conform to all AWS requirements, including workmanship, quality control, and inspection, which shall be performed by the Contractor and observed by Laboratory's testing agency.

3.6 ROOF SUMP PANS

A. Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches o.c. with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size shown, coordinate with Plumbing drawings.

3.7 CONCRETE PLACEMENT

A. Concrete with admixtures containing chloride salts or other deleterious materials shall not be used with steel deck.

B. Steel deck used to support concrete buggy runways shall be adequately protected against wheel damage. Decking and any runways or shoring shall be evaluated and designed by Contractor's Engineer.

3.8 TOUCH-UP

A. After installation touch-up welds on galvanized decking with specified galvanized repair

paint to a dry film thickness of 2 mils, at all locations that will not receive concrete fill.

B. Touch-Up Painting: Where exposed to view, wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.

2. Where shop-painted surfaces are exposed in-service, apply touch-up paint to blend into adjacent surfaces.

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SECTION 05 40 00

COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.

B. Related Sections include the following:
   1. Section 05 50 00 "Metal Fabrications" for masonry shelf angles and connections.
   2. Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated on the Drawings.
   2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).
   3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of 1/2 inch.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
   3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work. All shop drawings shall be sealed by the qualified professional engineer responsible for their preparation.

D. Delegated-Design Submittal:
   1. For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified structural engineer in the state of Illinois responsible for their preparation.
   2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.
   3. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified structural engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For structural engineer.

B. Welding certificates.

C. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Horizontal drift deflection clips
   7. Miscellaneous structural clips and accessories.

D. Research/Evaluation Reports: For cold-formed metal framing.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified structural engineer.

B. Structural Engineer Qualifications: A structural engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency, or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. Welding: Qualify procedures and personnel according to AWS D1.1 (D1.1M), "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

F. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Comply with AISI's "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Clark Steel Framing.
   2. Dale/Incor.
   3. Dietrich Metal Framing; a Worthington Industries Company.
   4. MarinoWare; a division of Ware Industries.
   5. United Metal Products, Inc.
   6. Unimast Inc.

2.2 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Steel Sheet: ASTM A 1003 (A 1003M), Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90 (Z275) or equivalent.

C. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653 (A 653M), structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G90 (Z275).

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   2. Flange Width: 1-5/8 inches (41 mm).

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch (20 gauge).
   2. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dietrich Metal Framing; a Worthington Industries Company.
      b. MarinoWare, a division of Ware Industries.
      c. SCAFCO Corporation
      d. The Steel Network, Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
   2. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
   1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
      a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
      b. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
   2. Inner Track: Of web depth indicated, and as follows:
      a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
      b. Flange Width: 2 inch (50mm)

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003 (A 1003M), Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   6. Foundation clips.

7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36 (A 36M), zinc coated by hot-dip process according to ASTM A 123 (A 123M).

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load in accordance with ACI 318 Appendix D, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.7 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 “Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Install single-leg deflection tracks and anchor to building structure.
   2. Install double deep-leg deflection tracks and anchor outer track to building structure.
   3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
   4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   a. Install solid blocking at centers indicated.
2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Elevator machine beams, hoist beams,.
   2. Steel shapes for supporting elevator door sills.
   3. Shelf angles.
   4. Metal ladders.
   5. Metal bollards.
      a. Wired aluminum bollards
   6. Diamond panel wainscoting
   7. Miscellaneous steel trim including steel edgings loading-dock edge angles.
   8. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section:
   1. Loose steel lintels.

C. Related Sections:
   1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
   2. Section 04 20 00 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
   3. Section 05 51 00 "Metal Stairs."
   4. Section 07 72 00 “Roof Accessories” for roof hatch and floor access safety railing assemblies.
   5. Section 08 31 13 “Access Door and Frame” for floor hatch assembly details.
   6. Division 26 “General Electrical Requirements” for wiring and related electrical connection coordination requirements.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Aluminum Ladders: Aluminum ladders[, including landings,] shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Grout.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Aluminum bollards: include the plans and details for each type of wired device to be installed in the aluminum bollards.
   a. Include the wiring details from the location of the bollard to the panel or wiring branch to which it will be connected in this submittal

D. Samples for Verification: For each type and finish of extruded material.

E. Delegated-Design Submittal:
1. For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer in the state of Illinois responsible for their preparation.
2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional structural engineer in the state of Illinois.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages and wired electrical components.
   1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
   2. Furnish setting drawings, templates, and directions for installing wired devices, including inserts, bolts, wiring, and items with integral gasketing and electrical connections, that are to be installed in aluminum bollard tubing.
   3. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

2.3 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
   1. Diamond pattern at wainscot areas

B. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

C. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
   1. Provide stainless-steel fasteners for fastening aluminum.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, GradeC3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 2.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3.

G. Lag Screws: ASME B18.2.1.

H. Wood Screws: Flat head, ASME B18.6.1.

I. Plain Washers: Round, ASME B18.22.1.

J. Lock Washers: Helical, spring type, ASME B18.21.1.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. VOC Limits for Installation Adhesives: Use products that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Multipurpose Construction Adhesives: 70 g/L.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Nonshrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
   1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with where indicated.

2.8 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. Galvanize shelf angles located in exterior walls.

2.9 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3 unless otherwise indicated.
   2. For elevator pit ladders, comply with ASME A17.1.

B. Steel Ladders:
   1. Space siderails 16 inches apart unless otherwise indicated.
   2. Space siderails of elevator pit ladders 12 inches apart.
   3. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
   4. Rungs: 3/4-inch diameter or 3/4-inch square steel bars.
   5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
   7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
   8. Galvanize exterior ladders, including brackets and fasteners.

2.10 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
   1. Fabricate ships' ladders, including railings from steel.
   2. Fabricate treads from rolled-steel floor plate.

B. Galvanize steel ships' ladders, including treads, railings, brackets, and fasteners.

C. Prime steel ships' ladders , including treads, railings, brackets, and fasteners, with

2.11 LADDER SAFETY CAGES

A. General:
   1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
   2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
   3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:
   1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
   2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
   3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.
   4. Galvanize ladder safety cages, including brackets and fasteners.
   5. Prime ladder safety cages, including brackets and fasteners, with zinc-rich primer.

2.12 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor plate of thickness indicated below:
   1. Thickness: As indicated.

B. Provide steel angle supports as indicated.

2.13 METAL BOLLARDS (“PIPE BUMPERS”)

A. Fabricate metal bollards from Schedule 40 steel pipe.
   1. Except as otherwise indicated:
      a. Size: 6 inch nominal diameter
      b. Length: 7 ft

c. Embedment: 3 ft 6 in
d. Installation method: Direct embedment

B. Fabricate sleeves for bollard anchorage from steel pipe with 1/4-inch- thick steel plate welded to bottom of sleeve. Make sleeves not less than 8 inches deep and 3/4 inch larger than OD of bollard.

C. Prime bollards with zinc-rich primer.

2.14 ALUMINUM BOLLARDS (WIRED)

A. Fabricate metal bollards from Aluminum square tubing ASTM B 221, Alloy 6063-T6.
1. Except as otherwise indicated:
a. Size: 6 inch nominal square
b. Length: 4 ft
c. Anchor Embedment: minimum 8 in
d. Installation method: Attached to embedded steel anchors
2. Cap bollards with 1/4-inch- thick aluminum plate attached with counter sunk ¾ inch stainless steel fasteners to match fasteners attaching tube to anchor.
3. Where bollards are indicated to receive controls for light fixtures, door operators or other control devices, provide necessary cutouts for controls and holes for wire.

B. Finish: Class I, Clear Anodic Finish: AA-M12C22A41 (Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

C. Fabricate anchor sleeves for bollards from 1/4-inch wall-thickness tubing with an OD approximately 1/16 inch less than ID of bollards. Match drill sleeve and bollard for 3/4 inch stainless steel machine bolt.

2.15 ALUMINUM DIAMOND PLATE WAINSCOTING

A. Provide aluminum diamond pattern wainscoting to interior walls adjacent to the loading dock and where indicated in the Drawings.
1. Thickness: 1/8 inch
2. Size: 5 foot from floor elevation
3. Provide 6 inch aluminum wall base and 4 inch corner protection with same pattern and finish as the wall panel.
4. Aluminum Finish: Dull mill

2.16 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.17 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

2.18 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.19 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.20 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING METAL BOLLARDS (PIPE BUMPERS)

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
   1. Do not fill removable bollards with concrete.

B. Anchor bollards in concrete in formed or core-drilled holes not less than 8 inches deep and 3/4 inch larger than OD of bollard. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING ALUMINUM BOLLARDS

A. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with nonshrink, nonmetallic grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard in all exterior locations and flush with the floor finish for all interior locations.

3.5 INSTALLING ALUMINUM DIAMOND PLATE WAINSCOTING

A. Adhere and mechanically fasten aluminum plate to wall using multipurpose construction adhesive attaching wainscoting to gypsum wall and stainless steel mechanical fasteners at metal stud locations.
   1. Edges of wall panel to be finished a described in general fabrication article
      a. Refer to Division 07 Sealant section for polyurethane sealers for edges and seams.
   2. Aluminum wall base to be adhered and mechanically fastened.
   3. Corner protection to be adhered and mechanically fastened.
   4. Coordinate extent of placement of aluminum wainscoting with Architect unless indicated on the Drawings.
   5. Protect surface and finish of wainscoting until Substantial Completion.

3.6 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

END OF SECTION

SECTION 05 51 00

METAL STAIRS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Preassembled steel stairs with concrete-filled treads.
2. Steel tube railings attached to metal stairs.
3. Steel tube handrails attached to walls adjacent to metal stairs and ramps.
4. Rails and guardrails at loading dock.

B. Related Sections:
1. Section 03 30 00 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 05 50 00 "Metal Fabrications" for metal treads and nosings installed at locations other than in metal stairs.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design:
1. For metal stairs indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer in the state of Illinois responsible for their preparation.
2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..

b. Infill load and other loads need not be assumed to act concurrently.

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:
1. Prefilled metal-pan stair treads.
2. Abrasive nosings.
3. Grout.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:
1. Abrasive nosings.

E. Delegated-Design Submittal:
1. For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer in the state of Illinois responsible for their preparation.
2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer .

B. Welding certificates.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for railings.
1. Test railings according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.
1. Preassembled Stairs: class.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Wire Rod for Grating Crossbars: ASTM A 510.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating, either commercial steel, Type B, or structural steel, Grade 33, unless another grade is required by design loads.

2.3 NONFERROUS METALS

A. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 ABRASIVE NOSINGS

A. Cast-Metal Units: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
1. Configuration: Cross-hatched units, 3 inches wide without lip.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

D. Apply clear lacquer to concealed surfaces of extruded units set into concrete.

2.5 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.

D. Machine Screws: ASME B18.6.3.

E. Lag Screws: ASME B18.2.1.

F. Plain Washers: Round, ASME B18.22.1.

G. Lock Washers: Helical, spring type, ASME B18.21.1.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 2 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Concrete Materials and Properties: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

F. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused,

aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

2.7 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.8 STEEL-FRAMED STAIRS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alfab, Inc.
   2. American Stair, Inc.
   3. Sharon Companies Ltd. (The).

B. Stair Framing:
   1. Fabricate stringers of steel plates or channels.
      a. Provide closures for exposed ends of channel stringers.
   2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
   3. Weld stringers to headers; weld framing members to stringers and headers.
   4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
   5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch.
   1. Directly weld metal pans to stringers; locate welds on top of subtreads where they will be concealed by concrete fill. Do not weld risers to stringers.
   2. Shape metal pans to include nosing integral with riser.
   3. Attach abrasive nosings to risers.
   4. At Contractor's option, provide stair assemblies with metal-pan subtreads filled with reinforced concrete during fabrication.
   5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.
      a. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.9 STAIR RAILINGS

A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
   1. Rails and Posts: 1-5/8-inch- diameter top and bottom rails and 1-1/2-inch- square posts.
   2. Picket Infill: 1/2-inch- square pickets spaced less than 4 inches clear.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

C. Form changes in direction of railings as follows:

D. Close exposed ends of railing members with prefabricated end fittings.

E. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
   1. Connect posts to stair framing by direct welding unless otherwise indicated.
   2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

2.10 GUARD RAILINGS

A. Steel Guard Railings, Basis of Design: Tufguard Modular Safety Guard Railing by Allied Modular Building Systems, Inc.
   1. Post and rail modular system with steel base
   2. Material: 10 gauge corrugated steel
   3. Dimension: as Indicated on the drawings
   4. Finish: Powder Coat, Standard Safety Yellow

2.11 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed products:

E. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   1. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 033000 "Cast-in-Place Concrete."
   1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

3.2 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 05 53 00

METAL GRATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Metal bar gratings.
2. Metal frames and supports for gratings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design gratings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
1. Floors: Uniform load of 250 lbf/sq. ft. (11.97 kN/sq. m) or concentrated load of 3000 lbf (13.40 kN), whichever produces the greater stress.
2. Limit deflection to L/240 or 1/4 inch (6.4 mm), whichever is less.

C. Seismic Performance: Provide gratings capable of withstanding the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Clips and anchorage devices for gratings.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual."

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for gratings, grating frames, and supports. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

D. Wire Rod for Bar Grating Crossbars: ASTM A 510 (ASTM A 510M).

E. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30 (Grade 205).

F. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230), with G90 (Z275) coating.

2.2 FASTENERS

A. General: Unless otherwise indicated, zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

D. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

E. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

F. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.

2.3 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy that is welded.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.
1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Fabricate toeplates for attaching in the field.
3. Toeplate Height: 4 inches (100 mm) unless otherwise indicated.

2.5 METAL BAR GRATINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alabama Metal Industries Corporation; a Gibraltar Industries company.
2. All American Grating.
3. BarnettBates Corporation.
4. Borden Metal Products (Canada) Limited.
5. Fisher & Ludlow; Division of Harris Steel Limited.
6. Grating Pacific, Inc.
7. IKG Industries; a division of Harsco Corporation.
8. Marwas Steel Co.; Laurel Steel Products Division.
9. Ohio Gratings, Inc.
10. Seidelhuber Metal Products; Division of Brodhead Steel Products.

B. Welded Steel Grating:
1. Grating Mark W-15-4 (1 x 1/8) STEEL: 1-by-1/8-inch (25-by-3.2-mm) bearing bars at 15/16 inch (24 mm) o.c., and crossbars at 4 inches (102 mm) o.c.
2. Grating Mark: As indicated.
3. Traffic Surface: Plain.
4. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. (550 g/sq. m) of coated surface.

C. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.
1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

D. Do not notch bearing bars at supports to maintain elevation.

2.6 GRATING FRAMES AND SUPPORTS

A. Frames and Supports for Metal Gratings: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.
1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches (600 mm) o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long.

B. Galvanize steel frames and supports in the following locations:

1. Interior, where indicated.

2.7 STEEL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish gratings, frames, and supports after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing gratings to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.
1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

3.3 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 05 70 00

DECORATIVE METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Stainless steel supports for lavatory counter
2. Miscellaneous metal for millwork counters

B. Related Sections:
1. Section 05 50 00 "Metal Fabrications" for non-decorative metal fabrications.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including finishing materials.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Product Data for Credit IEQ 4.2: For Paints and Coatings, documentation including printed statement of VOC content.

C. Shop Drawings: Show fabrication and installation details for decorative metal.
1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Patterns, Models, or Plaster Castings: Made from proposed patterns for each design of custom casting required.

E. Samples for Initial Selection: For products involving selection of color, texture, or design.

F. Samples for Verification: For each type of exposed finish required.
1. Sections of linear shapes.
2. Full-size Samples of castings and forgings.
   a. For custom castings, submit finished Samples showing ability to reproduce detail, cast-metal color, and quality of finish.
3. Samples of welded and brazed joints showing quality of workmanship and color matching of materials.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified organic-coating applicator.

B. Mill Certificates: Signed by manufacturers of stainless-steel certifying that products furnished comply with requirements.

C. Welding certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Organic-Coating Applicator Qualifications: A firm experienced in successfully applying organic coatings, of type indicated, to aluminum extrusions and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

C. Anodic Finisher Qualifications: A firm experienced in successfully applying anodic finishes of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

D. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3, "Structural Welding Code - Sheet Steel."

F. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. Provide materials without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

2.2 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

2.3 STAINLESS STEEL

A. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304, No. 4 finish, unless otherwise specified.

2.4 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:
1. Aluminum Items: Aluminum fasteners.
2. Stainless-Steel Items: Type 304 stainless-steel fasteners.
3. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
4. Galvanized-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
5. Dissimilar Metals: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless exposed fasteners are unavoidable.
1. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion type or chemical type.
1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
1. For aluminum, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Brazing Rods: For copper alloys, provide type and alloy as recommended by producer of metal to be brazed and as required for color match, strength, and compatibility in fabricated items.

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

F. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
   1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

H. Shop Primer for Galvanized Steel: Water-based galvanized metal primer complying with MPI#134.

I. Intermediate Coats and Topcoats for Steel: Provide products that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.6 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

C. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

E. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

G. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

H. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

I. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

J. Comply with AWS for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.
   1. Where welding and brazing cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

K. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish: Three -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
   1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

F. Field Brazing: Comply with requirements for brazing and for finishing brazed connections in "Fabrication, General" Article. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.

G. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.3 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART - 1. GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Lumber.
2. Softwood plywood.
3. Rough hardware.
4. Blocking, nailers, furring and grounds.

1.3 RELATED WORK

A. Specified Elsewhere:
1. 09 29 00 - Gypsum Board.

1.4 SUBMITTALS

A. Product Data:
1. Include location(s) of product manufacture.
2. Include FSC certification of sustainably harvested wood.

B. LEED Submittals:
1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
3. Product Data for Credit IEQ 4.4: For composite wood products, documentation indicating that product contains no urea formaldehyde.

1.5 SYSTEM REQUIREMENTS

A. Design Requirements:
1. Grading:
   a. Furnish each piece of lumber factory-marked with official grade stamp of inspection agency, identifying grading agency, grade, species, and moisture content at time of surfacing, and mill.
   b. For lumber which will be exposed to view in completed Work furnish grade stamps applied to back or ends of each piece, or omit grade stamps entirely and submit certificates of grade compliance issued by inspection agency.
2. Sizes: Provide finish sizes in accordance with U. S. Product Standard PS 20, “American Softwood Lumber Standard”; dressed lumber, S4S.

B. Interface with Other Systems:
1. Coordinate with Work of other trades affected by Work of this Section.
2. Provide items, such as anchors or supports, in a timely manner so as not to delay job progress.
3. Correlate location of furring, nailers, blocking, grounds and similar supports to allow attachment of other Work.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable requirements of authorities having jurisdiction over Work.

B. Reference Standards: Except as modified by governing code, comply with requirements of specified lumber inspection bureau of association.

C. Certifications:
1. Provide certification from composite wood panel manufacturer that binding resins in plywood used within the building are free of urea-formaldehyde.
2. Provide certification from adhesive manufacturer that each specified adhesive meets or exceeds requirements for VOC content.

1.7 DELIVERY, STORAGE AND HANDLING

A. Storage:
1. Keep rough carpentry materials dry until finish is applied and building is enclosed.
2. Provide air circulation in stacks of lumber and plywood. For pressure preservative treated wood, place spacers between each bundle to provide air circulation.

PART - 2. PRODUCTS

2.1 MATERIALS

A. Wood Materials, General:
1. Provide products manufactured within a 500-mile radium of the project site.
2. Wood components shall be FSC-certified as originating from a sustainably harvested forestry operation.

B. Lumber, General:
1. Type: Sound, thoroughly seasoned, well manufactured and free from warp that cannot be corrected in process of bridging or nailing.
2. Use same species for members in any one assembly.
3. Seasoning: Season lumber two inches (50 mm) and less in thickness to moisture content of 19 percent or less, with indication of “S-Dry” on grade stamp.
4. Grades for framing materials: Conform to grading rules of manufacturer’s association for specie of wood being used.

C. Softwood Lumber for Concealed Locations:
1. Light framing (sizes 2 inches to 4 inches thick and 2 inches to 4 inches wide) (sizes 50 mm to 100 mm thick and 50 mm to 100 mm wide):
   a. Douglas FirLarch or HemFir; WWPA Construction or Standard.
2. Furring, cant strips, blocking, nailers, plates, grounds: Same material as light framing except utility grade is acceptable.

D. Plywood:

1. Provide panels bearing APA grade-trademark.
2. Panels for general interior utility use not otherwise specified: APA EXT B-B where both sides are exposed; APA EXT B-C where one side is exposed.
3. Equipment mounting panels: APA C-D Plugged, Exposure 1; fire-retardant treated; ¾ inch (19 mm) thick, unless otherwise indicated.
4. Roof sheathing: APA Rated Sheathing, Exposure 1, span rating as required for indicated use.
5. For fire-retardant treated APA Rated plywood, apply allowable stress reduction factors as recommended by APA, and manufacturer and applicator of fire-retardant treatment.
6. Binding resins in plywood used within the building interior shall be free of urea-formaldehyde.

2.2 ACCESSORIES

A. Rough Hardware:
1. General:
   a. Provide fasteners of type, material, finish and quantity required for proper installation of carpentry, millwork and other specified items; and where necessary to coordinate, secure and complete Work.
   b. Provide in sizes to rigidly secure and support members in place.
   c. Where Work to be fastened is exposed to weather, high moisture conditions, in ground contact, or in contact with concrete, masonry or pressure-treated lumber, provide fasteners galvanized in accordance with ASTM A153, or of Type 304 stainless steel.
   d. Where fasteners of less than 1/2-inch diameter are used in conjunction with pressure preservative treated lumber, provide fasteners of Type 304 stainless steel.
2. Nails, wire, brads, and staples: FS FF-N-105.
3. Power-driven fasteners: CABO NER-272.
4. Wood screws: ASME B18.6.1.
5. Lag bolts: ASME B18.2.1.
6. Bolts, nuts and washers:
   a. Steel bolts:
   b. Nuts: ASTM A563 hex huts and flat washers.

B. Adhesives: field-applied adhesives used within the building interior shall have a VOC (volatile organic compound) content not to exceed 30 g/L for wood substrates.

PART - 3. EXECUTION

3.1 EXAMINATION

A. Examine substrates and adjoining construction, and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Installing Rough Carpentry:
1. Lay out work carefully
2. Cut material to fit; level, plumb and brace to hold wood in proper position; drive nails and spikes home; pull bolt nuts tight with heads and washers in close contact with Work.
3. Avoid shims and wedges. Do not shim framing components.
4. Fasten Work securely in place.
5. Frame openings and provide blocking for Work of other trades.
6. Erection tolerances: If framing members receive finish surface, align finish subsurface to vary not more than 1/8 inch (3 mm) from plane of surfaces of adjacent furring and framing members.
7. Blocking:

a. Install wood blocking, nailers and furring in partitions, located as required for wall-hung cabinetry and other wall-hung items, whether or not such blocking, nailers and furring are indicated on Drawings.
b. Coordination with 09 29 00 - Gypsum Board.

B. Sorting:
1. Sort framing material to suit placement so that permitted defects will have least detrimental effect on stability of Work.
2. Avoid large or unsound knots at connections.
3. Use straight material at corners.
4. Set horizontal and sloped members with crown up.

C. Installing Plywood: Conform to recommendations of APA.

3.3 WASTE MANAGEMENT

A. Recycle clean (unpainted, untreated) waste wood materials in accordance with Division 01 Construction Waste Management requirements.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Wall sheathing.
2. Sheathing joint and penetration treatment.

B. Related Requirements:
1. Division 06 "Rough Carpentry" for plywood backing panels.
2. Division 07 "Weather Barriers" for water-resistive barrier applied over wall sheathing.
3. Division 07 “Metal Wall Panels” for insulated metal panel assemblies

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
1. Products: Subject to compliance with requirements, provide one of the following:
a. CertainTeed Corporation; GlasRoc.
b. G-P Gypsum Corporation; Dens-Glass Gold.
c. National Gypsum Company; Gold Bond e(2)XP.
d. United States Gypsum Co.; Securock.
2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.2 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
   1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C 1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
   1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:
   1. NES NER-272 for power-driven fasteners.
   2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
   3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

END OF SECTION

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SECTION 06 40 23

INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Interior Medium Density Fiberboard (Masonite) wall base and trim.

1.3 DEFINITIONS

A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction before woodwork installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
   3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
   4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   5. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

C. Samples for Initial Selection:
   1. Shop-applied opaque finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product, signed by product manufacturer.

1.6 QUALITY ASSURANCE

A. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to Finish Schedule included on Drawing Sheet A10.0.0 for additional wall base information and location.

B. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

C. Wood Products: Comply with the following:
1. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
2. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.

2.2 MISCELLANEOUS MATERIALS

A. Adhesives, General: Adhesives shall not contain urea formaldehyde.

B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. VOC Limits for Installation Adhesives: Installation adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Wood Glues: 30 g/L.
2. Multipurpose Construction Adhesives: 70 g/L.
3. Contact Adhesive: 250 g/L.

2.3 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom grade interior woodwork complying with referenced quality standard.

B. Fabricate woodwork to dimensions, profiles, and details indicated.

2.4 INTERIOR STANDING AND RUNNING TRIM FOR OPAQUE FINISH

A. Grade: Custom.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

B. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches (2400 mm) long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base if finished.

3.3 CLEANING

A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 06 41 13

WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Architectural wood cabinets.
2. Display case
3. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
4. Shop finishing of architectural wood cabinets.

B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Section 08 80 00 “Glazing” for tempered glass shelving.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, cabinet hardware, and accessories and finishing materials and processes.
1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
5. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural wood cabinets.
   4. Show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.

D. Samples for Initial Selection:
   1. Shop-applied transparent finishes.
   2. Shop-applied opaque finishes.
   3. PVC edge material.
   4. Thermoset decorative panels.
   5. Glass shelf

E. Samples for Verification:
   1. Lumber for transparent finish, not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
   2. Veneer leaves representative of and selected from flitches to be used for transparent-finished cabinets.
   3. Lumber and panel products with shop-applied opaque finish, 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color, with one-half of exposed surface finished.
   4. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
   5. Corner pieces as follows:
      a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
      b. Miter joints for standing trim.
   6. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For the following:
   1. Composite wood and agrifiber products.
   2. Thermoset decorative panels.
   3. Adhesives.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that wood-veneer-faced architectural cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET FABRICATORS

A. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of architectural wood cabinets with sequence-matched wood veneers wood paneling wood doors with face veneers that are sequence matched with woodwork and transparent-finished wood doors that are required to be of same species as woodwork.

2.2 ARCHITECTURAL WOOD CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural wood cabinets indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Custom.

B. Type of Construction: Frameless.

C. Cabinet and Door and Drawer Front Interface Style: Flush overlay.

D. Reveal Dimension: 1/2 inch.

E. Wood for Exposed Surfaces:
   1. Species: Curly maple (Dodge Veneers, Inc.; Log #614192).
   2. Cut: half round cut.
   3. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
   4. Matching of Veneer Leaves: Slip match.
   5. Veneer Matching within Panel Face: Balance match.
   6. Semiexposed Surfaces: Provide surface materials indicated below:
   7. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
      a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
   8. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, stained to match species indicated for exposed surfaces.
   9. Drawer Bottoms: Hardwood plywood.

F. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.4 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
   2. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
   2. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
   3. Softwood Plywood: DOC PS 1, medium-density overlay.

4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.
5. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.5 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:
1. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Wire Pulls: Basis of Design: model DP120A by Doug Mockett & Company, Inc.; Back mounted, solid aluminum, 5-19/32 inches long, 1-5/16 inches deep, square with anodized satin finish.
1. http://www.mockett.com/furniture-hardware/dp120a.html

D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
6. For computer keyboard shelves, provide Grade 1HD-100.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: Match adjacent door hardware.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

M. Display Case:
1. Brackets and Track:
   a. Bracket with C-Style tracks
   b. SH15 series by Doug Mockett;
      http://www.mockett.com/furniture-hardware/supports/shelf-supports/shelf-track-systems/sh15atrc6.html

2. Door Hardware:
   a. Refer to Division 08 Section “Door Hardware” for pivot hinge and closure hardware information and requirements.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Display Case Shelving and Doors:
   1. ½ inch clear tempered glass with polished and eased edges
   2. Refer to Division 08 section “Glazing” for additional information and requirements for glazing.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Corners of Cabinets: 1/16 inch unless otherwise indicated.

C. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 SHOP FINISHING

A. General: Finish architectural wood cabinets at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural wood cabinets, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

C. Transparent Finish:
   1. Grade: Custom.
   2. Finish: System - 11, catalyzed polyurethane.
   3. Staining: Match approved sample for color.
   4. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
   5. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
   6. Sheen: Semigloss, 46-60 gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
   1. For shop finished items use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Maintain veneer sequence matching of cabinets with transparent finish.
   3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.
   1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 06 41 16

PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Plastic-laminate-faced architectural cabinets.
2. Solid-surfacing-material countertops.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, solid-surfacing material, adhesive for bonding plastic laminate, fire-retardant-treated materials, and cabinet hardware, and accessories.
1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
3. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
5. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

C. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.

3. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.

D. Samples for Initial Selection:
1. Plastic laminates.
2. PVC edge material.
3. Thermoset decorative panels.
4. Solid-surfacing materials.

E. Samples for Verification:
1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.
2. Wood-grain plastic laminates, 12 by 24 inches, for each type, pattern and surface finish, with one sample applied to core material and specified edge material applied to one edge.
3. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
4. Solid-surfacing materials, 6 inches square.
5. Corner pieces as follows:
   a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.
6. Exposed cabinet hardware and accessories, one unit for each type and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:
1. Composite wood and agrifiber products.
2. Thermoset decorative panels.
3. High-pressure decorative laminate.
4. Adhesives.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Fabricator of products.

C. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Regional Materials: Plastic-laminate cabinets shall be manufactured within 500 miles of Project site.

D. Type of Construction: Frameless.

E. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

F. Reveal Dimension: 1/2 inch.

G. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Formica Corporation product indicated on Drawings or comparable product by one of the following:
      a. Abet Laminati, Inc.
      b. Lamin-Art, Inc.
      c. Panolam Industries International, Inc.
      d. Wilsonart International; Div. of Premark International, Inc.
      e. Refer to Finish Schedule on Drawings for Plastic Laminate Types PL-1 through PL-3.

H. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Postformed Surfaces: Grade HGP.
   3. Vertical Surfaces: Grade HGS.
   4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
   5. Pattern Direction: As indicated.

I. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
      a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
      b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
      c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
   2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
   3. Drawer Bottoms: Thermoset decorative panels.

J. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

K. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

L. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glued dovetail joints.

M. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by laminate manufacturer's designations.
   2. Match Architect's sample.
   3. As selected by Architect from laminate manufacturer's full range in the following categories:
      a. Solid colors, gloss finish.
      b. Solid colors with core same color as surface, gloss finish.
      c. Wood grains, gloss finish.
      d. Patterns, gloss finish.

N. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with ISSFA-2.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide LG Chemical, Ltd. or comparable product by one of the following:
      a. Avonite, Inc.
      b. E. I. du Pont de Nemours and Company.
      c. Formica Corporation.
      d. Nevamar Company, LLC; Decorative Products Div.
      e. Samsung; Cheil Industries Inc.
      f. Swan Corporation (The).
      g. Wilsonart International; Div. of Premark International, Inc.
   2. Type: Standard type, unless Special Purpose type is indicated.
   3. Colors and Patterns: Refer to Finish Schedule on Drawings.
      a. Solid Surface Types: SS-1 through SS-3.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

C. Medium-Density Fiberboard: ANSI A208.2, Grade 130.
   1. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
   2. Particleboard: Straw-based particleboard complying with requirements in ANSI A208.1, Grade M-2, except for density.
      a. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
   3. Softwood Plywood: DOC PS 1, medium-density overlay.
   4. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 71 11 "Door Hardware".

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch- thick metal, and as follows:
   1. Semiconcealed Hinges for Flush Doors: BHMA A156.9, B01361.
   2. Semiconcealed Hinges for Overlay Doors: BHMA A156.9, B01521.

C. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

D. Catches: Push-in magnetic catches, BHMA A156.9, B03131.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.

F. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

G. Drawer Slides: BHMA A156.9.
   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
   5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
   6. For computer keyboard shelves, provide Grade 1HD-100.
   7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-200.

H. Door Locks: BHMA A156.11, E07121.

I. Drawer Locks: BHMA A156.11, E07041.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Match adjacent door hardware finish and as indicated on the Door Hardware Schedule.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate cabinets to dimensions, profiles, and details indicated.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets' level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
   1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

G. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   2. Install countertops with no more than 1/8 inch in 96 inch sag, bow, or other variation from a straight line.
   3. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
   4. Calk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 06 42 00

WOOD PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Board paneling.
   2. Mineral Composite Paneling.

B. Related Sections include the following:
   1. Division 06 Section "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling and that are concealed within other construction before paneling installation.
   2. Division 06 Section "Interior Architectural Woodwork" for interior woodwork other than paneling.
   3. Division 08 Section "Flush Wood Doors."

1.3 DEFINITIONS

A. Paneling includes wood furring, blocking, and shims for installing paneling, unless concealed within other construction before paneling installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including finishing materials and processes.

B. Product Data: For panel products adhesives and finishing materials and processes.
   1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

C. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that products specified to be made from certified wood comply with forest certification and chain-of-custody requirements. Include statement indicating cost for each certified wood product.
   2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   1. Product Data for Credit IEQ 4.2: For Paints and Coatings, documentation including printed statement of VOC content.
   1. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that products contain no urea formaldehyde.

D. Shop Drawings: Show location of paneling, large-scale details, attachment devices, and other components. Include dimensioned plans and elevations.
   1. Show details full size.
   2. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
   3. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
   4. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
   5. Apply WI-certified compliance label to first page of Shop Drawings.

E. Samples for Initial Selection:
   1. Shop-applied transparent finishes.
   2. Shop-applied opaque finishes.
   3. High-pressure decorative laminates.

F. Samples for Verification:
   1. Lumber with or for transparent finish, not less than 50 sq. in. (300 sq. cm), for each species and cut, finished on 1 side and 1 edge.
   2. Veneer leaves representative of and selected from flitches to be used for transparent-finished paneling.
   3. Veneer-faced panel products with or for transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face-veneer seam and finish as specified.
   4. Lumber and panel products with shop-applied opaque finish 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (200 by 250 mm) for panels, for each finish system and color, with 1/2 of exposed surface finished.
   5. Plastic laminates, 8 by 10 inches (200 by 250 mm), for each type, color, pattern, and surface finish, with 1 sample applied to core material.
   6. Corner pieces for stile and rail paneling, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Source Limitations: Engage a qualified woodworking firm to assume undivided responsibility for production of paneling and interior architectural wood work.

D. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of paneling indicated for construction, finishes, installation, and other requirements.
   1. Provide AWI Quality Certification Program labels and certificates indicating that paneling, including installation, complies with requirements of grades specified.

E. Fire-Test-Response Characteristics: Where fire-retardant materials or products are indicated, provide materials and products with specified fire-test-response characteristics as determined by testing identical products per test method indicated by UL, ITS, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify with appropriate markings of applicable testing and inspecting agency in the form of separable paper label or, where required by authorities having jurisdiction, imprint on surfaces of materials that will be concealed from view after installation.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that could damage paneling have been completed in installation areas. If paneling must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature between 60 and 90 deg F (16 and 32 deg C) and relative humidity between 43 and 70 percent during the remainder of the construction period.

C. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.
   2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating paneling without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.9 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Available Fabricators: Subject to compliance with requirements, fabricators offering paneling that may be incorporated into the Work include, but are not limited to, the following:

B. Fabricators: Subject to compliance with requirements, provide paneling by one of the following:

2.2 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for quality grade specified, unless otherwise indicated.

B. Certified Wood: Provide paneling produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

C. Recycled Content of Medium-Density Fiberboard and Particleboard: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

D. Wood Products: Comply with the following:
   1. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
   2. Medium-Density Fiberboard: ANSI A208.2, Grade MD, made with binder containing no urea formaldehyde.
   3. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.
   4. Softwood Plywood: DOC PS 1, Medium Density Overlay.
   5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no urea formaldehyde.

E. Adhesives, General: Adhesives shall not contain urea formaldehyde.

F. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Wood Glues: 30 g/L.
   2. Panel Adhesives: 50 g/L.
   3. Contact Adhesive: 80 g/L.
   4. Special-Purpose Contact Adhesive (contact adhesive that is used to bond melamine covered board, metal, unsupported vinyl, rubber, or wood veneer 1/16 inch or less in thickness to any surface): 250 g/L.

2.3 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.4 FABRICATION, GENERAL

A. Paneling Grade: Provide Premium grade paneling complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.
   1. Lay out one elevation at a time if approved by Architect.
   2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
   3. Provide lighting of similar type and level as that of final installation for viewing layout, unless otherwise approved by Architect.
   4. Rearrange paneling as directed by Architect until layout is approved.
   5. Do not trim end units and other nonmodular size units to less than modular size until after Architect's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
   6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

E. Complete fabrication, including assembly and finishing, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times paneling fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

F. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.5 BOARD PANELING FOR TRANSPARENT FINISH

A. Refer to Finish Schedule included on Drawing Sheet A10.0.0 for additional information and location.
   1. Wood Panel Type: WD-1

B. Shop fabricate board paneling in lengths to provide pieces that are uninterrupted by joints. Machine edges of boards to provide joint profiles indicated.

C. Shop fabricate board paneling from boards of standard random lengths, complying with applicable grading rules. Machine edges and ends of boards to provide joint profiles indicated.

D. Preassemble board paneling into largest units that can be delivered into installation areas using permanent or temporary backing members as indicated. To maximum extent possible, fabricate units in sizes determined by field measurements of existing conditions and that will avoid fitting in the field; make provision for separate scribing pieces to be fitted to adjoining finished surfaces. Provide shop-prepared detachable pieces for forming joints with other units at Project site and with other types of architectural woodwork.

2.6 MINERAL COMPOSITE PANELING

A. Refer to Finish Schedule included on Drawing Sheet A10.0.0 for additional information and location.
   1. Paneling Type: MCP-1
      a. Manuf.: Modularts, Inc.
      b. Product: Interlockingrock Panels

c. Pattern: Delux Design Group - Burle
d. Orientation: Horizontal
e. Finish: Field Painted Airless Spray Application;
   1) Color To Match Paint P-3, Flat Finish
   2) Note: Plywood Substrate Required
   3) Assemble and finish mock up as described on the Drawings.
   4) Contact: Danielle Firle (206-755-4210)

2.7 SHOP FINISHING

A. Grade: Provide finishes of same grades as paneling to be finished.

B. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

C. General: Shop finish transparent-finished paneling at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing of opaque-finished paneling.

D. General: Drawings indicate paneling that is required to be shop finished. Finish such paneling at fabrication shop as specified in this Section. Refer to Division 09 painting Sections for finishing paneling not indicated to be shop finished.

E. Finishing Materials: Products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished paneling specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

G. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
   1. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling. Concealed surfaces of plastic-laminate-clad paneling do not require backpriming when surfaced with plastic laminate.

H. Transparent Finish:
   1. Grade: Premium.
   2. AWI Finish System: Match Architects sample.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with requirements for same grade specified in Part 2 for fabrication of type of paneling involved.

B. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm). Install with no more than 1/16 inch in 96-inch (1.6 mm in 2400-mm) vertical cup or bow and 1/8 inch in 96-inch (3 mm in 2400-mm) horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch (0.8 mm).

C. Scribe and cut paneling to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

E. Refer to Division 09 Sections for final finishing of installed paneling.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate functional and visual defects; where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

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SECTION 07 13 26

SELF-ADHERING SHEET WATERPROOFING

PART 1- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Self-adhering sheet membrane waterproofing systems for positive-side waterproofing applications over concrete on below grade foundation walls.

1.3 RELATED WORK

A. Specified Elsewhere:
1. 03 30 00 – Cast-in-Place Concrete.
2. 07 21 00 - Building Insulation.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

C. Samples: For the following products:
1. 12-by-12-inch (300-by-300-mm) square of waterproofing and flashing sheet.
2. 12-by-12-inch (300-by-300-mm) square of insulation.
3. 4-by-4-inch (100-by-100-mm) square of drainage panel.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For Installer.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for waterproofing.

G. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.

B. Source Limitations: Obtain waterproofing materials and molded-sheet drainage panels through one source from a single manufacturer or molded-sheet drainage panel may provided by a manufacturer acceptable to waterproofing manufacturer that maintains the warranty.

C. Mockups: Before beginning installation, install waterproofing to 100 sq. ft. (9.3 sq. m) on 100 sq. ft. (9.3 sq. m) of wall to demonstrate surface preparation, crack and joint treatment, corner treatment, and execution quality.
   1. If Architect/Engineer determines mockups do not comply with requirements, reapply waterproofing until mockups are approved.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.
   2. Ensure the Architect/Engineer and independent testing agency are provided notice of the meeting at least one week prior.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Store rolls according to manufacturer's written instructions.

E. Protect stored materials from direct sunlight.

1.7 ROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
   1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace waterproofing material that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch (1.6 mm) in width.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Special Installer's Warranty: Signed by Installer, covering Work of this Section, for warranty period of two years.
   1. Warranty includes removing and reinstalling protection board, drainage panels, and insulation.

PART 2- PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Not less than 60-mil- (1.5-mm-) thick, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated to a 4-mil- (0.10-mm-) thick, polyethylene film with release liner on adhesive side and formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. American Hydrotech, Inc.; VM 75.
      b. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
      c. Grace, W. R. & Co.; Bituthene 3000.
      d. Henry Company; Blueskin WP 200.
      e. Meadows, W. R., Inc.; SealTight Mel-Rol.
   2. Physical Properties:
      a. Tensile Strength: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
      b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
      c. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
      d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
      e. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
      f. Hydrostatic-Head Resistance: 150 feet (45 m) minimum; ASTM D 5385.
      g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
      h. Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

2.2 ADHESIVE-COATED HDPE SHEET WATERPROOFING

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:
   1. Grace, W. R. & Co.; Preprufe 300R.

C. Adhesive-Coated HDPE Sheet for Horizontal Applications: 46-mil- (1.2-mm-) thick, uniform, flexible sheets consisting of 30-mil- (0.76-mm-) thick, HDPE sheet coated with a pressure-sensitive rubber adhesive, a protective adhesive coating, a detackifying surface treatment, an uncoated self-adhering side lap strip, and a release liner with the following physical properties:
   1. Tensile Strength, Film: 4000 psi (27.6 MPa) minimum; ASTM D 412.
   2. Low-Temperature Flexibility: Pass at minus 10 deg F (minus 23 deg C); ASTM D 1970.
   3. Peel Adhesion to Concrete: 5 lbf/in. (875 N/m); ASTM D 903, modified.
   4. Lap Adhesion: 2.5 lbf/in. (440 N/m); ASTM D 1876, modified.
   5. Hydrostatic-Head Resistance: 231 feet (70 m); ASTM D 5385, modified.
   6. Vapor Permeance: 0.01 perms (0.6 ng/Pa x s x sq. m); ASTM E 96, Water Method.
   7. Water Absorption: 0.5 percent; ASTM D 570.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
   1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by manufacturer of sheet waterproofing material.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.

F. Sheet Strips: Self-adhering, rubberized-asphalt sheet strips of same material and thickness as sheet waterproofing.

G. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
   1. Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 4-1/2 inches (114 mm) wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side.

H. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick, predrilled at 9-inch (229-mm) centers.

2.4 MOLDED-SHEET DRAINAGE PANELS

A. Nonwoven-Geotextile-Faced, Molded-Sheet Drainage Panel: Manufactured composite subsurface drainage panels consisting of a nonwoven, needle-punched geotextile facing with an apparent opening size not exceeding No. 70 (0.21-mm) sieve laminated to one side with a polymeric film bonded to the other side of a studded, nonbiodegradable, molded-plastic-sheet drainage core, with a vertical flow rate of 9 to 15 gpm per ft. (112 to 188 L/min. per m).
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Carlisle Coatings & Waterproofing; CCW MiraDRAIN 6200XL.
      b. American Hydrotech, Inc; Hydrodrain 420.
      c. JDR Enterprises, Inc; J-Drain 420.
      d. American Wick Drain Corporation; Amerdrain 520.
      e. Grace, W. R. & Co.; Hydroduct 220

2.5 INSULATION

A. Board Insulation: Extruded-polystyrene board insulation complying with ASTM C 578, square or shiplap edged.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Diversifoam Products.
      b. Dow Chemical Company (The).
      c. Owens Corning.
      d. Pactiv Building Products.
      e. T. Clear Corporation.
   2. Type IV, 25-psi (173-kPa) minimum compressive strength.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
   2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   3. Verify that compacted subgrade is dry, smooth, and sound; and ready to receive adhesive-coated HDPE sheet.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

F. Bridge and cover construction jointsand discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips.
   1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:
      a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
      b. At plaza deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and according to recommendations in ASTM D 6135. Prime substrates unless manufacturer recommends against priming.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.

D. Install 6-inch- (165-mm-) wide strip of membrane over seams, centered over the seam, full height.

E. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

F. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.

G. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic.

H. Install sheet waterproofing and auxiliary materials to tie into adjacent waterproofing.

I. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

J. Install molded-sheet drainage panels over waterproofing membrane immediately.

K. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 MOLDED-SHEET DRAINAGE PANEL INSTALLATION

A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesives that do not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity.
   1. Protect installed molded-sheet drainage panels during subsequent construction. Ensure top edge of panels is protected to prevent backfill material or any other debris from getting behind the panels.

3.5 INSULATION INSTALLATION

A. Install over waterproofed surfaces. Cut and fit to within 1/4 inch (19 mm) of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. The Contractor shall provide a schedule in advance to the Testing Agency and whenever Work is to be done, notify Testing Agency in sufficient time to arrange inspections.

3.7 PROTECTION AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing and molded-sheet drainage panels from damage and wear during remainder of construction period.

C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 16 19

METAL OXIDE WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal-oxide waterproofing for negative-side application to concrete.

B. Related Sections:
1. Section 03 30 00 "Cast-in-Place Concrete" for waterstops, and finishing concrete walls and slabs to receive waterproofing.
2. Section 07 92 00 "Joint Sealants" for elastomeric and preformed sealants in concrete and masonry walls and floors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions and installation instructions for metal-oxide waterproofing.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.2: For Paints and Coatings, documentation including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for metal-oxide waterproofing.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying metal-oxide waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and that employs workers trained and approved by manufacturer.

1.6 PROJECT CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit metal-oxide waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Metal-Oxide Waterproofing Compound: A product specifically formulated for waterproofing concrete and masonry substrates; containing pulverized iron and a chemical oxidizing agent to cause the iron particles to rust and grow in size in the presence of water; with VOC content complying with limits of authorities having jurisdiction.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Anti-Hydro International, Inc.; A-H Metallic Waterproofing.
      b. Euclid Chemical Company (The); Iron Waterpeller.
      c. Metalcrete Industries; Metalcrete Waterproofing.
      d. Specco Industries, Inc.; Speccrete Metallic Waterproofer.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

B. Portland Cement: ASTM C 150, Type I.

C. Sand: ASTM C 144.

D. Water: Potable.

2.3 MIXES

A. Metal-Oxide Coats: Add metal-oxide waterproofing compound to portland cement, sand, and water according to manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency for each coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

B. Proceed with application only after unsatisfactory conditions have been corrected.

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

A. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

B. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

C. Stop active water leaks with plugging compound according to waterproofing manufacturer's written instructions.

D. Repair damaged or unsatisfactory substrate with patching compound according to manufacturer's written instructions.
   1. At holes and cracks in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and approximately 1 inch deep. Fill reveal with patching compound flush with surface.

E. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.
   1. Clean concrete surfaces according to ASTM D 4258.
      a. Prepare smooth-formed and trowel-finished concrete by mechanical abrading or abrasive-blast cleaning according to ASTM D 4259.
   2. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

3.3 APPLICATION

A. General: Comply with waterproofing manufacturer's written instructions for application and curing.
   1. Saturate surface for several hours prior to application with water and maintain damp condition until applying waterproofing. Remove standing water.
   2. Apply waterproofing to surfaces indicated on Drawings.
   3. Number of Metal-Oxide Coats: Three
   4. Application Method: Brush apply the waterproofing, vigorously working first coat onto the substrate and forcing the material into surface voids. Brush each subsequent coat into full contact with previous coat.
   5. Dampen surface between coats.
   6. Allow each coat to set for 24 hours between coats.

B. Final Coat Finish: Smooth

C. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
   1. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches for cast-in-place concrete.
   2. Onto every substrate in areas indicated for treatment, including pits and similar offsets and features.

END OF SECTION

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SECTION 07 21 00

BUILDING INSULATION

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide work as shown on drawings and specified herein including:
   a. Thermal batt insulation.
   b. Thermal semi-rigid insulation.
   c. Thermal rigid insulation.

1.2 RELATED WORK

A. Specified Elsewhere:
   1. 01 33 00 - Submittals
   2. 04 20 00 - Unit Masonry.
   3. 07 42 13 - Metal Panels.
   4. 07 54 23 - Thermoplastic Polyolefin (TPO) Roofing.
   5. 08 41 13- Aluminum-Framed Entrances and Storefront.
   6. 09 29 00 - Gypsum Board.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

D. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Sample Construction
   1. Install a sample of batt insulation in metal stud furring and vapor retarder, minimum 8 feet (2.4 meters) wide, full height of wall for approval of workmanship.
   2. Approved sample construction shall be a standard of workmanship for the Project and may remain in place.

1.5 PRE-CONSTRUCTION MOCK-UP

A. Refer to Section 01 40 00 “Quality Requirements” for general mockup requirements.

B. Prior to commencing Work and preceding pre-installation conference, provide pre-construction mock-up of all insulation types as indicated on the drawings for preconstruction mock-up. Coordinate interface with exterior wall and roof systems and related work, including attachments, fire stopping, sealants, and interior finishes.

C. Extent and Location: As indicated on the drawings, in location acceptable to Architect/Engineer.

D. Materials: Incorporate complete materials as required for finished Work.

E. Architect/Engineer's Review:
1. Architect/Engineer will review sample installation for visual acceptance of workmanship.
2. Obtain Architect/Engineer's approval of sample installations before proceeding with subsequent Work.

F. Maintain accepted sample installation during construction as standard for subsequent Work.

G. Properly finished and maintained sample installation may be incorporated into completed work.

H. Dismantle unacceptable sample installation and remove from site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in their original containers or packages or bundles bearing label clearly identifying manufacturer's name, brand, grade, UL listing, and other pertinent information.

B. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside, under cover, protected from the weather in a dry location clear of the ground.
1. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

C. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Form XPS-1: Extruded-Polystyrene Board Insulation of thickness and width indicated and manufacturer's standard length as required to suit job conditions: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Basis of design is Ultracavity-Mate by Dow Chemical Company (The) or subject to compliance with requirements, provide products by the following :
   a. Owens Corning; Formular High-R CW
2. Type IV, 25 psi (173 kPa).
3. Thickness: 1.75 inches for each of two layers for a total of 3.5 inches.
4. Refer to Section 07 42 43 "Composite Wall Panels" Article 3.3.I for rain screen principle installation and additional system requirements.

2.2 GLASS-FIBER BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   1. CertainTeed Corporation.
   2. Johns Manville.
   3. Knauf Insulation.
   4. Owens Corning.

B. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35% percent.

C. Form FG-4: Foil-Faced, Glass-Fiber Board Insulation of thickness indicated with width and length as required to suit job conditions: ASTM C 612, Type IA; faced on one side with foil-scrim-kraft or foil-scrim-polyethylene vapor retarder having maximum permeance of 0.10 perm (5.75 x 10^{-9} g/Pa-s-m^2) when tested in accordance with ASTM E96, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84.
   1. Nominal density of 2.25 lb/cu. ft. (36 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

D. Form FG-7: Semi-Rigid, Glass-Fiber Insulation with white faced on one side All Service Jacket (ASJ), of thickness indicated with width and length as required to suit job conditions: For application on underside of exposed floor decks, ASTM C 612, Type 1A & 1B.
   1. Vapor retarder having maximum permeance of 0.02 perms per ASTM C 1136.
   2. Maximum fire hazard classification – 25 for flame spread, 50 for smoke developed, when tested in accordance with ASTM E84.
   3. Nominal density of 3 lb/cu. ft. (48 kg/cu. m), thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F (29.8 K x m/W at 24 deg C).

E. Sustainability Requirements: Provide glass-fiber board insulation as follows:
   1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
   2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.3 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   1. Fibrex Insulations Inc.
   2. Isolatek International.
   3. Owens Corning.
   4. Roxul Inc.
   5. Thermafiber.

B. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35% percent.

C. Form MW-1: Un-faced, Semi-Rigid Mineral-Wool Board Insulation of thickness indicated with width and length as required to suit job conditions: ASTM C 612, Type 1A; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Minimum thermal resistivity (r) of 4.3 deg. F x h x sq. ft./Btu x in. (29.8 K x m/W) at mean temperature of 75 degrees F (24 degrees C).
   2. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

D. Form MW-2: Foil-Faced, Semi-Rigid Mineral-Wool Board Insulation of thickness indicated with width and length as required to suit job conditions: ASTM C 612, Type 1A; faced on one side with foil-scrim or foil-scrim-polyethylene vapor retarder having maximum permeance of 0.10 perm (5.75×10^{-9} g/Pa-s-m^2) when tested in accordance with ASTM E96; with maximum flame-spread and smoke-developed indexes of 25 and 5, respectively, per ASTM E 84.
   1. Minimum thermal resistivity (r) of 4.3 deg. F x h x sq. ft./Btu x in. (29.8 K x m/W) at mean temperature of 75 degrees F (24 degrees C).
   2. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).

2.4 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   1. CertainTeed Corporation.
   2. Guardian Building Products, Inc.
   3. Johns Manville.
   4. Knauf Insulation.
   5. Owens Corning.

B. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35% percent.

C. Form FG-8: Un-faced, Glass-Fiber Blanket Insulation of thickness indicated with width and length as required to suit job conditions: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Minimum density of 0.6 lbs. per cubic foot (16 kg per cubic meter).
   2. Minimum thermal resistivity (r) of 3.1deg F x h x sq. ft./Btu x in. (21.7 K x m/W) at mean temperature of 75 degrees F (24 degrees F).

D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
   1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
   2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.5 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
   1. Fibrex Insulations Inc.
   2. Owens Corning.
   3. Roxul Inc.
   4. Thermafiber.

B. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35% percent.

C. MW-3: Un-faced, Mineral-Wool Blanket Insulation of thickness indicated with width and length as required to suit job conditions: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
   1. Minimum density of 0.6 lbs. per cubic foot (16 kg per cubic meter).
   2. Minimum thermal resistivity (r) of 3.1deg F x h x sq. ft./Btu x in. (21.7 K x m/W) at mean temperature of 75 degrees F (24 degrees F).
   3. Nailing tabs for installation between wood studs.

2.6 SPRAY POLYURETHANE FOAM INSULATION

A. PU-1: Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. BASF Corporation.
      b. BaySystems NorthAmerica, LLC.
      c. Dow Chemical Company (The).
      d. ERSystems, Inc.
      e. Gaco Western Inc.
      f. Henry Company.
      g. NCFI; Division of Barnhardt Mfg. Co.
      h. SWD Urethane Company.
      i. Volatile Free, Inc.
   2. Minimum density of 1.5 lb/cu. ft. (24 kg/cu. m), thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F (43 K x m/W at 24 deg C).

2.7 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGM Industries, Inc.; TACTOO Insul-Hangers.
      b. Gemco; Spindle Type.
      c. Sunbelt Stud Welding; Spindle Type.
   2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
   3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGM Industries, Inc.; SC150.
      b. Gemco; S-150.
      c. Sunbelt Stud Welding; K150S.
   2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap where exposed to possible human contact.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AGM Industries, Inc.; TACTOO Adhesive.
      b. Gemco; Tuff Bond Hanger Adhesive.
      c. Sunbelt Stud Welding; IHA-170 Insulation Hanger Adhesive.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units using manufacturer's recommended spot-applied adhesive compatible with waterproofing according to manufacturer's written instructions.

B. On horizontal surfaces on vapor retarder specified in Division 3, loosely lay insulation units according to manufacturer's written instructions, and level to finish flush with underside of floor slab. Stagger end and side joints and tightly abut insulation units.

C. Loosely lay insulation according to manufacturer's written instructions, and cover with protection board with joints taped and located so as not to occur directly over joints in insulation.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches (610 mm) o.c. both ways on inside face, and as recommended by manufacturer. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.
   1. Over concrete block surfaces impale semi-rigid insulation over mechanical fasteners (such as Miracle Adhesive Corp, galvanized spindle anchors, washers and adhesive or as recommended by the manufacturer). Install insulation to fasteners with speed fasteners or clips.

3.5 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
   1. Use insulation in as long lengths and widths as practicable that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
   2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and cut as required to fit adjoining framing members and-or building construction with no gaps or voids.
   3. Secure insulation blankets to framing members with fasteners as recommended by the insulation manufacturer.

4. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
5. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
   a. Provide galvanized metal furring or metal bands or wire lacing as required to hold insulation blankets in place without sagging.

C. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

D. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF INSULATION IN CEILINGS FOR SOUND ATTENUATION

A. Where glass-fiber blankets are indicated for sound attenuation above ceilings, install blanket insulation over entire ceiling area in thicknesses indicated. Extend insulation 48 inches (1219 mm) up either side of partitions.

3.7 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
1. Clean and prepare concrete substrates and fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.8 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.
1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.
2. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

3.9 PROTECTION

A. Protect installed insulation, vapor retarders and adjacent construction from damage due to harmful weather exposures, physical abuse, and other causes until Substantial Completion.
   1. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

3.10 INSULATION SCHEDULE

A. Insulation Type XPS-1: Type IV extruded-polystyrene board insulation.

B. Insulation Type FG-4: Foil-faced, flexible glass-fiber board insulation.

C. Insulation Type FG-7: Unfaced, glass-fiber board insulation.

D. Insulation Type MW-1: Unfaced, mineral-wool board insulation.

E. Insulation Type MW-2: Foil-faced, mineral-wool board insulation.

F. Insulation Type FG-8: Unfaced, glass-fiber blanket insulation.

G. Insulation Type MW-3: Unfaced, mineral-wool blanket insulation.

H. Insulation Type PU-1: Polyurethane spray foam insulation.

END OF SECTION

SECTION 072613.13

CONCRETE SLAB APPLIED VAPOR RETARDER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes water vapor retarders applied on concrete floor slab scheduled to receive floor finishes, which do not meet the water vapor emission limits specified.

B. Contractor's Responsibility: Suitability of concrete slab to meet vapor emission limits as required by scheduled floor finish materials is the responsibility of the Contractor. As an option, Contractor may apply topical vapor retarders specified in this section to mitigate excessive concrete slab water vapor emission.

1.3 ACTION SUBMITTALS

A. Product Data: Include product performance characteristics, test reports, and application instructions.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.2: For applied vapor retarder, including printed statement of VOC content.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Test Reports: For applied vapor retarder, for tests performed by a qualified testing agency acceptable to the Architect.
1. ASTM E 96/96 M, Standard Test Methods for Water Vapor Transmission of Materials, Water Method.
2. ASTM D 1308, Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes; minimum 14 days.
3. ASTM D 4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
4. ASTM D 7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.

C. Field quality-control reports.

D. Certifications: Furnish written certification that the manufacturer has verified the compatibility between the vapor retarder provided and the flooring product scheduled to be applied, including adhesives and floor leveling materials.

E. Flooring Manufacturer Acceptance of Vapor Retarder Application: Furnish a signed written statement obtained from flooring manufacturer, stating that the water vapor emission levels, after application of vapor retarders, are acceptable and suitable for their flooring application.

F. Sample Warranty: For manufacturer's special warranty.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.7 WARRANTY

A. Manufacturer’s Special Warranty: Manufacturer and Installer agree to repair or replace the applied concrete vapor retarder, the new floor covering or coating, including materials and labor for applied concrete vapor retarder that fails to remain adhered to the substrate or is affected by moisture or alkalinity within the specified warranty period. Manufacturer’s warranty requires manufacturer’s inspection and written authorization, prior to removal of existing floor covering and applied concrete vapor retarder.

B. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide vapor retarders that are compatible with adhesives and floor covering scheduled to be applied on top of the vapor retarder, and with floor leveling products required for flooring installation, as demonstrated by vapor retarder manufacturer, based on testing and field experience.

B. VOC Content: Products shall comply with VOC limits of Bay Area Air Quality Management District (BAAQMD), Reg. 8, Rule 3, effective 01/01/2011 and LEED-NC, whichever is more stringent, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   1. Sealers: 250 g/L.

2.2 VAPOR RETARDERS

A. Manufacturers and Products: Subject to compliance with requirements, provide products by one of the following:
   1. Ardex Engineered Cements; MC Rapid.
   2. BASF; Chemrex MV-Block
   3. Koster American Corporation; VAP I 2000 UFS.
   4. Refer to Division 01 section “Substitution Procedures” 01 25 00 for substitute request procedures and requirements.

B. Performance Requirements:
   1. Permeance: Maximum 0.3 perms, when tested in accordance with ASTM E 96 (water method).
   2. Alkalinity Resistance: Unaffected by a pH of 14 when tested in accordance with ASTM D 1308,

minimum 14 days.

3. Install on concrete with moisture vapor emission rates of up to 20 lbs of water per 1000 sq. ft. in 24 hours, when tested in accordance with ASTM F 1869, anhydrous calcium chloride test; and up to 95% relative humidity when tested in accordance with ASTM F 2170, in situ hygrometer probe test.
4. Adhesion to concrete: 500 psi or greater, as tested in accordance with ASTM D 4541 or ASTM D 7234.

2.3 RELATED MATERIALS

A. Primers and Cement Topcoat: Where primers and cement topcoats are necessary for floor finishing installation, use primer and cement-based underlayment products recommended by vapor retarder manufacturer.

B. Concrete Testing Equipment: Subject to compliance with requirements, provide the following products by American Moisture Test, Inc.:
   1. Calcium Chloride Moisture Test Kit for ASTM F 1869.
   2. In-Situ Relative Humidity Meter and Probe for ASTM F 2170.
   3. Digital Ph Meter for ASTM F 2170.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Water Vapor Emission Testing:
   1. Perform pre-installation testing of the concrete slab prior to the application of applied vapor retarder.
      a. Testing shall be performed by a qualified testing personnel and testing laboratory.
   2. Condition the area to be tested for at least 48 hours prior to testing to allow the concrete slab to reach equilibrium with the building's ambient conditions at the service temperature and humidity expected during normal operation.
   3. Maintain the temperature and relative humidity for the duration of the testing.

B. Perform three tests for the first 1000 sq. ft. of flooring.
   1. Add one test for each additional 1000 sq. ft. or fraction thereof.
   2. Conduct tests around the perimeters of the room, at columns, and where moisture may be evident.

C. Moisture:
   1. Perform ASTM F 1869 anhydrous calcium chloride testing on clean concrete slabs when required by flooring finish manufacturer; free of curing, sealing, adhesive residue, water and surface contaminates in an area 20 inches by 20 inches, 24-hours before test kits are installed.
   2. Perform ASTM F 2170 in situ hygrometer probe test at depth of 40% slab thickness for concrete slab that is allowed to dry from top only, and at depth of 20% of slab thickness for concrete slab that is allowed to dry from top and bottom.
   3. Alkalinity: Perform ASTM F 710 alkalinity testing during retrieval of moisture tests, directly inside dome area by placing several drops of manufacturer provided solution to concrete surface. Wait 60-seconds and apply digital LCD pH meter. Record results to the nearest hundredth on final test report.
   4. Temperature, Humidity and Surface Thermometer: Document temperature, humidity and surface temperature before testing at installation of kits or probe sleeves, and on final testing report.
   5. Record on finish floor plans the number and location of tests conducted on concrete surface.

3.2 SURFACE PREPARATION

A. Concrete surfaces to be tested shall be clean and free of residue, debris, and sealing compounds.

B. Shot blast concrete surfaces to International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) 3 to 4.

C. Diamond-grind concrete surface near wall base, edges, and corners.

D. Sweep and vacuum clean substrates as required, immediately before application of vapor retarder.

3.3 APPLICATION

A. Apply vapor retarder by squeegee, spray, and/or roller method to saturate the concrete surface. Apply materials in accordance with manufacturer's instructions.

B. Coverage rates shall be in accordance with manufacturer's recommendations based on concrete density and porosity.

C. Allow materials to penetrate and cure. Re-test substrate and re-apply vapor retarder if areas exceed the following:
   1. ASTM F 1869 (as modified to exclude removal of surface finish): Water vapor emission not to exceed 3.0 lb of water/1000 sq. ft. in 24 hours.
   2. ASTM F 710: No reaction to up to 9.0 pH alkali solution.

END OF SECTION

SECTION 07 27 13

MODIFIED BITUMINOUS SHEET AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes self-adhering, vapor-retarding, modified bituminous sheet air barriers.

B. Related Sections include the following:
1. Division 04 Section "Unit Masonry" for embedded flashings.
2. Division 06 Section "Sheathing" for wall sheathings, wall sheathing joint-and-penetration treatments, building paper, and building wraps.
3. Division 07 low-slope roofing Sections for roof air barriers.
4. Division 07 Section "Building Insulation" for foam-plastic board insulation.
5. Division 07 Section "Fluid-Applied Membrane Air Barriers."
6. Division 07 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
7. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air Barrier Assembly Air Leakage: Not to exceed 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa).

1.5 PRECONSTRUCTION TESTING

A. Refer to Section 01 40 00 “Quality Requirements” for general mock up requirements.

B. Mockup Testing: Air barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
1. Owner will engage a qualified testing agency.
2. Quantitative Air Leakage Testing: Testing of the mockup for air leakage will be conducted not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage when tested according to ASTM E 783.
3. Notify Architect seven days in advance of the dates and times when mockup testing will take place.

1.6 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
   1. Include details of interfaces with other materials that form part of air barrier.
   2. Include details of mockups.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with air barrier; signed by product manufacturer.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.8 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 150 sq. ft. (14 sq. m), incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.
   1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
   2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
   3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed curtain walls, and door frames.
   2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil thick, polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   2. Products: Subject to compliance with requirements, provide one of the following:
      a. Henry Company; Blueskin SA. (Basis of Design)
      b. Carlisle Coatings & Waterproofing; CCW-705.
      c. Grace, W. R. & Co.; Perm-A-Barrier.
      d. Meadows, W. R., Inc.; SealTight Air-Shield.
      e. NEI; AC AirSeal.
      f. Rubber Polymer Corporation; Rub-R-Wall SA.
      g. Tremco, Incorporated; ExoAir 110
   3. Physical and Performance Properties:
      a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. (0.02 L/s x sq. m of surface area at 75-Pa) pressure difference; ASTM E 2178.
      b. Tensile Strength: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
      c. Ultimate Elongation: 200 percent minimum; ASTM D 412, Die C, modified.
      d. Low-Temperature Flexibility: Pass at minus 20 deg F (minus 29 deg C); ASTM D 1970.
      e. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836.
      f. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154.
      g. Water Absorption: 0.15 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
      h. Vapor Permeance: 0.05 perms (2.9 ng/Pa x s x sq. m); ASTM E 96, Water Method.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor-retarding, 30- to 40-mil- (0.76- to 1.0-mm-) thick, self adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Modified Bituminous Strip: Vapor-retarding, 40-mil- (1.0-mm-) thick, smooth-surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

F. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

G. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch (0.64 mm) thick, and Series 300 stainless-steel fasteners.

J. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. (24 to 32 kg/cu. m) density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

K. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil- (1.0-mm-) thick, smooth-surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

L. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

M. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

N. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 07 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
   3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   4. Verify that masonry joints are flush and completely filled with mortar.
   5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.
   1. Install modified bituminous strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch (1.6 mm).

G. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints with overlapping modified bituminous strips.

H. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

I. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 INSTALLATION

A. Install modified bituminous sheets according to air barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.
   1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous air barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
   1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier sheets. Accurately align sheets and maintain a uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.
   1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.
   2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. CMU: Install air barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air barrier sheet immediately below protruding masonry ties or joint reinforcement or ties and firmly adhere in place.
   1. Overlap horizontally adjacent sheets a minimum of 2 inches (50 mm) and roll seams.
   2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.
   3. Seal around masonry reinforcing or ties and penetrations with termination mastic.
   4. Continue the membrane into all openings in the wall, such as doors, windows, and terminate at points to maintain an airtight barrier that will not be visible from interior.

H. Seal top of through-wall flashings to air barrier sheet with an additional 6-inch- (150-mm-) wide, counterflashing strip.

I. Seal exposed edges of sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Install air barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

K. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings using accessory materials.

L. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches (75 mm) of coverage is achieved over both substrates. Maintain 3 inches (75 mm) of full contact over firm bearing to perimeter frames with not less than 1 inch (25 mm) of full contact.
   1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
   2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches (150 mm) o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
   3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
   4. Use the transition strip method that is acceptable to the manufacturer.

M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

N. At end or each working day, seal top edge of membrane to substrate with termination mastic.

O. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

P. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air barrier sheet extending 6 inches (150 mm) beyond repaired areas in all directions.

Q. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

R. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: Testing to be performed will be determined by Owner's testing agency from among the following tests:
1. Quantitative Air Leakage Testing: Testing not to exceed the test pressure differential, positive and negative, indicated in "Performance Requirements" Article for air barrier assembly air leakage according to ASTM E 783.

D. Remove and replace deficient air barrier components and retest as specified above.

3.5 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 30 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

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SECTION 07 27 26

FLUID APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide work as shown on the drawings and specified herein including, fluid-applied membrane air barrier, vapor impermeable, for exterior walls.

1.2 RELATED WORK

A. Specified Elsewhere:
1. 01 33 00 – Submittals
2. 04 22 00 – Unit Masonry.
3. 07 13 26 - Self-Adhering Sheet Waterproofing.
4. 07 21 00 - Building Insulation.
5. 07 42 13 - Metal Wall Panels.
6. 07 62 00 - Sheet Metal Flashing And Trim.
7. 08 11 13 - Hollow Metal Doors And Frames.
8. 08 41 13 – Aluminum-Framed Entrances And Storefront.
9. 08 44 13 - Aluminum-Framed Curtain Walls.

1.3 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier: A designated "plane" of reduced air flow between different environments.

C. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

D. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

E. Air Barrier Assembly: The air barrier materials and accessories that provide a continuous designated plane to the movement of air through portions of building enclosure assemblies.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Provide an air barrier assembly that:
1. Is capable of withstanding combined positive and negative design wind, fan and stack pressures on the envelope without damage or displacement, and will transfer the load to the structure.
2. Will not displace adjacent materials under full load.
3. Will be joined in an airtight and flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of assemblies due to thermal and moisture variations and creep, and anticipated seismic movement.

C. Air Barrier Assembly Air Leakage: Not to exceed 0.04 cfm x sq. ft. of surface area at 1.57 lbf/sq. ft. when tested in accordance with ASTM E 2357.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.

D. Qualification Data: For Applicator.

E. Product Certificates: For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

F. Product Test Reports: Based on evaluation of comprehensive tests required by this specification performed by a qualified testing agency, for air barriers.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance and that is an ABAA-licensed contractor, employs certified and registered installers, and complies with ABAA's Quality Assurance Program.

B. Preinstallation Conference: Conduct conference at Project site.
1. Include installers of other construction connecting to air barrier, including but not limited to roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.
3. Ensure the A/E and independent testing agency are provided notice of the meeting at least one week prior.

C. Provide products which comply with all state and local regulations controlling use of VOCs.

1.7 PRE-CONSTRUCTION MOCK-UP

A. Refer to Specification Section 01 40 00 – “Quality Requirement”

B. Prior to commencing Work and preceding pre-installation conference, provide pre-construction mock-up incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by A/E's testing agency of air barrier before external insulation and cladding is installed.
2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

C. If Architect/Engineer determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

D. Extent and Location: As indicated on the drawings, in location acceptable to Architect/Engineer.

E. Materials: Incorporate complete materials as required for finished Work.

F. Architect/Engineer’s Review:
1. Architect/Engineer will review sample installation for visual acceptance of workmanship.
2. Obtain Architect/Engineer’s approval of sample installations before proceeding with subsequent Work.

G. Maintain accepted sample installation during construction as standard for subsequent Work.

H. Properly finished and maintained sample installation may be incorporated into completed work.

I. Dismantle unacceptable sample installation and remove from site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Synthetic Polymer Membrane:
1) Henry Company; Air-Bloc 32MR. (Basis of Design)
2) Grace, W. R. & Co.; Perm-A-Barrier Liquid.
3) Meadows, WR, Inc,; Air-shield LM.
2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm x sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Membrane Vapor Permeance: Not to exceed 0.1 perm; ASTM E 96.

2.2 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type accessory materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne or solvent-borne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous, 40-mil thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor-retarding, 30 to 40 mil thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 304 stainless-steel fasteners.

I. Sprayed Polyurethane Foam Sealant: 1- or 2 component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil thick polyethylene film with release liner backing.

K. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50 to 65-mil thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

L. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

M. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with 07 92 00 Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
   3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   4. Verify that masonry joints are flush and completely filled with mortar.
   5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
   1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and accessory materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
   1. Install compatible strip on roofing vapor barrier so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered in same day. Reprime areas exposed for more than 24 hours.
   1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing vapor barrier system, below-grade waterproofing system, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, dissimilar material junctures, inside and outside corners extending a minimum of 3 inches on each side, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over both substrates.
   1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
   2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
   3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and membrane.
   4. Use the transition strip method that is acceptable to the manufacturer.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch wide, counterflashing strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR BARRIER MEMBRANE INSTALLATION

A. Apply air barrier membrane to form a seal with strips and transition strips and to achieve a continuous air barrier according to air barrier manufacturer's written instructions.

B. Apply air barrier membrane within manufacturer's recommended application temperature ranges.

C. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.
   1. Manufacturer must approve not using primer.
   2. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

D. Apply a continuous unbroken air barrier to substrates according to the following minimum thickness. Apply membrane in full contact around protrusions such as masonry ties.
   1. Vapor-Retarding Membrane Air Barrier: 40-mil dry film thickness.

E. Apply strip and transition strip a minimum of 3 inches onto cured air membrane or strip and transition strip over cured air membrane overlapping 3 inches onto each surface according to air barrier manufacturer's written instructions.

F. Do not cover air barrier until it has been tested and inspected by A/E's testing agency.

G. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.6 FIELD QUALITY CONTROL

A. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:
   1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air barrier system has been provided.
   3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
   4. Site conditions for application temperature and dryness of substrates have been maintained.
   5. Maximum exposure time of materials to UV deterioration has not been exceeded.
   6. Surfaces have been primed.
   7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
   8. Termination mastic has been applied on cut edges.
   9. Strips and transition strips have been firmly adhered to substrate.
   10. Compatible materials have been used.
   11. Transitions at changes in direction and structural support at gaps have been provided.
   12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
   13. All penetrations have been sealed.

B. The Contractor shall:
   1. Allow sufficient time for inspection and provide a schedule.
   2. Provide to the Architect/Engineer copies of Quality Assurance Program documentation such as daily site reports completed by installers.

C. Remove and replace deficient air barrier components and retest as specified above.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
   1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
   2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

SECTION 07 42 43

COMPOSITE WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes metal-faced composite wall panels.
   1. Coordinate installation with the installation and assembly work provided by the cold formed framing sub contractor.

B. Related Sections:
   1. Division 05 Section "Cold-Formed Metal Framing" for cold-formed metal framing supporting metal-faced composite wall panels.
   2. Division 07 Section "Sheet Metal Flashing and Trim" for field-formed flashings and other sheet metal work not part of metal-faced composite wall panel assemblies.

1.3 DEFINITION

A. Metal-Faced Composite Wall Panel Assembly: Metal-faced composite wall panels, attachment system components, miscellaneous metal framing, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal-faced composite wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal-faced composite wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Drained and back ventilated rain screen performance; per AAMA 509-09:
   1. Water penetration through panel system: W1 classification
   2. Ventilation: V4 classification

D. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
   1. Test-Pressure Difference: 1.57 lbf/sq. ft. .

E. Water Penetration Under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
   1. Test-Pressure Difference: 6.24 lbf/sq. ft. .

F. Structural Performance: Provide metal-faced composite wall panel assemblies capable of withstanding the effects of the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 330:
   1. Wind Loads: Determine loads based on the following minimum design wind pressures:
      a. Uniform pressure of 20 lbf/sq. ft., acting inward or outward.
      b. Uniform pressure as indicated on Drawings.
   2. Deflection Limits: Metal-faced composite wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/175 of the span at the perimeter and 1/60 of the span anywhere in the panel.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal-faced composite wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal-faced composite wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish among factory, shop, and field-assembled work.
   1. Curved Panel section: Full size for approval prior to panel production.
   2. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches (1:10):
      a. Flashing and trim.
      b. Anchorage systems.

C. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

D. Samples for Initial Selection: For each type of metal-faced composite wall panel indicated with factory-applied color finishes.
   1. Include similar Samples of trim and accessories involving color selection.
   2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Metal-Faced Composite Wall Panels: Minimum 12 x 12 inches . Include fasteners, closures, and other metal-faced composite wall panel accessories.
      a. Composite Panels: Include four-way joint.
   2. Trim and Closures: 12 inches long. Include fasteners and other exposed accessories.
   3. Accessories: 12-inch long Samples for each type of accessory.
   4. Exposed Gaskets: 12 inches long.

5. Exposed Sealants: For each type and color of joint sealant required. Install joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of metal-faced composite wall panels adjacent to joint sealants.

F. Delegated-Design Submittal: For metal-faced composite wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

G. Non-Combustibility Requirement: For area indicated on the Drawings only, provide firerated core ACM complying with ASTM 84 maximum flame spread, maximum smoke developed 450, NFPA 285 Intermediate Scale Multi-Story Test.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Exterior elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Wall panels and attachments.
2. Stud framing.
3. Wall-mounted items including doors, windows, louvers, and lighting fixtures.
4. Penetrations of wall by pipes and utilities.

B. Qualification Data: For Structural engineer and testing agency.

C. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

E. Field quality-control reports.

F. Warranties: Samples of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal wall panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Source Limitations: Obtain each type of metal-faced composite wall panel from single source from single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit samples of materials that will contact joint sealants to joint-sealant manufacturers for testing indicated in subparagraphs below:
1. Use manufacturer's standard test methods to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
a. Perform tests under environmental conditions replicating those that will exist during installation.

2. Submit no fewer than nine pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule enough time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.

D. Fire-Resistance Ratings: Where indicated, provide metal-faced composite wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall AND corner panel, including soffit, as shown on Drawings; approximately one bay wide by one story high by full thickness, including supports, attachments, and accessories.
   a. Include four-way joint for metal-faced composite wall panels.
2. Conduct water-spray test of mockup of metal-faced composite wall panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. For curved wall area provide coordination of metal stud framing/finished substrate board installation with metal panel shop drawings allowing for a 1/175 deflection limit tolerance and maximum 1/4" tolerance.

G. Preinstallation Conference: Conduct conference at Project site.
1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, metal-faced composite wall panel Installer, metal-faced composite wall panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal-faced composite wall panels including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal-faced composite wall panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal-faced composite wall panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal-faced composite wall panel assembly during and after installation.
8. Review wall panel observation and repair procedures after metal-faced composite wall panel installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal-faced composite wall panels, and other manufactured items so as not to be damaged or deformed. Package metal-faced composite wall panels for protection during transportation and handling.

B. Unload, store, and erect metal-faced composite wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Store metal-faced composite wall panels vertically, covered with suitable weathertight and ventilated covering. Store metal-faced composite wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal-faced composite wall panels in contact with other materials that might cause staining, denting, or other surface damage. Do not allow storage space to exceed 120 deg F (49 deg C).

D. Retain strippable protective covering on metal-faced composite wall panel for period of panel installation.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal-faced composite wall panels to be performed according to manufacturer's written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal-faced composite wall panel fabrication and indicate measurements on Shop Drawings.

1.11 COORDINATION

A. Coordinate metal-faced composite wall panel assemblies with rain drainage work, flashing, trim, and construction of studs, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal-faced composite wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal-faced composite wall panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL MATERIALS

A. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
   1. Surface: Smooth, flat finish.

2. Exposed Coil-Coated Finishes:
   a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both prime coat and color topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
3. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:
   1. Joint Sealant: ASTM C 920; elastomeric polyurethane, polysulfide, or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal-faced composite wall panels and remain weathertight; and as recommended in writing by panel manufacturer.

2.2 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 645,Grade 50, G90 (Z180) hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Subgirts: Manufacturer's standard C- or Z-shaped sections 0.064-inch nominal thickness.

C. Zee Clips: 0.079-inch nominal thickness.

D. Base or Sill Angles: 0.079-inch nominal thickness.

E. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and finish indicated.

B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal-faced composite wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 METAL-FACED COMPOSITE WALL PANELS

A. General: Provide factory-formed and -assembled, metal-faced composite wall panels fabricated from two metal facings bonded, using no glues or adhesives, to solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment system components and accessories required for weathertight system.
   1. Fire-Retardant Core: Noncombustible, with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
      a. Use only in locations indicated on the Drawings. Fire retardant core not required in other locations.
      b. Flame-Spread Index: 25 or less.
      c. Smoke-Developed Index: 450 or less.

2. Basis of Design Product: Subject to compliance with requirements, provide CENTRIA Architectural Systems; Formabond II Wall System, or comparable product by one of the following:
   a. Alcan Composites USA Inc.; Alucobond
   b. Alcoa Inc.; Reynobond
   c. ALPOLIC, Division of Mitsubishi Chemical America, Inc.; ALPOLIC.

B. ACCEPTABLE FABRICATORS
1. Approved by the Architect ten (10) days prior to bid and in accordance with Division 01 Sections "Substitution Procedures" and Submittal Procedures".
   a. Centria
   b. Sobotec
   c. Northclad ACM
   d. Now Specialties
   e. Shaffner Heaney Associates, Inc.
   f. Litecore
   g. Metal Design Systems

C. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch thick, coil-coated aluminum sheet facings.
1. Panel Thickness: 0.157 inch .
2. Core: Fire retardant.
   a. Use only in locations indicated on the Drawings. Fire retardant core not required in other locations.
3. Exterior Finish: 2-coat fluoropolymer.
   a. Color: As selected by Architect from manufacturer's full range.

D. Attachment System Components: Formed from material compatible with panel facing.
1. Include manufacturer's standard panel stiffeners, panel clips, and anchor channels.

2.5 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal-faced composite wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal-faced composite wall panels unless otherwise indicated.

B. Flashing and Trim: Formed from 0.018-inch minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal-faced composite wall panels.

2.6 FABRICATION

A. General: Fabricate and finish metal-faced composite wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal-faced composite wall panels in a manner that eliminates condensation on interior side of panel .

C. Metal-Faced Composite Wall Panels: Factory form panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.

1. Form panel lines, breaks, and angles to be sharp and true, with surfaces free from warp and buckle.
2. Fabricate panels with sharply cut edges, with no displacement of face sheets or protrusion of core material.
3. Fabricate panels with panel stiffeners, as required to comply with deflection limits, attached to back of panels with structural silicone sealant or bond tape.
4. Dimensional Tolerances:
   a. Panel Bow: 0.8 percent maximum of panel length or width.
   b. Squareness: 0.25 inch maximum.

D. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal-faced composite wall panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal-faced composite wall panel manufacturer for application, but not less than thickness of metal being secured.

2.7 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal-faced composite wall panel supports, and other conditions affecting performance of the Work.
1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal-faced composite wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal-faced composite wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal-faced composite wall panels to verify actual locations of penetrations relative to seam locations of panels before panel installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorage according to ASTM C 754 and metal-faced composite wall panel manufacturer's written instructions.

3.3 METAL-FACED COMPOSITE WALL PANEL INSTALLATION

A. General: Install metal-faced composite wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Commence metal-faced composite wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
   2. Shim or otherwise plumb substrates receiving metal-faced composite wall panels.
   3. Flash and seal metal-faced composite wall panels at perimeter of all openings. Do not begin installation until weather barrier and flashings that will be concealed by panels are installed.
   4. Install flashing and trim as metal-faced composite wall panel work proceeds.
   5. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
   6. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:
   1. Aluminum Wall Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
   2. Copper Wall Panels: Use copper, stainless-steel, or hardware-bronze fasteners.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal-faced composite wall panel manufacturer.

D. Joint Sealers: Install joint fillers, and sealants where indicated and where required for weathertight performance of metal-faced composite wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by panel manufacturer.
   1. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

E. Attachment System Installation, General: Install attachment system required to support metal-faced composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
   2. Do not begin installation until weather barrier and flashings that will be concealed by composite panels are installed.

F. Clip Installation: Attach panel clips to supports at each metal-faced composite wall panel joint at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.
   1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Division 07 Section "Joint Sealants."

G. Track-Support Installation: Provide manufacturer's standard horizontal and vertical tracks that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach panels to wall by interlocking tracks with perimeter extrusions attached to wall panels. Fully engage integral gaskets and leave horizontal and vertical joints with open reveal.
   1. Attach routed-and-returned flanges of wall panels to perimeter extrusions with manufacturer's standard fasteners.
   2. Attach flush wall panels to perimeter extrusions by engaging panel edges and by attaching with manufacturer's standard structural silicone adhesive.
   3. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   4. Do not apply sealants to joints unless otherwise indicated on Drawings.

H. Subgirt-and-Spline Installation: Provide manufacturer's standard subgirts and splines that provide support and complete secondary drainage system, draining to the exterior at horizontal joints. Install support system at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by interlocking perimeter extrusions attached to routed-and-returned flanges of wall panels with subgirts and splines. Fully engage integral subgirt-and-spline gaskets and leave horizontal and vertical joints with open reveal.
   1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated on Drawings.

I. Rainscreen-Principle Installation: Provide manufacturer's standard pressure-equalized, rainscreen-principle system with vertical channel that provides support and complete secondary drainage system, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach wall panels by engaging horizontal support pins into notches in vertical channels and into flanges of wall panels. Leave horizontal and vertical joints with open reveal.
   1. Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
   2. Do not apply sealants to joints unless otherwise indicated on Drawings.

3.4 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal-faced composite wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal-faced composite wall panel units within installed tolerance of 1/4 inch in 20 feet , nonaccumulative, on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water Penetration: Test areas of installed system indicated on Drawings for compliance with system performance requirements according to ASTM E 1105 at minimum differential pressure of 20 percent of inward-acting, wind-load design pressure as defined by SEI/ASCE 7, but not less than 6.24 lbf/sq. ft. .

C. Water-Spray Test: After completing the installation of 75-foot by-2-story minimum area of metal-faced composite wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

D. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust completed metal-faced composite wall panel installation, including accessories.

E. Metal-faced composite wall panels will be considered defective if they do not pass tests and inspections.

F. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.7 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal-faced composite wall panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal-faced composite wall panel installation, clean finished surfaces as recommended by panel manufacturer. Maintain in a clean condition during construction.

B. After metal-faced composite wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal-faced composite wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 54 23

THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

PART - 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following:
1. Adhered TPO membrane roofing system.
2. Vapor retarder.
3. Roof insulation.
4. Substrate board.
5. Cover board.
6. Roof system accessories.
7. Roof system flashings and terminations.
8. Walkways.
9. Roof pavers.

B. Single Contract Responsibility: Retain a single firm or company, hereinafter referred to as “Roofing Contractor”, for furnishing the Work of this Section and related Sections to establish undivided responsibility for entire roofing system.

C. Products installed but not furnished under this Section:
1. Metal counterflashings and coping.
2. Sealants and joint fillers in conjunction with the above.

1.3 RELATED WORK

A. Specified Elsewhere:
1. 06 10 00 - Rough Carpentry.
2. 07 21 00 – Building Insulation
3. 07 62 00 - Sheet Metal Flashing and Trim.
4. 07 72 00 - Roofing Accessories.
5. 07 92 00 - Joint Sealants.
6. 22 10 30 - Plumbing Specialties.

1.4 DEFINITIONS

A. TPO: Thermoplastic polyolefin.

B. Roofing Terminology: See ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

C. Roofing System Manufacturer: Any of the manufacturers whose systems are specified under "Acceptable Roofing System Manufacturers" in this Section hereinafter called "manufacturer."

1.5 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals markings.
   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail Resistance: MH.

E. Solar Reflectance Index: Not less than 78 when calculated according to ASTM E 1980, based on testing identical products by a qualified testing agency.

F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low -slope roof products.
   1. Reference DOE “Guidelines for Selecting Cool Roofs” July 2010 v 1.2

1.6 SUBMITTALS

A. Combined Submittal: Submit items required below as a combined submittal with requirements of 07 62 00 Sheet Metal Flashing and Trim and 07 72 00 Roof Accessories.

B. Product Data: For each type of product indicated.

C. LEED Submittals:
   1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
   2. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   3. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
   4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

D. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work.
   1. Submit shop drawings to the manufacturer for review and comment.
   2. Submit only manufacturer reviewed shop drawings to the A/E.
   3. Minimum Scale for Roof Plan: 1/8" = 1' 0".
   4. Minimum Scale for Details: 1-1/2" = 1' 0.
   5. Submit the following:
      a. Base flashings and membrane terminations.
      b. Tapered insulation, including slopes.
      c. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
      d. Setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

E. Samples for Verification: For the following products:
   1. TPO membrane, of color specified, including T-shaped side and end lap seam.
      a. 4 inch x 6 inch, 3 pieces
   2. Roof insulation, 8 inch x 10 inch, 2 pieces.
   3. Insulation fastener and plate, 2 of each.
   4. Metal termination bars, 12 inches long, 3 pieces.
   5. Sheet metal used with roofing, 4-by-4 inch square of each type, 3 pieces.
   6. Plaza-deck paver, 4-by-4 inch square, in each color and texture required.

F. Qualification Data:
   1. Endorsement of Roofing Firm: Contractor: Within l5 days of receiving the Notice of Award, submit the manufacturer's endorsement of the installing firm.
   2. Include Roofing Contractor list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers with the oldest project no less than 5 years old.

G. Factory Mutual Global Information:
   1. Submit RoofNav Assembly number for roofing system. RoofNav can be accessed at website: www.roofnav.com.

H. Certificates:
   1. Roofing manufacturer certification:
      a. Roofing System Manufacturer’s Certificate (CDB Form RSMC): An acknowledgment signed by each specified manufacturer’s technical staff that they have reviewed plans & specs submitted by the A/E during the design phase for compliance with their requirements for signing the RSMW.
      b. Membrane thickness over the reinforcing scrim (top ply membrane thickness) is nominal 15 mil.
   2. Prior to pre-installation conference, submit roofing manufacturer's certification that Roofing Contractor is currently approved by roofing manufacturer.
   3. Submit certification from manufacturer of rigid insulation stating that insulation is manufactured free of, and does not contain, chlorofluorcarbons (CFC).
   4. Include EnergyStar Certification and initial and 3-year aged solar reflectance including test method used.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

J. Inspection reports: Submit copy of manufacturer's technical representative's field inspection reports.

1.7 CLOSEOUT SUBMITTALS

A. Warranty:
   1. General Contractor: Two years in accord with the Standard Documents for Construction.
   2. Roofing System Manufacturer's Warranty (CDB Form RSMW): A special CDB warranty form signed by manufacturers participating in the CDB Warranty Program, see Appendix "A."

B. Maintenance Proposal: Submit signed and dated proposal.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed and FM Approvals approved for membrane roofing system identical to that used for this Project.
   1. The A/E has certificates (CDB Form RSMC) on file from each of the specified manufacturers stating:
      a. They have examined project drawings, specifications and warranty requirements.
      b. Their specified products are acceptable for and compatible with the roofing and flashing system design.
      c. They will issue the specified warranty if the roofing and flashing systems are installed in accord with their requirements.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.
   1. Job foreman shall be trained by the manufacturer in the installation of the specified system.
   2. The installing contractor shall comply with the Illinois Roofing Industry Licensing Act.

C. Quality Control Plan: Develop a plan to ensure manufacturer and specification requirements are followed, including approved shop drawings, instructions from manufacturer, and inspection reports being maintained and accessible in the work area at all times. Refer to the approved sample installation.

D. Source Limitations: Obtain components including roof insulation for membrane roofing system from same manufacturer as membrane roofing.

E. Exterior Fire-Test Exposure: ASTM E 108, Class A; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Using Agency, Architect/Engineer, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
   2. Review methods and procedures related to roofing installation, including manufacturer's written instructions and Contractor's Quality Control Plan.
   3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
   5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Review requirements for sample installation.

H. Sample Installation: Install 100 sq. ft. of the membrane to include a parapet condition with associated flashing before proceeding with membrane installation.
1. Notify at least 48 hours in advance and to be in attendance during installation: Using Agency, Architect/Engineer, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative.
2. Do not disturb the approved sample installation area for the duration of the roof system installation.

1.9 PRECONSTUCTION MOCK-UP

A. Prior to commencing work and preceding pre-installation conference, provide pre-construction mock-up of roofing to set quality standards for materials and execution.
1. Refer to Specification Section 01 40 00– Quality Requirements

B. Size and Location: As indicated on Drawings.

C. Materials and Extent:
1. Complete installation roof assembly components and with adhesives, anchors, protection board, insulation, flashings, supports, vapor barriers, and sealants indicated and in accordance with final Shop Drawings.
2. Include intersections of curtain wall and metal panel unit rainscreen system with roofing.
3. Show details and workmanship expected in the final Work.
4. Incorporate the following related primary materials and products specified in other Sections:
a. CMU backup and associated mortar and joint reinforcement.
b. Insulation.
c. Air barriers.
d. Composite Metal panel.
e. Aluminum-framed curtain wall.
f. Glass and glazing.
g. Joint sealers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.11 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.12 WARRANTY

A. Special Warranty: Specific to the project, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.
   1. Special warranty includes roofing assembly from top of substrate deck to top of roofing including all components such as fasteners, adhesives, roofing membrane, seals and sealants, walkways and flashing.
   2. Warranty Period: 20years from date of Substantial Completion.

1.13 MAINTENANCE PROPOSAL

A. Provide five year maintenance proposal for roofing maintenance by installer for Using Agency’s review and optional acceptance.

B. If Using Agency elects to purchase maintenance service, include executed maintenance agreement in Project Record Documents.

PART - 2 PRODUCTS

1.14 TPO MEMBRANE ROOFING

A. Fabric-Reinforced Thermoplastic Polyolefin Sheet: ASTM D 6878, internally fabric or scrim reinforced, uniform, flexible TPO sheet.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Carlisle SynTec Incorporated.
      b. Firestone Building Products Company; Ultraply TPO
      c. Johns Manville.
   2. Thickness: 60 mils, nominal with felt backing.
   3. Exposed Face Color: White.

1.15 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use, and compatible with membrane roofing.
   1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
   2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Plastic Foam Adhesives: 50 g/L.
      b. Gypsum Board and Panel Adhesives: 50 g/L.
      c. Multipurpose Construction Adhesives: 70 g/L.
      d. Fiberglass Adhesives: 80 g/L.
      e. Single-Ply Roof Membrane Adhesives: 250 g/L.
      f. Other Adhesives: 250 g/L.
      g. Single-Ply Roof Membrane Sealants: 450 g/L.

h. Nonmembrane Roof Sealants: 300 g/L.
i. Sealant Primers for Nonporous Substrates: 250 g/L.
j. Sealant Primers for Porous Substrates: 775 g/L.

B. Sheet Flashing: Manufacturer's standard unreinforced thermoplastic polyolefin sheet flashing, 55 mils thick, minimum, of same color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Metal Termination Bars: Manufacturer's predrilled stainless-steel or aluminum bars with ribs, approximately 1 by 1/8 inch thick and angled top edge sealant pocket; with anchors.

E. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories

1.16 SUBSTRATE AND COVER BOARDS

A. Substrate and Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate and cover board, 1/2 inch thick specifically for adhered single-ply systems.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Georgia-Pacific Corporation; Dens Deck Prime.
b. USG; SECUROCK Gypsum-Fiber Roof Board.
c. ISOGARD HD Cover Board by Firestone Building Products Co.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

1.17 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured by TPO membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class I, Grade 3 (25 psi), felt or glass-fiber mat facer on both major surfaces.
1. Long Term Thermal Resistance LTTR (15 year average in accordance with CAN/ULC-S770); R-Value: 6.0 per inch

C. Roof Insulation for Non-tapered Areas
1. Thickness: Two layers of board insulation with a combined thickness of 4 inches.
1) 1/2-inch glass-mat, water-resistant gypsum substrate layer
2) First insulation board layer thickness: 2 inches.
3) Second insulation board layer thickness: 2 inches.
4) 1/2-inch glass-mat, water-resistant gypsum overlay.
5) Assembly including the final membrane layer to achieve R30 insulating r-factor.

D. Roof insulation for Tapered Areas:
1. 1/2-inch glass-mat, water-resistant gypsum substrate layer.
2. Provide factory-tapered insulation boards fabricated to slope as indicated and required for slope to drains.
3. Slope: 1/4 inch/foot, minimum.
4. 1/2-inch glass-mat, water-resistant gypsum overlay.

E. Insulation Restrictions:
   1. Minimum thickness of roof insulation: 4 inches (or R-30 insulation factor)
   2. Board size: 4'-0” x 4'-0” maximum.

F. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated and as required for tapered insulation.

1.18 VAPOR RETARDER

A. Polyethylene Film: ASTM D 4397, 10 mils thick, minimum, with maximum permeance rating of 0.04 perm in accordance with ASTM E 96.
   1. Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
   2. Acceptable products and manufacturers:
      a. Stego Wrap Vapor Barrier (10-mil) by Stego Industries LLC.
      b. Griffolyn Type-65 by Reef Industries, Inc.
      c. Moistop Ultra 10 by Forifiber Industries.

1.19 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

C. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

1.20 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface textured walkway pads or rolls, approximately 3/16 inch thick, and acceptable to membrane roofing manufacturer.

PART - 3 EXECUTION

1.21 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and confirm that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in 05 30 00 Steel Decking.
   4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1.22 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

1.23 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.
1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.
3. Ensure cover board end joints are supported by metal deck flutes and fasteners are countersunk to prevent vapor retarder damage.

1.24 VAPOR-RETARDER INSTALLATION

A. General:
1. Install products in accordance with manufacturer’s instructions.
2. Coordinate with construction of substrate and installation of roof penetrations and accessories.

B. Primer:
1. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by vapor retarder sheet in same day. Reprime areas exposed for more than 24 hours,
2. Prime substrates with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Vapor Retarder:
1. Install vapor retarder to prepared surfaces in accordance with manufacturer’s instructions and within manufacturer’s recommended application temperature ranges.
2. Position membrane to avoid fish-mouths, wrinkles and blisters.
3. Overlap edges a minimum of 2-1/2 inches.
4. Stagger end laps.

1.25 INSULATION INSTALLATION

A. Coordinate installation of membrane roofing system components to prevent exposure of insulation to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Install minimum of two layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:
   1. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place or set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place according to manufacturer’s instructions and as required to comply with performance requirements.

1.26 COVER BOARD INSTALLATION

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Adhere to insulation and ensure tight joints.
   1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.

1.27 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere membrane roofing over area to receive roofing and install according to membrane roofing system manufacturer's written instructions.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap membrane roofing, and hot-air weld side and end laps of membrane roofing and sheet flashings according to manufacturer's written instructions to ensure a watertight seam installation.
   1. Roll all seams with a silicone roller to ensure a continuous hot air welded seam.
      a. Splice seams shall be overlaid with non-reinforced flashing.
   2. Test all lap edges with probe to verify seam weld continuity after thoroughly cooled. Apply lap sealant to seal cut edges of sheet membrane.
   3. Verify field strength of seams a minimum of twice daily and repair seam sample areas.
   4. Repair tears, voids, and lapped seams in roofing that does not comply with requirements same day discovered.

H. Spread sealant bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

I. Membrane Lining for Gutters and Scuppers:
   1. Fully adhere to substrates, as specified for roofing membrane.
   2. Extend membrane into drain leader as prescribed by membrane manufacturer.

1.28 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

1.29 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

1.30 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

B. Flood Testing: Flood test each roofing area for leaks, according to recommendations in ASTM D 5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
   1. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
   2. Flood each area for 24 hours.
   3. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

1.31 COORDINATION

A. Coordinate with Section 01 81 13 “Sustainable Design Requirements” for LEED Requirements concerning temporarily sealing roof openings/penetrations to block VOC’s emitted from roofing products from entering the building interior.

1.32 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect/Engineer and Using Agency.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements; repair substrates; and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes flashing as required.

B. Single Contractor Responsibility:
   1. Provide flashing in conjunction with roofing system under single Prime Contract provisions as specified in 07 54 23 Thermoplastic Polyolefin (TPO) Roofing.

1.3 RELATED WORK

A. Specified Elsewhere
   1. 01 33 00 – Submittals
   2. 04 20 00 – Unit Masonry.
   3. 05 40 00 - Cold Formed Metal Framing.
   4. 07 27 26 - Fluid-Applied Membrane Air Barriers.
   5. 07 42 13- Metal Wall Panels.
   6. 07 54 23 – Thermoplastic Polyolefin (TPO) Roofing.
   7. 07 92 00- Joint Sealants.
   8. 08 41 13 – Aluminum-Framed Entrances and Storefronts.
   9. 08 44 13 – Glaze Aluminum Curtain Walls
   10. 08 44 23 – Structural Sealant Glazed Curtain Walls

1.4 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install copings capable of resisting forces according to recommendations in FMG Loss Prevention Data Sheet 1-49.

C. Edge Securement: Provide sheet metal flashing and trim complying with requirements for wind uplift testing in applicable edition of International Building Code (IBC) and ANSI/SPRI ES-1.

D. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Combined Submittal: Submit following as combined submittal with Work specified in Section 07 54 23 Thermoplastic Polyolefin (TPO) Roofing.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

C. LEED Submittals:
   1. Product Data for Credit SS 7.2: For roof materials, indicating that roof materials comply with Solar Reflectance Index requirement.
   2. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   3. Product Certificates for Credit MR 5.1 and MR 5.2: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
   4. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

D. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, dimensions, and keyed details. Distinguish between shop- and field-assembled Work. Include the following:
   1. Identification of material, thickness, weight, and finish for each item and location in Project.
   2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
   3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   4. Details of termination points and assemblies, including fixed points.
   5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
   6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   7. Details of special conditions.
   8. Details of connections to adjoining work.
   9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches (1:5).

E. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

F. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
   1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
   2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
   3. Accessories and Miscellaneous Materials: Full-size Sample.
   4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

G. Qualification Data: For qualified fabricator.

H. Warranty: Submit combined warranty as specified in Section 07 54 23 Thermoplastic Polyolefin (TPO) Roofing.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.7 SYSTEM REQUIREMENTS

A. Performance Requirements: Provide permanently watertight flashing and sheet metal installation which will not deteriorate in excess of manufacturer's published limitation.

B. Metal Gage and Weight Requirements:
1. Thicknesses, gages and weights specified are minimum.
2. Manufacturer is to state thickness, gage or weight of material he intends to provide and recommends for intended application, use and configurations indicated to provide straight, rigid and flat surfaces for completed fabrications.

C. Interface with Other Systems:
1. Do not proceed with installation of flashing and sheet metal until completion of curb and substrate construction, cants, blocking, reglets and other construction required to receive flashing.
2. Coordinate flashing with other Work for correct sequencing of items comprising entire membrane or system of roofing or waterproofing and rain drainage.

1.8 QUALITY ASSURANCE

A. Installer/Fabricator Qualifications: Not less than 5 years documented, successful experience with work comparable to Work of this Project, approved or acceptable to roofing membrane manufacturer. If SMACNA's "Architectural Sheet Metal Manual" is not standard office practice in the area of Project, substitute another standard in first paragraph below such as "The NRCA Roofing and Waterproofing Manual."

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Pre-installation Conference: Conduct conference at Project site.
1. Meet with Using Agency, Architect/Engineer, Using Agency's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.9 PRECONSTRUCTION MOCK-UP

A. Prior to commencing work and preceding pre-installation conference, provide pre-construction mock-up of sheet metal flashing and trim to set quality standards for materials and execution.
1. Refer to Specification Section 01 40 00 – Quality Requirements

B. Size and Location: As indicated on Drawings.

C. Materials and Extent:
   1. Complete installation with sheet metal flashing and trim with assembly components and with anchors, and sealants indicated and in accordance with final Shop Drawings.
   2. Include intersections of curtain wall openings and metal panel system with sheet metal flashing and trim.
   3. Show details and workmanship expected in the final Work.
   4. Incorporate the following related primary materials and products specified in other Sections:
      a. CMU backup and associated mortar and joint reinforcement.
      b. Insulation.
      c. Air barriers.
      d. Aluminum-framed curtain wall.
      e. Metal panel
      f. Glass and glazing.
      g. Joint sealers.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver manufactured materials to the Project site in their original unopened containers, or packages or bundles, bearing label clearly identifying manufacturer’s name, brand name, and other pertinent information.

B. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

C. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.11 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Warrant sheet metal Work, except items embedded in built-up roofing and forming an integral part of built-up roof system, for two (2) years against defective materials, workmanship and leaks, except leaks caused by abuse, lightning, hurricane, tornado, hail storm, unusual climatic phenomena or failure of related Work installed by other parties.

C. During the warranty period, restore defective Work to the standard of the Contract Documents, including all materials, labor, refinishing and other costs incidental to the Work.
   1. Within 24 hours after receipt of notice from the Using Agency, inspect the Work and immediately repair leaks.
   2. Restore Work found to be defective as defined in the Contract Documents within 10 days after receipt of notice from the Using Agency.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
   1. Surface: Embossed.
   2. Exposed Coil-Coated Finishes:
      a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   3. Color: To match Architect/Engineer’s sample. Finish in subparagraph below is frequently retained as a factory finish for interior surfaces of coil-coated sheet. Usually delete for other finishes.
   4. Concealed Finish: Pre-treat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

C. Stainless-Steel Sheet: ASTM A 167, A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.
   1. Finish: 2D (dull, cold rolled) per ASTM A 480.
   2. Surface: Smooth, flat.

2.2 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F .
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F .
   3. Products: Subject to compliance with requirements, provide one of the following:
      a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
      b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
      c. Henry Company; Blueskin PE200 HT.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 304 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 304 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Epoxy Seam Sealer: Two-part, non-corrosive, aluminum seam-cementing compound or sealant, recommended by aluminum manufacturer for exterior non-moving joints, including aluminum riveted joints, as manufactured by Alcoa “Gutter Seal”, or as approved.

F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Bituminous Paint: Fed. Spec. TT-C-494B, Type II.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

I. Mastic: Asphalt base mixture complying with ASTM D 54586, Type I.

J. Expansion Shields: Fed. Spec. FF-S-325, machine bolt type, tubular type, or self-drilling tubular type.

2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Refer to 04 20 00 Unit Masonry for sheet metal flashings specified for masonry walls.

2.5 PRE-FABRICATED PRODUCTS

A. Formed Aluminum Copings:
1. ASTM B 209, alloy 6063-T52 or as recommended by manufacturer, smooth surface, 0.050 inch minimum thickness, of profiles and dimensions indicated on Drawings.
2. Fabricate with prefabricated mitered corner units.
3. Provide with manufacturer’s aluminum anchor plates, gutter/splice plates with butyl seal strips, and anchors suitable for substrate, to provide snap-on installation without use of exposed fasteners.
4. Finish:
   a. Manufacturer’s standard PVDF resin-based fluoropolymer coating.
   b. Color: To match adjoining materials.
5. Acceptable products and manufacturers:
   a. Permesnap Coping by W.W. Hickman Co., Ashville, NC.
   b. Perma-Tite Coping by Metal-Era, Waukesha, WI.
   c. TITE-LOC Coping by Peterson Aluminum Corporation.

B. Formed Aluminum Fascias:
1. Formed aluminum fascias (gravel stops): ASTM B 209, alloy 6063-T52 or as recommended by manufacturer, smooth surface, 0.050 inch minimum thickness, of profiles and dimensions indicated on Drawings.
2. Fabricate with prefabricated mitered corner units.

3. Provide with manufacturer's aluminum cleats, splice plates, and anchors suitable for substrate, to provie snap-on installation without use of exposed fasteners.
4. Finish:
   a. Manufacturer's standard PVDF resin-based fluoropolymer coating,
   b. Color: To match adjoining materials.
5. Acceptable products and manufacturers:
   a. Safeguard Gravel Stop System by W.W. Hickman Co.
   b. Snap-Lok Fascia II by MM Systems Corporation.
   c. Perma-Tite Fascia by Metal-Era, Waukesha, WI.

C. Extruded Aluminum Trim and Flashing:
1. ASTM B 209, alloy 6063-T52, 0.08 inch minimum thickness, of profile and dimensions indicated.
2. Fabricate with formed aluminum joint covers and flashing assembly, and with prefabricated corner units.
3. Finish:
   a. Manufacturer's standard Kynar resin based fluoropolymer coating.
   b. Color: To match Architect/Engineer's sample.

D. Reglets:
1. Two-piece stainless steel reglet and counterflashing.
   a. Surface-mounted receivers are not permitted.
   b. Provide mortared-in receiver with 4 inch long flange, for use with new construction.
2. Acceptable products and manufacturers:
   a. Type D Reglet (surface) and Type B Snap Lock (mortared-in) by C. F. Cheney Flashing Company, Trention, NJ.
   b. Springlok Type SM (surface) and Type MA-4 (mortared-in) by Fry Reglet, Norcross, GA.
   c. Surface Mounted Type and Flat 4 inch In-Wall Flashing by Keystone Flashing Company, Philadelphia, PA.

E. Roof Drain Flashing:
1. 0.024 inch thick stainless steel.

F. Scuppers, Roof Penetration and Equipment Support Flashing.
1. 0.040 inch thick aluminum.

G. Exposed Formed Trim, Gravel Stops and Fasciae:
1. 0.050 inch thick aluminum.

H. Copings: SMACNA figure designation 3-4A.
1. 0.050 inch thick aluminum.

I. Counterflashing:
1. 0.032 inch thick aluminum.

2.6 FORMED MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
1. Stainless Steel: 0.024 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Stainless Steel: 0.025 inch thick.

2.7 FABRICATION

A. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

B. Form sections in longest practical lengths, minimum 8 feet. Make allowances for expansion at joints.

C. Provide flat lock seams, except corners. Fabricate corners minimum 18 inches x 18 inches mitered and sealed as one piece.

D. Factory fabricate end dams and special shapes.

E. Hem exposed edges of flashing on underside 1/2 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, free of loose materials and projections which might puncture flashings, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Polyethylene Sheet: Install polyethylene sheet with adhesive for anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped and taped joints of not less than 2 inches.

C. Felt Underlayment: Install felt underlayment with adhesive for temporary anchorage to minimize use of mechanical fasteners under sheet metal flashing and trim. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

D. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General
   1. Surfaces to be flashed or covered with sheet metal shall be clean and free from defects. Clean foreign matter from surfaces. Drive projecting nails flush.

2. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
3. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
5. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
6. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
7. Install sealant tape where indicated.
8. Torch cutting of sheet metal flashing and trim is not permitted.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of uncoated aluminum and stainless-steel sheet metal flashing and trim with heavy-bodied bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious or masonry construction.
2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in 07 92 00 Joint Sealants.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Copings
1. Install flexible flashing with adhesive recommended by flashing manufacturer. Lap joints 3 inches.
2. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate with screw fasteners and washers evenly spaced not over 12 inches on centers.
3. Anchor interior leg of coping with washers and screw fasteners through slotted holes evenly spaced not over 12 inches on centers.
4. Where construction is concrete or masonry, drive screws into lead expansion shields set into concrete or masonry.

5. Install strip to extend over the supporting construction to form a drip and to allow the metal coping to be hooked over the lower edge at least 3/4 inch .
6. Install coping with joints butted and backed up by concealed splice plates. Fill joints with concealed double beads and the top surface with a single bead of metal joint sealant.

C. Pipe or Post Counter-flashing: Install counter-flashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Cap Flashing / Counter-flashing
1. Coordinate installation of counter-flashing with installation of base flashing.
2. Install metal cap flashing over composition base flashing which turns up into vertical surfaces.
3. In new masonry work, set flashing in a bed of mortar both above and below the metal.
4. At concrete and existing masonry walls, wedge the upper receiver portion of counter-flashing into a reglet with coiled metal plugs compatible with the receiver metal or neoprene wedges, 12 to 16 inches on center, unless otherwise indicated, or anchor stainless steel clamping bar to wall with screws and expansion shields as indicated.
5. Hook lower portion of counter-flashing into upper receiver portion of counter-flashing and fasten with screws at 12 inch spacing and of length required to join the metal but not project into substrate behind the flashing.
6. At roof curbs, apply metal joint sealant and install one-piece cap flashing as indicated.
7. Lap section ends a minimum of 3 inches and seal watertight with mastic.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in 04 22 00 Concrete Unit Masonry.

C. Reglets: Installation of reglets is specified in 03 30 00 Cast-in-Place Concrete.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans independent from structure above as indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturers written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

E. Protect this Work and adjacent construction against damage during progress of Work until Substantial Completion. Take precautions to prevent damage to Work from traffic or placement of heavy materials thereon.

F. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 72 00

ROOF ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Roof curbs.
2. Equipment supports.
3. Preformed flashing sleeves.
4. Roof hatches

B. Related Sections:
1. Division 05 Section "Metal Fabrications" for metal vertical ladders, ships' ladders, stairs for access to roof hatches.
2. Division 05 Section "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Division 07 low-slope roofing Sections for roofing accessories.
4. Division 07 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

A. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.

B. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant and field assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:
   1. Size and location of roof accessories specified in this Section.
   2. Method of attaching roof accessories to roof or building structure.
   3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
   4. Required clearances.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.7 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation and mill phosphatized for field painting where indicated.
   1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
   2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
   1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
   2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

2.2 MISCELLANEOUS MATERIALS

A. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.

2.3 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units with integral spring-type vibration isolators and capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, thick.
   1. Finish: Two-coat fluoropolymer .
   2. Color: As selected by Architect from manufacturer's full range.

D. Material: Aluminum sheet, 0.090 inch thick.
   1. Finish: Clear anodic.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, all welded construction, continuous lid-to-curb counter-flashing and weather-tight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Type NB-50T by Bilco Company (The) or comparable product by the following:
      a. Babcock-Davis.
      b. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.

B. Type and Size: Single-leaf lid, 30 by 54 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: 0.090 (2.3mm) aluminum with a 4” (102mm) beaded flange with formed reinforcing members. Cover shall have a heavy extruded EPDM rubber gasket which is bonded to the cover interior to ensure a continuous seal when compressed to the top surface of the curb.

E. Construction:
   1. Insulation: 2 inches thick glass-polyisocyanurate board.
   2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid, continuously welded or soldered corners and fitted with neoprene gasket.
   3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
   4. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.

F. Lifting Mechanisms: Provide compression spring operators enclosed in telescopic tubes to provide controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe that is bolted to the curb assembly.

G. Finishes: Factory mill finish aluminum.

H. Hardware:
1. Heavy stainless steel pintle hinges shall be provided.
2. Cover shall be equipped with a spring latch with interior and exterior turn handles.
3. Equip with interior and exterior padlock hasps.
4. The latch strike shall be bolted to the curb assembly.
5. Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1 inch diameter red vinyl grip handle to permit easy release for closing.
6. Compression spring tubes shall be an anti-corrosive composite material and all other hardware shall be zinc plated and chromate sealed. Springs shall have an electrocoated acrylic finish for corrosion resistance. For installation in highly corrosive environments or when prolonged exposure to hot water or steam is anticipated, specify Type 316 stainless steel hardware.
7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

I. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.
1. Height: 42 inches above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter or galvanized-steel tube, 1-5/8 inches in diameter.
3. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.
4. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
5. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
6. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
7. Fabricate joints exposed to weather to be watertight.
8. Fasteners: Manufacturer's standard, finished to match railing system.
9. Finish: Manufacturer's standard.
   a. Color: As selected by Architect from manufacturer's full range.

J. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch- diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.
   a. Color: As indicated by manufacturer's designations.

2.5 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Greenheck Fan Corporation.
   b. LM Curbs.
   c. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   d. Thybar Corporation.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, thick.
   1. Finish: Two-coat fluoropolymer .
   2. Color: As selected by Architect from manufacturer's full range.

D. Material: Aluminum sheet, 0.090 inch thick.
   1. Finish: Clear anodic.

E. Construction:
   1. Insulation: Factory insulated with thick glass-fiber board insulation.
   2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
   3. Fabricate equipment supports to minimum height of 12 inches unless otherwise indicated.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Roof-Hatch Installation:
   1. Install roof hatch so top surface of hatch curb is level.
   2. Anchor counter-flashing to wood nailer with lag screws and lead washers.

3. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
4. Attach safety railing system to roof-hatch curb.
5. Attach ladder-assist post according to manufacturer's written instructions.

E. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

F. Preformed Flashing-Sleeve Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting"

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 84 13

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Sections:
1. Section 07 84 46 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For penetration firestopping sealants and sealant primers, documentation including printed statement of VOC content.

C. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) UL in its "Fire Resistance Directory."
         2) Insert name of qualified testing and inspecting agency.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. A/D Fire Protection Systems Inc.
   2. Grace Construction Products.
   3. Hilti, Inc.
   4. Johns Manville.
   5. RectorSeal Corporation.

6. 3M Fire Protection Products.
7. Tremco, Inc.; Tremco Fire Protection Systems Group.
8. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Fire-resistance-rated walls include fire walls, fire-barrier walls, smoke-barrier walls, and fire partitions.
2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. Horizontal assemblies include floors, floor/ceiling assemblies, and ceiling membranes of roof/ceiling assemblies.
2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Penetration firestopping sealants and sealant primers shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
1. Permanent forming/damming/backing materials, including the following:
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
   1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
   2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections.

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

A. Refer to Appendix A following this section and Partition Details as shown on the A9.00 series of the Drawing Sheets.

END OF SECTION

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TYPE OF PENETRANT	PENTRATION FIRESTOPPING SCHEDULE FIRESTOPPING SYSTEMS ARE LISTED USING THE ALPH-ALPHA-NUMERIC IDENTIFICATION SYSTEM UL'S FIRE RESISTANCE DIRECTORY, VOLS. 2A-2B			
	CONSTRUCTION			
	FLOOR PENTRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR F)			
	CONCRETE FLOORS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 5 INCHES (127 MM)		CONCRETE FLOORS WITH A MINIMUM THICKNESS OF MORE THAN 5 INCHES (127 MM)	
	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:
NO PENETRATING ITEMS	C-AJ-0001-0999 OR F-A-0001-0999		C-BJ-0001-0999 OR F-B-0001-0999	Latex sealant Silicone sealant Intumescent putty Mortar
METALLIC PIPE, CONDUIT OR TUBING	C-AJ-1001-1999 OR F-A-1001-1999		C-BJ-1001-1999 C-BK-1001-1999 OR F-B-1001-1999	Latex sealant Silicone sealant Intumescent putty Mortar
NONMETALLIC PIPE, CONDUIT, OR TUBING	C-AJ-2001-2999 OR F-A-2001-2999		C-BJ-2001-2999 C-BK-2001-2999 OR F-B-2001-2999	Latex sealant Silicone sealant Intumescent putty Intumescent wrap strips Mortar
ELECTRICAL CABLES	C-AJ-3001-399O OR F-A-3001-3999		C-BJ-3001-3999 C-BK-3001-3999 OR F-B-3001-3999	
CABLE TRAYS WITH ELECTRICAL CABLES	C-AJ-4001-4999 OR F-A-4001-4999		C-BJ-4001-4999 OR F-B-4001-4999	
INSULATED PIPES	C-AJ-5001-5999 OR F-A-5001-5999		C-AJ-5001-5999 C-BJ-5001-5999 OR F-B-5001-5999	Latex sealant Silicone foam Intumescent putty Intumescent wrap strips
MISCELLANEOUS ELECTRICAL PENETRANTS	C-AJ-6001-6999 OR F-A-6001-6999		C-BJ-6001-6999	
MISCELLANEOUS MECHANICAL PENETRANTS	C-AJ-7001-7999 OR F-A-7001-7999		C-BJ-7001-7999 OR F-B-7001-7999	
GROUPINGS OF PENETRATIONS	C-AJ-8001-8999 OR F-A-8001-8999		C-BJ-8001-8999 OR F-B-8001-8999	Latex sealant Mortar Intumescent wrap strips Firestop device Intumescent composite sheet

TYPE OF PENETRANT	PENTRATION FIRESTOPPING SCHEDULE FIRESTOPPING SYSTEMS ARE LISTED USING THE ALPH-ALPHA-NUMERIC IDENTIFICATION SYSTEM UL'S FIRE RESISTANCE DIRECTORY, VOLS. 2A-2B			
	CONSTRUCTION			
	FLOOR PENTRATION SYSTEMS (FIRST ALPHA COMPONENT = C OR F)			
	FRAMED FLOORS		FLOOR-CEILING ASSEMBLIES CONSISTING OF CONCRETE WITH MEMBRANE PROTECTION	
	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:
NO PENETRATING ITEMS	F-C-1001-1999			
METALLIC PIPE, CONDUIT OR TUBING	F-C-1001-1999		F-E-1001-1999	
NONMETALLIC PIPE, CONDUIT, OR TUBING	F-C-2001-2999		F-E-2001-2999	
ELECTRICAL CABLES	F-C-3001-3999		F-C-3001-3999	
CABLE TRAYS WITH ELECTRICAL CABLES				
INSULATED PIPES	F-C-5001-5999	Latex sealant Silicone foam Intumescent putty Intumescent wrap strips	F-E-5001-5999	
MISCELLANEOUS ELECTRICAL PENETRANTS				
MISCELLANEOUS MECHANICAL PENETRANTS	F-C-7001-7999	Latex sealant Mortar	F-E-7001-7999	
GROUPINGS OF PENETRATIONS	F-C-8001-8999	Latex sealant Mortar Intumescent wrap strips Firestop device Intumescent composite sheet	F-C-8001-8999	

PENTRATION FIRESTOPPING SCHEDULE
FIRESTOPPING SYSTEMS ARE LISTED USING THE ALPH-ALPHA-NUMERIC IDENTIFICATION SYSTEM
UL'S FIRE RESISTANCE DIRECTORY, VOLS. 2A-2B

CONSTRUCTION
WALL PENETRATIONS
(FIRST ALPHA COMPONENT = C OR W)

TYPE OF PENETRANT	CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS LESS THAN OR EQUAL TO 8 INCHES (203 MM)		CONCRETE OR MASONRY WALLS WITH A MINIMUM THICKNESS OF MORE THAN 8 INCHES (203 MM)	
	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:	SYSTEM	TYPE OF FILL MATERIALS: ONE OR MORE OF THE FOLLOWING:
NO PENETRATING ITEMS	C-AJ-0001-0999 C-BJ-0001-0999 OR W-J-0001-0999			
METALLIC PIPE, CONDUIT OR TUBING	C-AJ-1001-1999 C-BJ-1001-1999 OR W-J-1001-1999	Latex sealant Silicone sealant Intumescent putty Mortar	C-BK-1001-1999 OR W-K-1001-1999	Latex sealant Silicone sealant Intumescent putty Mortar
NONMETALLIC PIPE, CONDUIT, OR TUBING	C-AJ-2001-2999 C-BJ-2001-2999 OR W-J-2001-2999	Latex sealant Silicone sealant Intumescent putty Intumescent wrap strips Mortar	C-BK-2001-2999 OR 2001-2999	
ELECTRICAL CABLES	C-AJ-3001-3999 C-BJ-3001-3999 OR W-J-3001-3999		C-BK-3001-3999 OR W-K-3001-3999	
CABLE TRAYS WITH ELECTRICAL CABLES	C-AJ-4001-4000 C-BJ-4001-4999 OR W-J-4001-4999		W-L-401-4999	
INSULATED PIPES	C-AJ-5001-5999 C-BJ-5001-5999 OR W-J-5001-5999	Latex sealant Silicone foam Intumescent putty Intumescent wrap strips	C-BK-5001-5999	
MISCELLANEOUS ELECTRICAL PENETRANTS	C-AJ-6001-6999 C-BJ-6001-6999 OR W-H-6001-6999	Latex sealant Intumescent putty Mortar		
MISCELLANEOUS MECHANICAL PENETRANTS	C-AJ-7001-7999 C-BJ-7001-7999 OR W-J-7001-7999	Latex sealant Mortar		
GROUPINGS OF PENETRATIONS	C-AJ-8001-7999 C-BJ-8001-7999 OR W-J-8001-7999	Latex sealant Mortar Intumescent wrap strips Firestop device Intumescent composite sheet		

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SECTION 07 84 46

FIRE-RESISTIVE JOINT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior curtain-wall/floor intersections.
3. Joints in smoke barriers.

B. Related Sections:
1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For fire-resistive joint system sealants, documentation including printed statement of VOC content.

C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
   1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
      a. Fire-resistive joint system products bear classification marking of qualified testing agency.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
   1. Joints include those installed in or between fire-resistance-rated walls, floor or floor/ceiling assemblies, and roofs or roof/ceiling assemblies.
   2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.

C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg or ASTM E 2307.
   1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
   1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.

E. Exposed Fire-Resistive Joint Systems: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

F. VOC Content: Fire-resistive joint system sealants shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

G. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:
   1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
   2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
   3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:
   1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
   2. Apply fill materials so they contact and adhere to substrates formed by joints.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.5 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Silicone joint sealants.
2. Urethane joint sealants.

B. Related Sections:
1. Division 04 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Division 07 "Expansion Control" for building expansion joints.
3. Division 07 "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Division 08 "Glazed Aluminum Curtain Walls" for structural and other glazing sealants.
5. Division 08 "Structural-Sealant-Glazed Curtain Walls" for structural and other glazing sealants.
6. Division 08 "Glazing" for glazing sealants.
7. Division 09 "Gypsum Board" for sealing perimeter joints.
8. Division 09 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than three pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each application indicated below:
   a. Each kind of sealant and joint substrate indicated.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for

opposite side.

5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. LEED Submittals:
1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

F. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

G. Field-Adhesion Test Reports: For each sealant application tested.

H. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

D. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.

1.7 PRE-CONSTRUCTION MOCK-UP

A. Refer to Specification Section 01 33 00 – Submittals

B. Prior to commencing Work and preceding pre-installation conference, provide pre-construction mock-up of sealant components in conjunction with exterior wall system and related work, including attachments, sealants, and interior finishes as indicated on the drawings. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

C. Extent and Location: As indicated on the drawings, in location acceptable to Architect/Engineer.

D. Materials: Incorporate complete materials as required for finished Work.

E. Architect/Engineer’s Review:
1. Architect/Engineer will review sample installation for visual acceptance of workmanship.
2. Obtain Architect/Engineer’s approval of sample installations before proceeding with subsequent Work.

F. Maintain accepted sample installation during construction as standard for subsequent Work.

G. Properly finished and maintained sample installation may be incorporated into completed work.

H. Dismantle unacceptable sample installation and remove from site.

1.8 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from natural causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
   1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Sealant JS-S1 - single-component, elastomeric sealant complying with ASTM C920, Type S, Grade NS, Use NT, Class 50, a silicone sealant from the following Table that has a current validation certificate from the Sealant, Waterproofing and Restoration Institute (SWRI).

B. Sealant JS-S2 - single-component, elastomeric sealant complying with ASTM C920, Type S, Grade NS,

Use NT, Class 100/50, a silicone sealant from the following Table that has a current validation certificate from the Sealant, Waterproofing and Restoration Institute (SWRI).

1. Products: Subject to compliance with requirements, provide:

Manufacturer	Product	Manufacturer Rated Movement Capability [CLASS]	Substrate Primer Required: Yes/No/Test			
			Mortar*	Anod. Alum.	Uncoated Glass	Other**
Dow Corning	790	+ 100/- 50%	No	Yes	No	Test
May National Associates, Inc.	Bondaflex Sil 290	+ 100/- 50%	Yes	Test	No	Test
Momentive Performance Materials, Inc.	Silpruf LM SCS2700	+ 100/- 50%	Yes	Test	No	Test
Pecora Corporation	890	+ 100/- 50%	Yes	Test	No	Test
Tremco Incorporated	Spectrum 1	+ 100/- 50%	Yes	Test	No	Test
Dow Corning	791	± 50%	Yes	Test	No	Test
Dow Corning	795	± 50%	No	Yes	No	Test
Dow Corning	756 SMS	± 50%	No	Yes	No	Test
May National Associates, Inc.	Bondaflex Sil 295	± 50%	Yes	Test	No	Test
Momentive Performance Materials, Inc.	Silpruf SCS2000	± 50%	Yes	Test	No	Test
Momentive Performance Materials, Inc.	Silpruf NB SCS 9000	± 50%	Yes	Test	No	Test
Pecora Corporation	864	± 50%	Yes	Test	No	Test
Pecora Corporation	895	± 50%	Yes	Test	No	Test
Tremco Incorporated	Spectrum 3	± 50%	Yes	Test	No	Test
Tremco Incorporated	Spectrum 4-TS	± 50%	Yes	Test	No	Test

Table Notes:
* Indicates substrates with a cement component, such as concrete, that require use of a primer.
** Indicates that other substrates shall be tested for adhesion to determine if a primer will be required.

2.3 WEATHER BARRIER SEALANTS

A. Sealant JS-W1 - single-component, elastomeric sealant complying with ASTM C920, Type S, Grade NS, Use NT, Class 25; tested and marketed specifically for sealing air barrier and vapor retarder sheets to common building materials, such as aluminum, vinyl, PVC, powder coat, paint and fluoropolymer coatings; UV resistant.
   1. Products: Subject to compliance with requirements, provide one of the following :
      a. Dow Corning 758

2.4 URETHANE JOINT SEALANTS

A. Multi-component, elastomeric, sealant complying with ASTM C920, Type M, Class 25, Use T. A primer shall be used for all exterior paving, walk way, and other similar horizontally oriented joints. At exterior joints, provide primer recommended by sealant manufacturer.
   1. Sealant JS-U1 - For Grade NS, a urethane material: LymTal International, Inc. 881NS.
   2. JS-U2 - For Grade P, a urethane material: LymTal International, Inc. 880GB.

2.5 LATEX JOINT SEALANTS

A. Sealant JS-L1 - Single-component latex sealant complying with ASTM C834.
1. Products: Subject to compliance with requirements, provide one of the following :
a. DAP, 230 sealant.
b. Pecora, AC-20 + silicone.
c. PTI, 738.

2.6 BUTYL RUBBER BASED JOINT SEALANTS

A. JS-B1 - Butyl-Rubber-Based Joint Sealant: ASTM C 1311.
1. Products: Subject to compliance with requirements, provide one of the following :
a. Bostik, Inc.; Chem-Calk 300.
b. Pecora Corporation; BC-158.
c. Tremco Incorporated; Tremco Butyl Sealant.

2.7 MILDEW-RESISTANT JOINT SEALANTS

A. Sealant JS-M1 - Single-component silicone sealant complying with ASTM C920.
1. Products: Subject to compliance with requirements, provide one of the following :
a. Dow Corning, 786.
b. GE Silicones Sanitary SCS1700.
c. Pecora, 898.

2.8 ACOUSTICAL JOINT SEALANTS

A. JS-A1 - Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include the following:
a. Pecora Corporation; AC-20 FTR .
b. USG Corporation; SHEETROCK Acoustical Sealant.
c. Tremco; Tremflex 834,

2.9 PREFORMED JOINT SEALANTS

A. JS-P1 – Pre-formed Silicone Joint Sealants: Manufacturer's standard sealant consisting of pre-cured low-modulus silicone extrusion, in sizes to fit joint widths indicated, combined with a neutral-curing silicone sealant for bonding extrusions to substrates complying with ASTM C 1518.
1. Products: Subject to compliance with requirements, provide one of the following :
a. Dow Corning Corporation; 123 Silicone Seal.
b. GE Advanced Materials - Silicones; UltraSpan US1100.
c. May National Associates, Inc.; Bondaflex Silbridge 300.
d. Pecora Corporation; Sil-Span.
e. Sealex, Inc.; ImmerSeal.

2.10 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.11 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Do not extend exterior sealants and primers into building interior (that is, inside the weatherproofing system) unless first verifying compliance with VOC requirements.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
   a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:
1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.

2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch. Hold edge of sealant bead 1/4 inch inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping. Do not pull or stretch material. Produce seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures, apply heat to sealant in compliance with sealant manufacturer's written instructions.

J. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces, JS-U1.
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Joints between plant-precast architectural concrete paving units.
      c. Joints between different materials listed above.
      d. Other joints as indicated.
   2. Urethane Joint Sealant: Multi-component, non-sag, traffic grade, Class 25.

B. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces subject to water immersion.
   1. Urethane Joint Sealant: Immersible, multi-component, non-sag, traffic grade .
   2. Joint-Sealant Color: As selected by Architect/Engineer from manufacturer's full range of colors**.**

C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Control and expansion joints in unit masonry.
      c. Joints between metal panels.
      d. Joints between different materials listed above.
      e. Perimeter joints between materials listed above and frames of doors windows and louvers.
      f. Control and expansion joints in ceilings and other overhead surfaces.
      g. Other joints as indicated.
   2. Silicone Joint Sealant: Single component, non-sag, neutral curing, Class 50 .
   3. Joint-Sealant Color: As selected by Architect/Engineer from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces, JS-L1.
   1. Joint Locations:
      a. Control and expansion joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints of exterior openings where indicated.
      c. Tile control and expansion joints.
      d. Vertical joints on exposed surfaces of interior unit masonry, and partitions.
      e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
      f. Other joints as indicated.
   2. Joint Sealant: Acrylic-latex or siliconized acrylic latex.
   3. Joint-Sealant Color: As selected by Architect/Engineer from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-M1.
   1. Joint Sealant Location:
      a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
      b. Tile control and expansion joints where indicated.
      c. Other joints as indicated.
   2. Joint Sealant: Single component, non-sag, mildew resistant, acid curing.
   3. Joint-Sealant Color: As selected by Architect/Engineer from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal non-traffic surfaces JS-A1.
   1. Joint Location:
      a. Acoustical joints where indicated.
      b. Other joints as indicated.
   2. Joint Sealant: Acoustical.
   3. Joint-Sealant Color: As selected by Architect/Engineer from manufacturer's full range.

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SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
1. Interior hollow-metal doors and frames
2. Exterior hollow-metal doors and frames
3. Tornado resistant (FEMA 361) rated doors and frames.
4. Fire rated door and framing systems for installation as full vision fire rated doors.

B. Related Requirements:
1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.
2. Section 08 80 00 “Glazing” for metal door glazing.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.

C. Shop Drawings: Include the following:
1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification:
1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

F. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
1. Test reports for FEMA 361 rated assemblies to include doors, frames (with wall anchors), and door hardware.

B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Temperature-Rise Limit: Where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9 . Label each individual glazed lite.

D. Fire-Rated Door Assembly Labels: Provide labels by a qualified testing agency for fire-protections ratings indicated complying with NFPA 80 in accordance with the requirements of the authority having jurisdiction.
1. Labels shall be applied in locations readily visible and convenient for identification by the authority having jurisdiction after installation of the assembly.
2. Labels shall be made from materials acceptable to the authority having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amweld International, LLC.
   2. Ceco Door Products; an Assa Abloy Group company.
   3. Commercial Door & Hardware Inc.
   4. Curries Company; an Assa Abloy Group company.
   5. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Frames: SDI A250.8, Level 1. At locations indicated in the Door and Frame Schedule.
   1. Exposed Finish: Prime.

C. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level B according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches.
      c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
      d. Edge Construction: Model 1, Full Flush.
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:
   a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Slip-on drywall.
4. Exposed Finish: Prime.

D. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At locations indicated in the Door and Frame Schedule.
   1. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
      d. Edge Construction: Model 2, Seamless.
      e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   3. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
      b. Construction: Full profile welded.
   4. Exposed Finish: Prime.

C. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum G60A60 coating.
      d. Edge Construction:Continuously welded with no visible seam.
      e. Core: Steel stiffened.
         1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
   3. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum G60A60 coating.
      b. Construction: Full profile welded.
   4. Exposed Finish: Prime.

2.5 FEMA P-361 RATED HOLLOW-METAL DOORS AND FRAMES

A. Construct FEMA RATED doors and frames to comply with the FEMA P-361 standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

1. Assemblies use multi-point exit devices.
2. Third party certified with Underwriters Laboratories with listings to meet FEMA P-361, Second Edition (August 2008) standards, and in compliance with ICC 500-2008.
3. Fire-rated through 3 hours.
4. Certified labels applied to each door.

B. Heavy-Duty Doors and Frames:
1. Basis of Design: StormPro 361 Door and Frame assembly
   a. Static Test Pressure: (+296 / -270 PSF)
   b. Static Design Pressure: (+246 / -255 PSF)
   c. Surface Vertical Rod Exit Device equal to Sargent FM8700
2. Door Construction:
   a. Face Skin and Bottom Edge Channel: 16 gauge (1.4)
   b. Impact Liner: 12 gage (2.6)
   c. Core: Polystyrene
      1) Rated Doors: Honeycomb core
   d. Top Flush End Cap and Closer reinforcement: 14 gauge (1.9)
3. Frames to be installed and anchored per submittal pages.
   a. Frames 14 (1.9) gauge
   b. Walls constructed as described in FEMA 361 9Design and Construction Guidance for Community Safe Rooms.

2.6 MANUFACTURER - FIRE RATED DOOR ASSEMBLY

A. Glass Material: Basis of Design; FireLite Plus® fire-rated glazing as fabricated and distributed by Technical Glass Products.
1. Refer to section 08 80 00 Glazing for fire protection glass type [GL-5]

B. Frame System: Basis of Design; “Fireframes® Designer Series by TGP” fire-rated steel frame system as manufactured and supplied by Technical Glass Products.

C. Materials - Glass
1. Fire Rated Glazing: ASTM C 1036 and ASTM C 1048; composed of ceramic glazing material.
2. Adjust list of products and thicknesses below to suit Project.
3. Thickness of Glazing Material: 5/16” FireLite Plus®.
4. Approximate Visible Transmission: Varies with thickness (approximate range 88 percent).
5. Logo: Each piece of fire-rated glazing shall be labeled with a permanent logo including name of product, manufacture, testing laboratory (UL® only), fire rating period, safety glazing standards, and date of manufacture.
6. Performance: Glass must be rated to stop fire from either direction and must meet all testing requirements including the required hose-stream test (where fire-rating exceeds 20 minutes).

D. Materials – Steel Frames And Doors
1. Steel Framing System including 90-minute rated doors.
   a. Steel: Profiled steel tubing formed using cold drawn and profiled steel tubing.
   b. Fasteners: As recommended by manufacturer
   c. Glazing Accessories: calcium silicate setting blocks.
   d. Glazing Compounds:
      1) FireLite Plus®: Approved Fibrefrax or pure silicone sealant. Glaze glass panels that exceed 1,393 sq. inches for 90-minute ratings with “Kerafix 2000” glazing tape supplied by manufacturer.

E. Rated Door and Frame Fabrication
1. Furnish rated frame assemblies pre-welded.

2. When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.
3. Fit with suitable fasteners.
4. Knock-down frames are not permitted
5. Field glaze door and frame assemblies.
6. Factory prepares steel door assemblies for field mounting of hardware when necessary.
7. Fabrication Dimensions: Fabricate to field dimensions.
8. Obtain approved shop drawings prior to fabrication.

F. Rated Door Hardware
1. Furnish hardware with 90 minute fire door by the manufacturer.
2. Select hardware from door manufacturer's standard recommended and approved hardware groups as specified in Division 8 Section – Door Hardware.
3. Provide high traffic areas or areas requiring a door motion force of greater than 20 pounds with power assisted hardware for use with manufacturer’s frame system.

2.7 FRAME ANCHORS

A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
3. FEMA P-361 Anchor requirements: Masonry or EO anchors
4. Jamb anchor options:
   a. Masonry - “T” anchors
   b. Masonry - wire anchors
   c. Welded exisiting opening preps with bolts
   d. 6 wall anchors per jamb
5. Welded WPS or WEMA anchors.
   a. WPS and WEMA anchors must be welded at the factory.
   b. Masonry expansion shell anchor bolt included when wps or wema anchors are ordered.
      1) 2 WPS or WEWA anchors per head up to 3'0"
      2) 3 WPS or WEWA anchors per head over 3'0" to 4'0"
      3) 4 WPS or WEMA anchors per head on pairs 6'0" and smaller
      4) 5 WPS or WEMA anchor per head on pairs over 6'0" and up to 8'0"
6. WPS or WEMA anchors required in head regardless of type of jamb anchor used.
   a. Anchor bolts to be included when WPS or WEMA anchors are ordered

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.8 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with the following minimum metallic coating:

1. Exterior doors and frames and where indicated on the Drawings: A60
2. Highly corrosive conditions: G90 as indicated on the Drawings.

E. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

H. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

J. Glazing: Comply with requirements in Section 088000 "Glazing."

K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.9 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:
   1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches apart. Spot weld to face sheets no more than 5 inches o.c. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
   2. Fire Door Cores: As required to provide fire-protection ratings indicated.
   3. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
   4. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
   5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
   6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
   7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
   2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
   3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
   4. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
         1) Three anchors per jamb up to 60 inches high.
         2) Four anchors per jamb from 60 to 90 inches high.
         3) Five anchors per jamb from 90 to 96 inches high.
         4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      b. Compression Type: Not less than two anchors in each frame.
   5. Head Anchors: Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
   6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
      a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
      b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
   7. Terminated Stops: Terminate stops 6 inches above finish floor with a 90-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
   1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
   2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow-metal work.
   5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI/SDI A250.3 for performance and acceptance criteria.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.11 ACCESSORIES

A. Louvers: Provide louvers for interior doors, where indicated, which comply with SDI 111C, with blades or baffles formed of 0.020-inch- thick, cold-rolled steel sheet set into 0.032-inch- thick steel frame.
   1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
   2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 as required by standards specified.
   1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
   a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
4. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
   a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
   b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
   c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
   d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors and gaskets according to NFPA 105.

D. FEMA Storm Door Installation: Third party certified with Underwriters Laboratories with listings to meet FEMA P-361, Second Edition (August 2008) standards, and in compliance with ICC 500-2008.

E. Rated Fire Door Installation:
1. Install fire door by a specialty contractor with appropriate experience qualifications; and in strict accordance with the reviewed shop drawings.
2. Install fire safing / fire stopping at edges of system
3. Install glazing in strict accordance with fire resistant glazing material manufacturer’s specifications.
   a. Field cutting or tampering is not permissible.
4. Do not install damaged frames or chipped glassing units.
5. Install plumb and true. Limit out of plumb or true to 1/8 inch in 10’-0” in any dimension.

F. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING - GENERAL

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

3.5 FIRE RATED GLAZED DOOR OPENING - PROTECTION AND CLEANING

A. Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
   1. Do not clean with astringent cleaners. Use a clean “grit free” cloth and a small amount of mild soap and water or mild detergent.
   2. Do not use any of the following:
      a. Steam jets
      b. Abrasives
      c. Strong acidic or alkaline detergents, or surface-reactive agents
      d. Detergents not recommended in writing by the manufacturer
      e. Do not use any detergent above 77 degrees F
      f. Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.
      g. Metal or hard parts of cleaning equipment must not touch the glass surface

B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

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SECTION 08 14 16
FLUSH WOOD DOORS

PART - 1. GENERAL

1.1 WORK INCLUDES

A. Base Bid:
   1. General Contractor:
      a. Interior flush wood doors.
      b. Acoustically rated wood doors.
      c. Glazed door (vision) panels.
      d. Transom panels.
      e. Applied wood molding.

1.2 RELATED WORK

A. Specified Elsewhere
   1. 06 42 00 – Wood Paneling.
   2. 08 41 13 - Aluminum-Framed Entrances and Storefront.
   3. 08 71 00 - Door Hardware.
   4. 08 80 00 – Glazing.

1.3 SUBMITTALS

A. Product Data:
   1. Submit manufacturer's specifications and installation instructions for each type of door. Include details of core and edge construction and trim for openings.
   2. Include shop-finishing specifications.
   3. Submit manufacturer's instructions for installation of positive pressure seals.

B. LEED Submittals:
   1. Certificates for Credit MR.7: Chain-of-custody certificates certifying that flush wood doors comply with forest certification requirements. Include evidence that manufacturer is certified for chain of custody by an FSC-accredited certification body.
      a. Include statement indicating costs for each certified wood product.
   2. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   3. Product Data for Credit IEQ 4.2: For Paints and Coatings, documentation including printed statement of VOC content.
   4. Product Data for Credit EQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

C. Shop Drawings - Door Schedule:
   1. Submit Shop Drawings for fabrication and installation of wood doors.
   2. Include locations, configurations, details, elevations, dimensions and locations of openings, STC rating and fire ratings.
   3. Include location and extent of hardware blocking, dimensions and locations of mortises and holes for hardware conditions, (including security hardware).
   4. Indicate requirements for veneer matching. Indicate doors to be shop-finished and finish requirements.

D. Samples:
   1. Submit three sample sets for each type of transparent finished veneer showing full range (high, middle and low) of color, texture and finish expected in completed Work.

2. Sample sets shall consist of minimum three samples in each set.
3. Samples shall be minimum 12 inches square.

E. Test Reports: Submit certified test reports performed by recognized testing laboratory showing that systems have been previously tested and meet or exceed specified STC ratings for acoustical door panels.

F. Certificates: Submit manufacturer's certification stating that material has been tested by independent laboratory and complies with required fire resistant ratings.

G. Warranty: Submit signed and dated warranty.

1.4 SYSTEM REQUIREMENTS

A. Fire Resistance Requirements:
1. Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
2. Temperature-rise rating: At exit enclosures, provide doors with temperature-rise rating of 250°F (140°C) maximum in 30 minutes of fire exposure.
3. Provide UL labels permanently fastened on each door within size limitations established by NFPA and UL for labeling.

B. Acoustic Ratings: Where sound ratings are indicated, provide doors identical to those tested by manufacturer to achieve South Transmission Class (STC) scheduled or indicated in accordance with ASTM E90 and E413.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Not less than 5 years documented, successful experience with work comparable to Work of this Project.

B. Manufacturer Qualifications:
1. Firm which complies with referenced standards.
2. Firm whose fire rated unites are inspected, tested and listed by UL for single point hardware and attachment provisions specified for the sizes and profiles shown.

C. Certificate of Fire Retardant Treatment:
1. Certify that fire-retardant salts used comply with local building code requirements, with AWPA Standard C20 for lumber and C27 for plywood, and will not bleed through finished surfaces.
2. State name of salts used.

D. Certificates: Provide manufacturer's certification stating that material has been tested by independent laboratory and complies with required fire resistant ratings.

E. Warranty: Provide signed and dated warranty.

F. Reference Standards: Comply with the following, except as specified.
1. Quality Architectural Woodwork Standards, 1300 and 1500; Architectural Woodwork Institute (AWI).

1.6 DELIVERY, STORAGE AND HANDLING

A. Package doors in vented opaque polybags at factory prior to shipment.

B. Protect doors against damage during handling, transit and storage.

C. Store doors in clean, dry, well-ventilated place, protected from dampness, moisture and weather, in accordance with manufacturer's directions.
   1. Locate stored doors out of direct sunlight, at temperature of not less than 40°F (4°C).
   2. Store doors by stacking flat so air will circulate under stack and doors do not bend or sag.
   3. Do not walk on nor place other materials on top of stacked doors.

D. Do not drag doors across one another or across other surfaces.

1.7 PROJECT CONDITIONS

A. Environmental Requirements:
   1. Do not install doors until concrete, masonry, plaster and tile Work are completed and dried in areas receiving doors.
   2. Condition doors to average prevailing humidity in installation areas prior to hanging.
   3. Do not subject doors to abnormal heat, dryness or humidity.
   4. Avoid sudden changes such as forced heat (used to dry out building).

1.8 WARRANTY

A. Provide written warranty signed by Contractor, door manufacturer and installer, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing or core construction in face veneers, or do not conform to tolerance limitations of referenced standards.

B. Warranty Period:
   1. Solid core and mineral core: "Life of Original Installation".
   2. Hollow core: 5 years.

PART - 2. PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers – Typical Flush Doors:
   1. Algoma Hardwoods, Inc.
   2. Eggers Industries.
   3. Lambton Doors.
   4. Marshfield Door Systems, Inc.
   5. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

A. Low-Emitting Materials: Provide doors made with adhesives and composite wood products that do not contain added urea formaldehyde.

B. Doors for Transparent Finish:
   1. Grade: Custom, with Grade A faces.
   2. Species: Curly Maple.
      a. Refer to Finish Schedule on Drawings
   3. Match between adjacent Veneer Leaves: Book match.
   4. Matching Within Door Face: Balance match.
   5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

C. Doors for Opaque Finish:

1. Grade: Premium.
2. Faces: Medium-density overlay.
   a. Apply medium-density overlay to standard-thickness, closed-grain, hardwood face veneers.
3. Exposed Vertical and Top Edges: Any closed-grain hardwood.
4. Core: Particleboard or Structural composite lumber.
5. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering.

2.3 SOLID CORE DOORS

A. Interior Veneer-Faced Doors:
   1. Core: Bonded Staved Lumber Core.
   2. Construction:
      a. Complying with AWS SLC-5.
      b. Bond stiles and rails to core, then abrasive plane entire unit before veneering.
   3. Crossband: Manufacturer’s standard hardwood veneer or engineered composite.

2.4 LIGHT FRAMES

A. Wood Beads for Light Openings in Non-Fire-Rated Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
   1. Wood Species: Same species as door faces.
   2. Profile: Flush rectangular beads.
   3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.5 ACCESSORY MATERIALS

A. Applied Wood Trim: Provide solid stock material to match specie and cut of door face veneer complying with requirements specified in Section 06 42 00 “Wood Paneling”.

B. General:
   1. Fabricate units rigid, neat, free from defects, warp or buckle.
   2. Doors to be field painted: Fabricate doors in sizes indicated for Project-site fitting.
   3. Transparent-Finish Doors:
      a. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
      1) Comply with clearance requirements of referenced quality standard for fitting.
      2) Comply with requirements in NFPA 80 for fire-rated doors.
      b. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
      1) Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
      c. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
   4. Provide factory cutouts for openings in doors where indicated.
   5. Factory glaze doors to receive glass, where practical.

C. Pre-Hung Wood Door Frames:
   1. Provide one piece frame with adjustable stop.
   2. Form profile to match manufacturer’s standard selected by Architect/Engineer.

D. Applied Wood Trim:
   1. Apply to flush wood doors as indicated.

2. Fabricate to profiles shown complying with Requirements specified in Section 06 42 00 “Wood Paneling”.
3. Provide concealed fasteners and/or adhesive as required for secure attachment.
4. For fire rated doors, provide fasteners and/or adhesive that will not affect required ratings.

2.6 SHOP FINISHES

A. Transparent Finish Interior Doors:
1. Provide complete factory finishing. Comply with AWI recommendations.
2. Finish faces and tops, bottoms and edges of doors.
3. Finish: Clear, satin gloss, UV-cured polyurethane topcoat; manufacturer’s standard finish with performance requirements comparable to AWI System catalyzed polyurethane transparent.
4. Finish: with Stain:
a. Provide water-base stain as required to match Architect/Engineer’s sample.
b. After staining, finish with clear, satin gloss, UV-cured polyurethane topcoat; manufacturer’s standard finish with performance requirements comparable to AWI System catalyzed polyurethane transparent.

B. Paint (Opaque) Finish Doors:
1. Prime doors with primer which is compatible with field applied finish paint coats. Prime faces and tops, bottoms, and edges of doors. Comply with AWI recommendations.
2. Finish: Refer to 09 91 13 Interior Painting.

C. Factory prime or finish cutouts after fabrication.

PART - 3. EXECUTION

3.1 EXAMINATION

A. Examine substrates and adjoining construction, and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Hardware: Install hardware in accordance with hardware manufacturer’s instructions and as specified in 08 71 00 Door Hardware. Adjust installation to provide uniform clearance at head and jambs and to contact stops uniformly.

B. Installation Instructions: Install doors in accordance with manufacturer's written instructions and the referenced quality standard, and as indicated.
1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80. Install positive pressure doors in accordance with manufacturer’s instructions furnished by Testing Agency.

C. Veneer-faced Doors.
1. Align doors in frames for uniform clearance at each edge.
2. Do not field cut, trim fit or machine transparent finish veneer doors unless necessary. Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING, REPAIR AND CLEANING

A. Adjusting:
1. Before completion of Work, adjust hardware until doors operate properly.
2. Adjust doors to provide uniform clearance at head and jambs and to contact stops uniformly.
3. Test security devises with operation of security system in Architect/Engineer’s present.

B. Repair:
   1. Remove and replace doors which are warped, bowed, not properly finished, fitted to frames or otherwise damaged; and doors which do not swing or operate freely. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.
   2. Touch-up marred finishes to match adjacent unmarred surfaces.
   3. Replace defective, damaged, missing or stolen hardware.

C. Cleaning: Clean doors.

3.4 PROTECTION

A. Protect units during construction so that they will be without any evidence of damage or use at time of acceptance.

END OF SECTION

SECTION 08 31 13

ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Access doors and frames for walls and ceilings.
2. Rated floor access doors and frames

B. Related sections:
1. Refer to Division 05, section 05 50 00 “Metal Fabrications” for ladder and cage requirements.
2. Refer to Division 07, section 07 72 00 “Roof Accessories” for hatch safety railing requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include construction details, fire ratings, materials, individual components and profiles, and finishes.

B. Shop Drawings:
1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics according to the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.

5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.
10. Larsen's Manufacturing Company.
11. Maxam Metal Products Limited.
12. Metropolitan Door Industries Corp.
13. MIFAB, Inc.
14. Milcor Inc.
15. Nystrom, Inc.
16. Williams Bros. Corporation of America (The).

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:
1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
2. Locations: Wall and ceiling .
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
   a. Finish: Factory prime .
4. Frame Material: Same material, thickness, and finish as door.
5. Hinges: Manufacturer's standard.
6. Hardware: Latch Lock.

D. Flush Access Doors with Concealed Flanges :
1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
2. Locations: Wall and ceiling .
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage.
   a. Finish: Factory prime .
4. Frame Material: Same material and thickness as door.
5. Hinges: Manufacturer's standard.
6. Hardware: Latch Lock.

E. Fire-Rated, Flush Access Doors with Concealed Flanges Insert drawing designation:
1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board beads for concealed flange installation.
2. Locations: Wall and ceiling.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Temperature-Rise Rating: 450 deg F at the end of 30 minutes.
5. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage.
   a. Finish: Factory prime.
6. Frame Material: Same material, thickness, and finish as door.
7. Hinges: Manufacturer's standard.
8. Hardware: Latch Lock.

F. Hardware:
1. Latch: Cam latch operated as indicated in schedule with interior release.
2. Lock: Mortise cylinder.
   a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware."

2.3 RATED FLOOR ACCESS DOORS AND FRAMES

A. Basis-of-Design Product: Subject to compliance with requirements, provide model FR-6 by Bilco Company (The) or comparable product by one of the following:
   1. Babcock-Davis.
   2. Milcor Inc.

B. Floor Doors, General: Equip each door with adjustable counterbalancing springs, heavy-duty hold-open arm that automatically locks door open at 90 degrees, release handle with red vinyl grip that allows for one-handed closure, and recessed lift handle.
   1. Cover: shall be reinforced to support a minimum live load of 150 psf with a maximum deflection of 1/150th of the span.
   2. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
   3. Operation of the cover shall not be affected by temperature.
   4. Door and frame assembly shall be tested in accordance with ASTM E119 and NFPA 251 and UL Listed as having a 1-hour fire rating when exposed to fire from the underside. In the closed position, the temperature on the unexposed surface of the door shall not exceed 325°F (162°C) above ambient for the duration of the 1-hour period. Manufacturer shall submit a test report certifying this performance.
   5. Door shall be equipped with a fusible link activated closing system that will automatically close and latch the door leaf in the event of fire when heat parts the UL Listed 165° (74°C) fusible link. Fire rated door may be specified to omit the automatic closing system when not required by the local authority having jurisdiction.

C. Cover: Shall have a 1” fillable pan to receive concrete.

D. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall interlock with a flanged support shoe fastened to a formed 1/4” (6.3 mm) gusset support plate.

E. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the and the latch release shall be protected by a flush, gasketed, removable screw plug].

F. Automatic closing system: Shall be a self-contained, pneumatic, fusible link activated, closing system that will automatically close and latch the door in the event of fire when heat parts the UL Listed 165° (74°C) fusible link.

G. Hold-open system: Door shall be equipped with a pneumatic hold-open system to automatically hold the door in the open position (90°). A release button for the hold-open system shall be provided and shall reset itself when the cover is closed.

H. Frame: Shall be 1/4” extruded aluminum with full anchor flange around the perimeter.
   1. Fire-Resistance Rating: Not less than 1 hour.
      a. Finish: Yellow with wording "FIRE DOOR - DO NOT STORE MATERIALS ON SURFACE."

I. Hardware: Provide the following:
   1. Hinges: Heavy-duty, stainless-steel butt hinges with stainless-steel pins.
   2. Latch: Stainless-steel slam latch.
   3. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover and a cable release handle shall be provided to open the cover from the underside.

4. Hardware Material: Type 316 Stainless steel, including latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.

J. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

K. Refer to Division 05 section 05 50 00 “Metal Fabrication” for ladder and cage design requirements

L. Refer to Division 07 section 07 72 00 “Roof Accessories” for roof hatch safety rail requirements and system to be attached to the adjacent penthouse floor per the manufacturers installation recommendations.

2.4 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Frame Anchors: Same type as door face.

D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.5 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
   2. Provide mounting holes in frames for attachment of units to metal or wood framing.
   3. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder locks, furnish two keys per lock and key all locks alike.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Steel and Metallic-Coated-Steel Finishes:
   1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

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SECTION 08 33 23

OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Insulated service doors

B. Related Sections:
   1. Division 05 Section "Metal Fabrications" for miscellaneous steel supports.
   2. Division 09 Sections “Exterior Painting” and “Interior Painting” for finish painting of factory-primed doors.
   3. Division 26 Sections for electrical service and connections for powered operators and accessories.
   4. Division 28 Sections for alarm system integration

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.
   1. Wind Loads: As indicated on Drawings.
   2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. Operability under Wind Load: Design overhead coiling doors to remain operable under design of 20 lb f/sq. ft. wind load, acting inward and outward.

D. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.
   1. Large Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.
   2. Small Missile Test: For overhead coiling doors located more than 30 feet (9.144 m) above grade.

E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the emergency-egress-door component will be fully operational after the seismic event."
   2. Seismic Component Importance Factor: 1.0.

F. Operation Cycles: Provide overhead coiling door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
1. Construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. For fire-rated doors, description of fire-release system including testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.
1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Show locations of replaceable fusible links.
3. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
1. Curtain Slats: 12 inches long
2. Bottom Bar: 6 inches long with sensor edge.
3. Guides: 6 inches long.
4. Brackets: 6 inches square.
5. Hood: 6 inches square.
6. Laminate-Clad Counter Panel Product: 6 inches square; for each type, color, pattern, and surface finish; laminated to core.

E. Delegated-Design Submittal: For overhead coiling doors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
2. Summary of forces and loads on walls and jambs.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For overhead coiling doors**,** accessories, and components, from manufacturer.

C. Oversize Construction Certification: For door assemblies required to be fire-rated and that exceed size limitations of labeled assemblies.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.
   1. Obtain operators and controls from overhead coiling door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

PART 2 - PRODUCTS

2.1 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm) and as required to meet requirements.
   2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within slat faces.
   3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.
   4. Gasket Seal: Provide insulated slats with manufacturer's standard interior-to-exterior thermal break or with continuous gaskets between slats.

B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

C. Bottom Bar for Service Doors: Consisting of two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from manufacturer's standard hot-dip galvanized steel, stainless steel, or aluminum extrusions to match curtain slats and finish.

D. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over travel of curtain, and a continuous bar for holding windlocks.

2.2 HOOD

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
   1. Galvanized Steel: Nominal 0.028-inch- (0.71-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
   2. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
   3. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.3 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.
   1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
   2. Keys: Provide Three for each cylinder.

2.4 CURTAIN ACCESSORIES

A. Weatherseals: Equip each exterior door with weather-stripping gaskets fitted to entire perimeter of door for a weathertight installation, unless otherwise indicated.
   1. At door head, use 1/8-inch-thick, replaceable, continuous sheet secured to inside of hood.
   2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.5 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Spring Balance: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.6 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for doorand operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.
   1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 11 Section "Common Motor Requirements for Equipment" unless otherwise indicated.
   1. Electrical Characteristics:
      a. Phase: Single phase
      b. Volts: 115/230 V.
      c. Hertz: 60.
   2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
   3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec. , without exceeding nameplate ratings or service factor.
   4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
   5. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
   1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
      a. Self-Monitoring Type: Four-wire configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
   1. Interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
   2. Exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf (111 N**)**

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.7 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Series 625 Stormtite Insulated Door Assembly by Overhead Door Corporation, or comparable product by one of the following:
   a. Cookson Company.
   b. Cornell Iron Works, Inc.

B. Operation Cycles: Not less than 100,000.
   1. Include tamperproof cycle counter.

C. STC Rating: 21.

D. Curtain R-Value: 7.7.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
   1. Insulated-Slat Interior Facing: Metal.

G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

H. Hood: Match curtain material and finish
   1. Shape: Round.
   2. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly.
   1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn and inside and outside with cylinders.

J. Manual Door Operator (Emergency): Chain-hoist operator.
   1. Provide operator with through-wall shaft operation.

K. Electric Door Operator:
   1. Usage Classification: Standard duty, up to 60 cycles per hour.
   2. Operator Location: Top of hood.
   3. Motor Exposure: Exterior, wet, and humid.
   4. Emergency Manual Operation: Chain type.
   5. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar ; self-monitoring type.
      a. Sensor Edge Bulb Color: Black.
   6. Remote-Control Station: Where shown on Drawings.
   7. Other Equipment: Audible and visual signals.

L. Door Finish:
   1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   2. Factory Prime Finish: Manufacturer's standard color.
   3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

B. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Perform installation and startup checks according to manufacturer's written instructions.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide weathertight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Laboratory's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Interior storefront framing.
2. Interior manual-swing doors.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   c. Glazing-to-glazing contact.
   d. Noise or vibration created by wind and by thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Sealant failure.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:
1. Wind Loads: As indicated on Drawings..
2. Seismic Loads: As indicated on Drawings.

D. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

G. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:
   1. Sound Transmission Class (STC): Minimum 35 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.
   2. Outdoor-Indoor Transmission Class (OITC): Minimum 34 OITC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.

G. Other Action Submittals:
   1. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

H. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of aluminum-framed systems.
   2. Include design calculations.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and testing agency.

B. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

C. Preconstruction Test Reports: For sealant.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

E. Source quality-control reports.

F. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

G. Field quality-control reports.

H. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

E. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Adhesive or cohesive sealant failures.
      e. Failure of operating components.
   2. Warranty Period: Five years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Door Hardware:
   1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Kawneer North America; an Alcoa company; TriFab 450 (2x4.5”).
2. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company; FG3000 (2x4.5”)
3. Wausau; 14000 (2x4.5”)

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Glazed.
2. Glazing System: Retained by sealant at vertical edges and mechanically with gaskets at horizontal edges .
3. Glazing Plane: As indicated.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

D. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
1. Sealants used inside the sealant system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain airtight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
1. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.; recommended by aluminum-framed-system manufacturers for this use.
a. Sealants used inside the acoustical sealant system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 DOOR SYSTEMS

A. Doors: Manufacturer's standard glazed doors for manual-swing operation.
1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: As indicated.
a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
3. Glazing Stops and Gaskets: Square , snap-on, extruded-aluminum stops and preformed gaskets.

B. Door Hardware: As specified in Section 087100 "Door Hardware."

2.6 DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.
1. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
2. Opening-Force Requirements:
a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbfto set the door in motion and not more than 15 lbf to open the door to its minimum required width.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07 92 00 "Joint Sealants."
1. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

D. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

E. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

F. Door Frames: Reinforce as required to support loads imposed by door operation and for installing door hardware.
   1. At doors, provide compression stripping at fixed stops.

G. Doors: Reinforce doors as required for installing door hardware.
   1. At pairs of doors, provide sliding-type stripping retained in adjustable strip and mortised into door edge.
   2. At doors, provide sweeps applied to door bottoms.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605 and containing not less than percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure nonmovement joints.

5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints airtight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce tight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Section 08 80 00 "Glazing."

G. Doors: Install doors to produce smooth operation and tight fit at contact points.
1. Interior Doors: Install to produce tight enclosure and tight fit at stripping.
2. Field-Installed Door Hardware: Install surface-mounted entrance door hardware according to door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Section 07 92 00 "Joint Sealants" to produce tight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
1. Sealant Compatibility and Adhesion: sealant shall be tested according to recommendations in ASTM C 1401.
a. Destructive Test Method A, "Hand Pull Tab (Destructive)," in ASTM C 1401, Appendix X2, shall be used.

2. Sealant Glazing Inspection: After installation of aluminum-framed systems is complete, structural-sealant glazing shall be inspected and evaluated according to recommendations in ASTM C 1401.
3. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft..

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.

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SECTION 08 44 13

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

B. Related Sections:
1. Division 05 Section “Cold Formed Metal Framing” for installation and coordination of structural framing not specified in this section.
2. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
3. Division 08 Section "Structural-Sealant-Glazed Curtain Walls" for structural-sealant-glazed curtain walls.
4. Division 08 Section “Glazing” for glass and glazing requirements.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by preconstruction testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:
1. Wind Loads: As indicated on Drawings.

D. Structural-Test Performance: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).
   a. Operable Units: Provide a minimum 1/16-inch (1.6-mm) clearance between framing members and operable units.
3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

F. Story Drift: Accommodate design displacement of adjacent stories indicated.
   1. Design Displacement: As indicated on Drawings.
   2. Test Performance: Meeting criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

G. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq.ft. (720 Pa)

H. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq.ft. (300 Pa)
   1. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.

I. Thermal Movements: Design and detail wall and its components to permit thermal movement without causing buckling; glass and glazing system damage or failure; sealant failure; excess stress on framing, anchors and fasteners; reduction of performance or other detrimental effects. Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:

   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
   2. Test Interior Ambient-Air Temperature: 75 deg F (24 deg C).

J. Energy Performance: Glazed aluminum curtain walls shall have certified and labeled energy performance ratings in accordance with NFRC.
   1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F (3.92 W/sq. m x K) as determined according to NFRC 100.
   2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.30 as determined according to NFRC 200.
   3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).
   4. Condensation Resistance: Design the wall and its components to not develop any visible interior condensation on framing members or glazing when the exterior air dry bulb temperature is ____ degrees C (____degrees F) and the interior air dry bulb temperature is ____degrees C (____degrees F) and a ____% relative humidity.
      a. Thermal performance will be verified during mock-up testing.

K. Sound Transmission: Provide glazed aluminum curtain walls with fixed glazing and framing areas having the following sound-transmission characteristics:
   1. Outdoor-Indoor Transmission Class: Minimum 34 when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Provide glazed aluminum curtain walls that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified testing agency.
   1. Preconstruction Testing Program: Perform tests specified in "Performance Requirements" Article on laboratory mockups in the following order:
      a. Structural-performance preloading at 50 percent of the specified wind-load design pressure when tested according to ASTM E 330.
      b. Air infiltration when tested according to ASTM E 283.
      c. Water penetration under static pressure when tested according to ASTM E 331.
      d. Water penetration under dynamic pressure when tested according to AAMA 501.1.
      e. Structural performance at design load when tested according to ASTM E 330.
      f. Periodic maintenance-equipment load at design load.
      g. Structure movement (vertical differential movement and lateral displacement) and thermal movement displacement, three cycles. Test procedure will be developed in conjunction with test laboratory.
      h. Thermal cycling with thermal performance test conditions maintained for 2 hours after equilibrium is achieved. Perform 6 cycles with a cycle consisting of one cold and one hot condition.
      i. Thermal performance with test conditions maintained for 2 hours after equilibrium is achieved.
      j. Repeat air filtration when tested according to ASTM E 283.
      k. Repeat water penetration under static pressure when tested according to ASTM E 331.
      l. Repeat water penetration under dynamic pressure when tested according to ASTM 501.1.
      m. Structural performance at maximum 150 percent of positive and negative wind-load design pressures when tested according to ASTM E 330.
      n. Periodic maintenance equipment load to 2.0 times design load.
   2. In the event of failure to meet the performance requirements, retest mock-up with previously agreed upon modifications or changes. The Architect will determine at which step in the testing procedure retesting shall resume.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittal:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
      a. Include statement indicating cost for each product having recycled content.
   2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.

c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
   a. Submit mock-up system Shop Drawings only after substantial approval of wall system Shop Drawings.
   b. Resubmit Shop Drawings with changes made to glazed aluminum curtain walls to successfully complete preconstruction testing.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Submit 3 sets of labeled Samples of the following:
   1. Typical extrusions and formed shapes, 300 mm (12 inches) long, with specified color and finish. Include 2 or more Samples in each set, indicating limits of variation, if any, in color and finish.
   2. Typical sheet, plate and panel, 150 mm (6 inches) square, with specified color and finish. Include 2 or more Samples in each set, indicating limits of variation, if any, in color and finish.

G. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.
   6. Cross-sectional sample of curtain wall showing a thermal break construction.

H. Delegated-Design Submittal:
   1. For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified structural engineer in the state of Illinois responsible for their preparation.
   2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.

I. Preconstruction Mockup Submittals:
   1. Preconstruction Testing Program: Developed specifically for Project.
   2. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency for each mockup test.
   3. Record Drawings: Submit record drawings of preconstruction mockups prepared by preconstruction testing agency including any modifications or additions made to meet the performance requirements.

J. Qualification Data: For qualified Installer and testing agency.

K. Welding certificates.

L. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

M. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for glazed aluminum curtain walls, indicating compliance with performance requirements.

N. Field quality-control reports.

O. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

P. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating glazed aluminum curtain walls that meet or exceed energy performance requirements indicated and of documenting this performance by certification, labeling, and inclusion in lists.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

F. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
   1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.

G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Furnish all labor and materials to completely erect, at an independent testing laboratory, mock-up unit of sufficient size and configuration to demonstrate the performance capabilities of the vertical wall system. Schedule mock-up erection and testing sufficiently in advance of wall system fabrication to cause no delay. Do not install mock-up materials as part of the wall system.
   2. After completion of mock-up construction and prior to start of testing sequence two vision glass lites and one spandrel panels are to be removed and replaced to successfully demonstrate project reglazing procedures.
   3. Mock-up shall have all details complete and identical to those approved on the wall system shop drawings. Mock-up shall demonstrate quality of materials, finish, and workmanship, as well as compliance with performance requirements.
   4. Provide schedule for mock-up fabrication, erection, glazing, sealing and testing a minimum of 30 days in advance of fabrication to permit owner and Architect to coordinate monitoring and observation.
   5. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
      a. Location of Mockups as indicated on the Drawings

H. Preinstallation Conference: Conduct conference at Project site, at least 2 weeks prior to fabrication and/or installation of wall system, arrange a meeting at fabrication or Project site with the glazier, sealant, and gasket manufacturers' technical representatives and any others necessary to review procedures, products to be used, and schedule for the Work. Give at least 2 weeks notice to Architect and other concerned parties.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for glazed aluminum curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
   2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   1. Kawneer North America; an Alcoa company.
   2. Wausau Window and Wall Systems.
   3. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308/B 308M.
   5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
   2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   1. Open-back mullions are unacceptable for system perimeters such as head, sill and jamb conditions.
   2. Construction: Thermally broken.
   3. Glazing System: Retained mechanically with gaskets on four sides.
   4. Glazing Plane: Front.
   5. Open-back mullions are unacceptable for system perimeters, such as at head, sill and jamb conditions.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. No exposed fastenings will be permitted in aluminum work, unless otherwise specified or indicated.
   4. In certain locations where it is impossible, or highly impractical, or in locations where exposed but hidden from view, consideration will be given to exposed fastenings where such fastenings are Phillips, flat head, or countersunk machine screws matching the finish of the adjacent wall system member.

D. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch (25.4 mm) that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials or dead-soft, 0.018-inch- (0.457-mm-) thick stainless steel, ASTM A 240/A 240M of type recommended by manufacturer.

F. Framing Sealants: Manufacturer's standard sealants with VOC content of 250g/L or less when calculated according to 40 CFR 59, Subpart D (EPA method 24).

G. Glazing: Comply with Division 08 Section "Glazing"

H. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

I. Glazing Sealants: As recommended by manufacturer.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 INSULATED SPANDREL PANELS

A. Insulated Spandrel Panels: Comply with Division 07 Section "Composite Wall Panels."

B. Refer to Division 07 Section “Structural Sealant Glazed Curtain Walls” for shadow box requirements.

2.5 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
   7. Components curved to indicated radii.

8. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
9. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

D. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
2. Seal joints watertight unless otherwise indicated.
3. Install glazing to comply with requirements in Division 08 Section "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605 and containing not less than percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Division 08 Section "Glazing."

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
   c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).
4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
   1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft. (2.25 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa)
      a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
      b. Perform a minimum of two tests in areas as directed by Architect.
      c. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
   2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa, and shall not evidence water penetration.
      a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
      b. Perform a minimum of two tests in areas as directed by Architect.
      c. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
   3. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
      a. Test Area: A minimum area of 75 feet (23 m) by one story of glazed aluminum curtain wall.

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

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SECTION 08 44 23

STRUCTURAL-SEALANT-GLAZED CURTAIN WALLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Factory-glazed, four-sided structural-sealant-glazed curtain-wall assemblies.
2. Factory glazed painted metal spandrel panel shadow box

B. Related Sections:
1. Division 05 Section “Cold Formed Metal Framing” for installation and coordination of structural framing not specified in this section.
2. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
3. Division 08 Section "Glazed Aluminum Curtain Walls" for glazed aluminum curtain walls.
4. Division 08 Section “Glazing” for glass and glazing requirements.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by preconstruction testing manufacturer's standard of structural-sealant-glazed curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Structural-sealant-glazed curtain walls shall withstand movements of supporting structure indicated on Drawings including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Delegated Design: Design structural-sealant-glazed curtain walls, including comprehensive engineering analysis by a qualified professional structural engineer, using performance requirements and design criteria indicated.

C. Structural Loads:
1. Wind Loads: As indicated on Drawings.

D. Structural-Test Performance: Provide structural-sealant-glazed curtain walls tested according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to 2 times the length of cantilevered member divided by 175.

F. Story Drift: Accommodate design displacement of adjacent stories indicated.
1. Design Displacement: As indicated on Drawings.
2. Test Performance: Meets criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

G. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

H. Water Penetration under Dynamic Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to AAMA 501.1 at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..
1. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior.

I. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
2. Test Interior Ambient-Air Temperature: 75 deg F.
3. Test Performance: No buckling, stress on glass, sealant failure, or excess stress on framing, anchors, and fasteners and no reduction of performance when tested according to AAMA 501.5.

J. Energy Performance: Structural-sealant-glazed curtain walls shall have certified and labeled energy performance ratings according to NFRC.
1. Thermal Transmittance (U-Factor): Fixed glazing and framing areas shall have U-factor of not more than 0.69 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a SHGC of no greater than 0.30 as determined according to NFRC 200.
3. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.30 cfm/sq. ft. of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..
4. Condensation Resistance: Design the wall and its components to not develop any visible interior condensation on framing members or glazing when the exterior air dry bulb temperature is ____ degrees C (____degrees F) and the interior air dry bulb temperature is ____degrees C (____degrees F) and a ____% relative humidity.
   a. Thermal performance will be verified during mock-up testing.

K. Sound Transmission: Fixed glazing and framing areas shall have the following sound-transmission characteristics:
1. Outdoor-Indoor Transmission Class: Minimum 34 when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 1332.

L. Structural Sealant: Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.
1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.

2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate because sealant-to-substrate bond strength exceeds sealant's internal strength.

M. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.
3. Design reviewed and approved by structural-sealant manufacturer.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Provide structural-sealant-glazed curtain walls that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified testing agency.
1. Preconstruction Testing Program: Perform tests specified in "Performance Requirements" Article on laboratory mockups in the following order:
a. Structural-performance preloading at 50 percent of the specified wind-load design pressure when tested according to ASTM E 330.
b. Air infiltration when tested according to ASTM E 283.
c. Water penetration under static pressure when tested according to ASTM E 331.
d. Water penetration under dynamic pressure when tested according to AAMA 501.1.
e. Structural performance at design load when tested according to ASTM E 330.
f. Periodic maintenance-equipment load at design load.
g. Structure movement (vertical differential movement and lateral displacement) and thermal movement displacement, three cycles. Test procedure will be developed in conjunction with test laboratory.
h. Thermal cycling with thermal performance test conditions maintained for 2 hours after equilibrium is achieved. Perform 6 cycles with a cycle consisting of one cold and one hot condition.
i. Thermal performance with test conditions maintained for 2 hours after equilibrium is achieved.
j. Repeat air filtration when tested according to ASTM E 283.
k. Repeat water penetration under static pressure when tested according to ASTM E 331.
l. Repeat water penetration under dynamic pressure when tested according to ASTM 501.1.
m. Structural performance at maximum 150 percent of positive and negative wind-load design pressures when tested according to ASTM E 330.
n. Periodic maintenance equipment load to 2.0 times design load.
2. In the event of failure to meet the performance requirements, retest mock-up with previously agreed upon modifications or changes. The Architect will determine at which step in the testing procedure retesting shall resume.

B. Preconstruction Sealant Testing: Perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition.
1. Test a minimum five production-run samples each of metal, glazing, and other material.
2. Prepare samples using techniques and primers required for installed assemblies.
3. Perform tests under environmental conditions that duplicate those under which assemblies will be installed.
4. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation

indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
a. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For structural-sealant-glazed curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.
1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of structural-sealant-glazed curtain walls, showing the following:
a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.
3. Include laboratory mockup Shop Drawings, prepared by a qualified preconstruction testing agency, showing details of laboratory mockup.
a. Submit mock-up system Shop Drawings only after substantial approval of wall system Shop Drawings.
b. Resubmit Shop Drawings with changes made to details of structural-sealant-glazed curtain walls, to successfully complete preconstruction testing.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
1. Anchorage.
2. Expansion provisions.
3. Glazing.
4. Flashing and drainage.

G. Delegated-Design Submittal:
1. For structural sealant glazed curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional structural engineer in the state of Illinois responsible for their preparation.
2. Submit for approval to Structural Engineer of Record loads imposed on the primary structural frame due to the dead, live, and wind/seismic loads indicated on the Contract Documents. Submittal shall include location, magnitude and direction of imposed loads (basic, unfactored load cases), graphically represented in their appropriate locations on a copy of the Contract Document structural framing plans or elevations as appropriate. Detail references indicating the connections applicable at each location shall be noted on the submittal drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Preconstruction Mockup Submittals:
1. Preconstruction Testing Program: Developed specifically for Project.
2. Preconstruction Test Reports: Prepared by a qualified preconstruction testing agency, for each mockup test.

3. Record Drawings: Submit record drawings of preconstruction mockups prepared by preconstruction testing agency.

B. Qualification Data: For qualified Installer and testing agency.

C. Welding certificates.

D. Energy-Performance Certificates: For structural-sealant-glazed curtain walls, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy-performance values for each structural-sealant-glazed curtain wall.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency, for structural-sealant-glazed curtain walls, indicating compliance with performance requirements.

F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Furnish all labor and materials to completely erect, at an independent testing laboratory, mock-up unit of sufficient size and configuration to demonstrate the performance capabilities of the vertical wall system. Schedule mock-up erection and testing sufficiently in advance of wall system fabrication to cause no delay. Do not install mock-up materials as part of the wall system.
   2. After completion of mock-up construction and prior to start of testing sequence two vision glass lites and one spandrel panels are to be removed and replaced to successfully demonstrate project reglazing procedures.
   3. Mock-up shall have all details complete and identical to those approved on the wall system shop drawings. Mock-up shall demonstrate quality of materials, finish, and workmanship, as well as compliance with performance requirements.
   4. Provide schedule for mock-up fabrication, erection, glazing, sealing and testing a minimum of 30 days in advance of fabrication to permit owner and Architect to coordinate monitoring and observation.
   5. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
      a. Location of Mockups as indicated on the Drawings

G. Preconstruction Test Reports: For structural-sealant-glazed curtain walls and elastomeric glazing sealants.

H. Quality-Control Program: Developed specifically for Project, including fabrication and installation, according to recommendations in ASTM C 1401. Include periodic quality-control reports.

I. Source quality-control reports.

J. Field quality-control reports.

K. Warranties: Sample of special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C 1401 recommendations for postinstallation-phase quality-control program.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for assemblies' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C 1401 for design and installation of structural-sealant-glazed curtain walls.

E. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

F. Energy-Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.
   1. Provide NFRC-certified, structural-sealant-glazed curtain walls with an attached label.

G. Preinstallation Conference: Conduct conference at Project site.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for structural-sealant-glazed curtain walls by field measurements before fabrication and indicate measurements on Shop Drawings.

1.10 WARRANTY

A. Special Assembly Warranty: Standard form in which manufacturer agrees to repair or replace components of structural-sealant-glazed curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kawneer North America; an Alcoa company.
   2. Wausau Window and Wall Systems.
   3. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
   1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

2.3 FRAMING

A. Framing Members: Manufacturer's standard formed- or extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.

C. Anchors: Three-way adjustable anchors, with minimum adjustment of 1 inch, that accommodate fabrication and installation tolerances in material and finish and are compatible with adjoining materials and recommended by manufacturer.
   1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

E. Framing Sealants: Manufacturer's standard sealants with VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: Manufacturer's standard permanent, nonmigrating types compatible with sealants and suitable for joint movement and assembly performance requirements.

C. Glazing Gaskets, Spacers, Setting Blocks, Sealant Backings, and Bond Breakers: As specified in Section 08 80 00 "Glazing."

D. Glazing Sealants: For structural-sealant-glazed curtain walls, as recommended by manufacturer for joint type, and as follows:
   1. Structural Sealant: ASTM C 1184, chemically curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in curtain-wall assembly indicated.
      a. Sealants used inside the weatherproofing system shall have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Color: Black.

2. Weatherseal Sealant: ASTM C 920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.
   a. Sealants used inside the weatherproofing system shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   b. Color: Matching structural sealant.

2.5 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

B. Cleaning Agent and Cloth: As recommended by structural-sealant manufacturer.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Physical and thermal isolation of glazing from framing members.
   4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
   6. Components curved to indicated radii.
   7. Internal guttering systems or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within structural-sealant-glazed curtain wall to exterior.

D. Factory-Assembled Frame Units:
   1. Rigidly secure nonmovement joints.
   2. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
   3. Preparation includes, but is not limited to, cleaning and priming surfaces.
   4. Seal joints watertight unless otherwise indicated.
   5. Install glazing to comply with requirements in Section 088000 "Glazing."

E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605 and containing not less than percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.8 SOURCE QUALITY CONTROL

A. Perform quality-control procedures complying with ASTM C 1401 recommendations including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:
1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmoving joints.
5. Install anchors with separators and isolators to prevent metal corrosion, electrolytic deterioration, and impediments to movement of joints.
6. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within structural-sealant-glazed curtain walls to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install weatherseal sealant according to Section 07 92 00 "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install to comply with the following nonaccumulating maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
   c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of structural-sealant-glazed curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.
   1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft., of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft..
      a. Test Area: One bay wide, but not less than 30 feet, by one story of structural-sealant-glazed curtain wall.
      b. Perform a minimum of two tests in areas as directed by Architect.
      c. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
   2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.
      a. Test Area: One bay wide, but not less than 30 feet, by one story of structural-sealant-glazed curtain wall.
      b. Perform a minimum of two tests in areas as directed by Architect.
      c. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.
   3. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
      a. Test Area: A minimum area of 75 feet by one story of structural-sealant-glazed curtain wall.

C. Structural-sealant-glazed curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:
   1. Mechanical door hardware for the following:
      a. Swinging doors.
      b. Sliding doors.
      c. Folding doors.
   2. Cylinders for door hardware specified in other Sections.
   3. Electrified door hardware.

B. Related Sections:
   1. Division 06 Section "Interior Architectural Woodwork" for cabinet door hardware provided as part of architectural woodwork.
   2. Division 08 Section "Hollow Metal Doors and Frames".
   3. Division 08 Section "Flush Wood Doors" .
   4. Division 12 Sections for cabinet door hardware provided as part of casework.
   5. Division 26 Sections for connections to electrical power system and for low-voltage wiring work.
   6. Division 28 Section "Access Control" for access control devices installed at door openings and provided as part of a security system.
   7. Division 28 Section "Digital, Addressable Fire-Alarm System" for connections to building fire-alarm system.
   8. Division 28 Section "Zoned (DC Loop) Fire-Alarm System" for connections to building fire-alarm system.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Details of electrified door hardware, indicating the following:
   1. Wiring Diagrams: For power, signal, and control wiring and including the following:
      a. Details of interface of electrified door hardware and building safety and security systems.
      b. Schematic diagram of systems that interface with electrified door hardware.
      c. Point-to-point wiring.
      d. Risers.
      e. Elevations doors controlled by electrified door hardware.
   2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Other Action Submittals:
   1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door

hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Submittal Sequence: Submit door hardware schedule concurrent with subJ-Csions of Product Data, Samples, and Shop Drawings. Coordinate subJ-Csion of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

c. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.

2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.

3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.

4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

5) Fastenings and other pertinent information.

6) Explanation of abbreviations, symbols, and codes contained in schedule.

7) Mounting locations for door hardware.

8) List of related door devices specified in other Sections for each door and frame.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For [Installer] [and] [Architectural Hardware Consultant].

B. Product Certificates: For electrified door hardware, from the manufacturer.

1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

C. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

D. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.

2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as follows:
   1. For door hardware, an Architectural Hardware Consultant (AHC).

C. Source Limitations: Obtain each type of door hardware from a single manufacturer.
   1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

E. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
   1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

F. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

G. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

H. Pre-installation Conference: Conduct conference at the project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Inspect and discuss preparatory work performed by other trades.
   3. Inspect and discuss electrical roughing-in for electrified door hardware.
   4. Review sequence of operation for each type of electrified door hardware.
   5. Review required testing, inspecting, and certifying procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

D. Deliver keys and permanent cores to Owner by registered mail or overnight package service.

1.8 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of doors and door hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

1.10 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Maintenance Service: Beginning at Substantial Completion, provide **six** months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
   1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated.
   2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.
2. References to BHMA Designations: Provide products complying with these designations and requirements for description, quality, and function.

2.2 HINGES

A. Hinges: BHMA A156.1.
   1.
   2. Products listed in sets are Ives 5BB1 series.
      a. Equal products from any B.H.M.A. member will also be acceptable.
   3. For out-swinging lockable doors, use tamper proof non-removable pins.

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch- (3.0-mm-) thick, hinge leaves with minimum overall width of 4 inches (102 mm); fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
   1. Products listed in sets are Select Products Ltd.
      a. Ives
      b. Pemko
      c. McKinney

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.
   1. Products listed in sets are Corbin Russwin ML2000 series with LWA lever trim.
      a. Sargent
      b. Yale
   2. Provide strikes with extended lips where required to protect trim from being marred by latch bolt.
   3. a. Provide strike lips which do not project more than 1/8" beyond door-frame trim at single doors and have 7/8" lip to center at pairs of 1-3/4" doors.

2.5 ELECTRIC STRIKES

A. Strike Functions: As indicated in door hardware schedule.
   1. Products listed in sets are Folger Adam 300 series and HES 1000 series.

2.6 AUTOMATIC FLUSH BOLTS

A. Automatic Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.
   1. Products listed in sets are Ives FB series.
      a. Equal products from any B.H.M.A. member will also be acceptable.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.
   1. Products listed in sets are Von Duprin 98 series.
      a. Corbin-Russwin

2.8 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
   1. Furnish Corbin-Russwin 6-pin cylinders factory keyed per the owner's instructions. (No substitutions)

B. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

C. Construction Cores: Provide construction keyed cylinders at all exterior doors and doors with exit devices. Provide 10 construction master keys.

D. Keys:
   1. Stamping: Permanently inscribe each key with a visual key control number.
   2. Quantity: In addition to one extra key blank for each lock, provide the following:
      a. Cylinder Change Keys: Three.
      b. Master Keys: Five.
      c. Grand Master Keys: Five.
      d. Great-Grand Master Keys: Five.

2.9 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.
   1. Products listed in sets are Ives.
      a. Equal products from any B.H.M.A. member will also be acceptable.

2.10 ACCESSORIES FOR PAIRS OF DOORS

A. Astragals: BHMA A156.22.

2.11 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
   1. Products listed in sets are LCN 4040 series.
      a. Corbn-Russwin
      b. Norton

B. Review the door frame and plan details to determine the proper length of arm and the degree of swing. State the degree of door swing in the Hardware Schedule. Provide accessories such as drop and adapter plates, panel adapters, thick-hub shoes, blade stop spacers, and shoe supports as required to install door closers correctly.

2.12 MECHANICAL STOPS AND HOLDERS

A. Wall Stops: BHMA A156.16.
   1. Products listed in sets are Ives.
      a. Equal products from any B.H.M.A. member will also be acceptable.

2.13 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.
   1. Products listed in sets are Glynn-Johnson.
      a. Equal products from any B.H.M.A. member will also be acceptable.

2.14 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
   1. Products listed in sets are National Guard Products.
   2. Comparable product by one of the following manufacturers will also be acceptable:
      a. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
      b. Reese Enterprises, Inc.
      c. Zero International.

2.15 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
   1. Products listed in sets are National Guard Products.
   2. Comparable product by one of the following manufacturers will also be acceptable:
      a. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
      b. Reese Enterprises, Inc.

2.16 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
   1. Products listed in sets are Ives.
      a. Equal products from any B.H.M.A. member will also be acceptable.

2.17 DOOR CONTACTS

A. NONE REQUIRED.

2.18 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
   1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
   1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head

or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
   a. Wood or Machine Screws: For the following:
      1) Hinges mortised to doors or frames[; use threaded-to-the-head wood screws for wood doors and frames].
      2) Strike plates to frames.
      3) Closers to doors and frames.
   b. Steel Through Bolts: For the following unless door blocking is provided:
      1) Surface hinges to doors.
      2) Closers to doors and frames.
      3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.19 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
   2. Custom Steel Doors and Frames: HMMA 831.
   3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.
   1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches (750 mm) of door height greater than 90 inches (2286 mm).

E. Lock Cylinders: Install keyed construction cores at all exterior doors to secure building and areas during construction period.
   1. Best representative will replace keyed construction cores and all temporary cores with permanent cores as directed by owner.
   2. Best representative will deliver all final keys to owner.

F. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

G. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
   1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

3.8 DOOR HARDWARE SCHEDULE

HW SET: 01

2	EA	CONTINUOUS HINGE	SL11 HD	628	SEL
2	EA	PULL/PUSHBAR	9190-2-NO	630	IVE
1	EA	AUTOMATIC OPERATOR	BY DIV 087113		B/O
2	EA	ACTIVATION SWITCHES	BY DIV 087113		B/O
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	MOUNTING PLATE	4040-18TJ	689	LCN
2	EA	OVERHEAD STOP	904S	630	GLY
1	SET	WEATHER SEAL	BY FRAME SUPPLIER	AL	B/O
2	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

HW SET: 02

2	SET	PIVOT SET	7230F	630	IVE
2	EA	PIVOT	7230F INT	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
2	EA	SURFACE CLOSER	4041 X ST-1630	689	LCN
2	EA	OVERHEAD STOP	104S	630	GLY
2	EA	KICK PLATE	8400 10" X 35"	630	IVE

HW SET: 03

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 X ST-1630	689	LCN
1	EA	OVERHEAD STOP	104S	630	GLY
1	EA	KICK PLATE	8400 10" X 34"	630	IVE

HW SET: 04

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	PRIVACY SET	ML2060 LWA	630	C-R
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HW SET: 05

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	OFFICE LOCK	ML2051 LWA	630	C-R
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	AUTOMATIC DOOR BOTTOM	423A	AL	NGP

HW SET: 06

1	EA	CONTINUOUS HINGE	SL24 HD	628	SEL
1	EA	PANIC HARDWARE	98NL	626	VON
1	EA	CYLINDER	RIM	626	C-R
1	EA	SURFACE CLOSER	4041 SCUSH X ST-1595	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	700NA	AL	NGP
1	EA	DRIP CAP	16A	AL	NGP
1	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

HW SET: 07

4	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303-0 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HW SET: 08

4	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	PRIVACY SET	ML2060 LWA	630	C-R
1	EA	OVERHEAD STOP	104S	630	GLY

HW SET: 09

1	EA	CONTINUOUS HINGE	SL24 HD	628	SEL
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	310-2-3/4 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 46"	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 10

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE

HW SET: 11

4	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	310-2-3/4 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES

HW SET: 12

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	310-2-3/4 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES. THE POWER SUPPLY WILL BE CONNECTED TO THE FIRE ALARM PANEL TO CUT POWER UPON ACTIVATION.

HW SET: 13

4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	FIRE EXIT HARDWARE	98NL-F	626	VON
1	EA	CYLINDER	RIM	626	C-R
1	EA	ELECTRIC STRIKE	310-4 FS 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE EXIT DEVICE WILL PERMIT EGRESS AT ALL TIMES. THE POWER SUPPLY WILL BE CONNECTED TO THE FIRE ALARM PANEL TO CUT POWER UPON ACTIVATION.

HW SET: 14

8	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	1006-KM 24VDC FAIL SECURE	626	HES
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 15

8	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	EA	METAL ASTRAGAL	139SP	600	NGP

HW SET: 16

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	310-2-3/4 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES. THE POWER SUPPLY WILL BE CONNECTED TO THE FIRE ALARM PANEL TO CUT POWER UPON ACTIVATION

HW SET: 17

8	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	SET	AUTO FLUSH BOLT	FB32	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	1006-KM 24VDC FAIL SECURE	626	HES
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES. THE POWER SUPPLY WILL BE CONNECTED TO THE FIRE ALARM PANEL TO CUT POWER UPON ACTIVATION.

HW SET: 18

2	EA	CONTINUOUS HINGE	SL24 HD	628	SEL
1	EA	MANUAL FLUSH BOLT	FB458-12" (BOTTOM)	626	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	ASTRAGAL	178SA	CL	NGP
2	EA	SURFACE CLOSER	4041 SCUSH X ST-1595	689	LCN
2	EA	KICK PLATE	8400 10" X 47"	630	IVE
1	SET	SEALS	700NA	AL	NGP
1	EA	DRIP CAP	16A	AL	NGP
2	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

HW SET: 19

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	310-2-3/4 24VDC FAIL SECURE	630	FOL
1	EA	SURFACE CLOSER	4041 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES. THE POWER SUPPLY WILL BE CONNECTED TO THE FIRE ALARM PANEL TO CUT POWER UPON ACTIVATION.

HW SET: 20

1	EA	CONTINUOUS HINGE	SL11 HD-EPT	628	SEL
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	CONTINUOUS HINGE	SL11 HD	628	SEL
1	EA	PANIC HARDWARE	3547A-EO	626	VON
1	EA	PANIC HARDWARE	EL3547A-NL-OP	626	VON
1	EA	CYLINDER	RIM	626	C-R
2	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
1	EA	AUTOMATIC OPERATOR	BY DIV 087113		B/O
2	EA	ACTIVATION SWITCHES	BY DIV 087113		B/O
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	MOUNTING PLATE	4040-18TJ	689	LCN
2	EA	OVERHEAD STOP	904S	630	GLY
1	EA	POWER SUPPLY	PS914-2RS	GRY	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICE FOR ENTRY. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES. THE EXTERIOR ACTIVATION SWITCH WILL BE ENABLED VIA THE ACCESS CONTROL SYSTEM. THE INSIDE ACTIVATION SWITCH WILL UNLOCK THE DOOR PRIOR TO ACTIVATING THE OPERATOR WHEN THE DOOR IS LOCKED.

HW SET: 21

2	EA	CONTINUOUS HINGE	SL11 HD-EPT	628	SEL
2	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	PANIC HARDWARE	EL3547A-EO	626	VON
1	EA	PANIC HARDWARE	EL3547A-NL-OP	626	VON
2	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
1	EA	AUTOMATIC OPERATOR	BY DIV 087113		B/O
2	EA	ACTIVATION SWITCHES	BY DIV 087113		B/O
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	MOUNTING PLATE	4040-18TJ	689	LCN
2	EA	OVERHEAD STOP	904S	630	GLY
1	SET	WEATHER SEAL	BY FRAME SUPPLIER	AL	B/O
2	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP
1	EA	POWER SUPPLY	PS914-2RS	GRY	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICES AND ACTIVATE THE AUTO OPERATOR FOR ENTRY. THE INSIDE WALL SWITCH WILL PERFORM THE SAME FUNCTION THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 22

2	SET	HINGES	AS REQUIRED BY FEMA 361	630	GEN
2	EA	EXIT DEVICE	AS REQUIRED BY FEMA 361	630	GEN
2	EA	SURFACE CLOSER	4041 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 41"	630	IVE
2	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN

NOTE: THE HINGES AND EXIT DEVICES MUST BE FURNISHED AS PART OF A LISTED ASSEMBLY INCLUDING THE DOOR AND FRAME CERTIFIED FOR BOTH FEMA 361 AND ICC 500. THE ELECTROMAGNETIC DOOR HOLDERS WILL BE POWERED BY THE FIRE ALARM PANEL, AND WILL CUT POWER TO RELEASE THE DOORS UPON ACTIVATION.

HW SET: 23

2	SET	HINGES	AS REQUIRED BY FEMA 361	630	GEN
2	EA	EXIT DEVICE	AS REQUIRED BY FEMA 361	630	GEN
2	EA	SURFACE CLOSER	4041 EDA	689	LCN
2	EA	KICK PLATE	8400 10" X 41"	630	IVE
2	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN

NOTE: THE HINGES AND EXIT DEVICES MUST BE FURNISHED AS PART OF A LISTED ASSEMBLY INCLUDING THE DOOR AND FRAME CERTIFIED FOR BOTH FEMA 361 AND ICC 500. THE ELECTROMAGNETIC DOOR HOLDERS WILL BE POWERED BY THE FIRE ALARM PANEL, AND WILL CUT POWER TO RELEASE THE DOORS UPON ACTIVATION.

HW SET: 24

8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	PANIC HARDWARE	9847EO-LBR	626	VON
1	EA	PANIC HARDWARE	9847L-LBR E996L	626	VON
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICE FOR ENTRY. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 25

8	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	FIRE EXIT HARDWARE	9847EO-F-LBR	626	VON
1	EA	FIRE EXIT HARDWARE	9847L-BE-F-LBR 996L-BE	626	VON
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP

HW SET: 26

8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	FIRE EXIT HARDWARE	9847EO-F-LBR	626	VON
1	EA	FIRE EXIT HARDWARE	9847L-F-LBR E996L	626	VON
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICE FOR ENTRY. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 27

8	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	METAL ASTRAGAL	139SP	600	NGP

HW SET: 28

8	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	ELECTRIC STRIKE	1006-KM 24VDC FAIL SECURE	626	HES
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 29

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 X ST-1630	689	LCN
1	EA	OVERHEAD STOP	104S	630	GLY
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 30

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 31

8	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	SET	AUTO FLUSH BOLT	FB32	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4041	689	LCN
2	EA	MOUNTING PLATE	4040-18TJ	689	LCN
1	EA	OVERHEAD STOP	104S	630	GLY
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP
1	EA	METAL ASTRAGAL	139SP	600	NGP

HW SET: 32

1	EA	CONTINUOUS HINGE	SL11 HD-EPT	628	SEL
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	PANIC HARDWARE	EL35A-NL-OP	626	VON
1	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	MOUNTING PLATE	4040-18TJ	689	LCN
1	EA	OVERHEAD STOP	904S	630	GLY
1	EA	POWER SUPPLY	PS914-2RS	GRY	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICE FOR ENTRY. THE INSIDE EXIT DEVICE WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 33

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE

HW SET: 34

2	SET	HINGES	AS REQUIRED BY FEMA 361	630	GEN
1	EA	POWER TRANSFER	EPT-2	689	VON
2	EA	EXIT DEVICE (1) W/E-TRIM	AS REQUIRED BY FEMA 361	630	GEN
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL RELEASE THE ELECTRIC STRIKE FOR ENTRY. THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES.
NOTE: THE HINGES AND EXIT DEVICES MUST BE FURNISHED AS PART OF A LISTED ASSEMBLY INCLUDING THE DOOR AND FRAME CERTIFIED FOR BOTH FEMA 361 AND ICC 500.

HW SET: 35

8	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	EA	WALL STOP	WS407CCV	630	IVE
1	EA	METAL ASTRAGAL	139SP	600	NGP

OPERATION: THE INSIDE LEVER WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 36

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS33	626	IVE

HW SET: 37

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	OFFICE LOCK	ML2051 LWA	630	C-R
1	EA	OVERHEAD STOP	104S	630	GLY

HW SET: 38

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
1	EA	WALL STOP	WS407CCV	630	IVE

HW SET: 39

1	EA	CONTINUOUS HINGE	SL11 HD-EPT	628	SEL
1	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	CONTINUOUS HINGE	SL11 HD	628	SEL
1	EA	PANIC HARDWARE	3547A-EO	626	VON
1	EA	PANIC HARDWARE	EL3547A-NL-OP	626	VON
1	EA	CYLINDER	RIM	626	C-R
2	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
2	EA	SURFACE CLOSER	4041	689	LCN
2	EA	MOUNTING PLATE	4040-18TJ	689	LCN
2	EA	WALL STOP	WS33	626	IVE
1	EA	POWER SUPPLY	PS914-2RS	GRY	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT DEVICE FOR ENTRY. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 39A (ALTERNATE A-1)

1	EA	ELEC STK HOUSING	ES-100-D W/(1) 310-1-3/4 24VDC	630	BLU
2	EA	BOTTOM PIVOT	7215 BTM	626	IVE
2	EA	PIVOT	7215 INT	626	IVE
1	EA	PANIC DEVICE	H-100-CYL W/PULL AS DIRECTED	630	BLU
1	EA	PANIC DEVICE	H-100 W/PULL AS DIRECTED	630	BLU
2	EA	OH CLOSER	RTS-88	626	DRM
1	EA	CYLINDER	MORTISE	626	C-R
2	EA	WALL STOP	WS33	626	IVE
1	EA	POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O

OPERATION: THE CARD READER WILL UNLOCK THE EXIT STRIKE FOR ENTRY. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 40

2	EA	CONTINUOUS HINGE	SL11 HD	628	SEL
2	EA	PANIC HARDWARE	3547A-EO	626	VON
2	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
2	EA	SURFACE CLOSER	4041	689	LCN
2	EA	MOUNTING PLATE	4040-18TJ	689	LCN
2	EA	WALL STOP	WS33	626	IVE

OPERATION: THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 40A (ALTERNATE A-1)

1	EA	STK HOUSING	S-100-D	630	BLU
2	EA	BOTTOM PIVOT	7215 BTM	626	IVE
2	EA	PIVOT	7215 INT	626	IVE
1	EA	PANIC DEVICE	H-100-CYL W/PULL AS DIRECTED	630	BLU
1	EA	PANIC DEVICE	H-100 W/PULL AS DIRECTED	630	BLU
2	EA	OH CLOSER	RTS-88	626	DRM
1	EA	CYLINDER	MORTISE	626	C-R
2	EA	WALL STOP	WS33	626	IVE

HW SET: 41

2	SET	PIVOT SET	7230F	630	IVE
2	EA	PIVOT	7230F INT	630	IVE
1	EA	MANUAL FLUSH BOLT	FB458-24" (TOP)	626	IVE
1	EA	CLASSROOM LOCK	ML2055 LWA	630	C-R
2	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 35"	630	IVE
1	EA	METAL ASTRAGAL	139SP	600	NGP

HW SET: 42

4	EA	HINGE	5BB1HW 4.5 X 4.5	630	IVE
1	EA	FIRE EXIT HARDWARE	98L-BE-F 996L-BE	626	VON
1	EA	SURFACE CLOSER	4041 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	SET	SEALS	2525B	BRN	NGP

HW SET: 43

1	EA	CONTINUOUS HINGE	SL24 HD	628	SEL
1	EA	STORE DOOR LOCK	ML2022 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH X ST-1595	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	SET	SEALS	700NA	AL	NGP
1	EA	DRIP CAP	16A	AL	NGP
1	EA	DOOR SWEEP	C627A	AL	NGP
1	EA	THRESHOLD	425	AL	NGP

HW SET: 44

2	EA	CONTINUOUS HINGE	SL11 HD-EPT	628	SEL
2	EA	POWER TRANSFER	EPT-2	689	VON
1	EA	PANIC HARDWARE	EL3547A-EO	626	VON
1	EA	PANIC HARDWARE	EL3547A-NL-OP	626	VON
1	EA	CYLINDER	RIM	626	C-R
2	EA	OFFSET DOOR PULL	8190-2-O	630	IVE
2	EA	AUTOMATIC OPERATOR	BY DIV 087113		B/O
2	EA	MOTION SENSOR ACTIVATION	BY DIV 087113		B/O
1	EA	POWER SUPPLY	PS914-2RS	GRY	VON
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
2	EA	OVERHEAD STOP	904S	630	GLY

OPERATION: WHEN THE DOORS ARE UNLOCKED THE MOTION SENSORS WILL ACTIVATE THE OPERATORS. WHEN THE DOORS ARE LOCKED, THE CARD READER WILL UNLOCK THE EXIT DEVICES AND ACTIVATE THE AUTO OPERATOR FOR ENTRY, AND THE INSIDE MOTION SENSOR WILL PERFORM THE SAME FUNCTION. THE INSIDE EXIT DEVICES WILL PERMIT EGRESS AT ALL TIMES.

HW SET: 45

8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT-2	689	VON
1	SET	AUTO FLUSH BOLT	FB32	630	IVE
1	EA	FIRE EXIT HARDWARE	EL-9875L-F 996L	630	C-R
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	AUTOMATIC OPERATOR	BY DIV 087113		B/O
2	EA	MOTION SENSOR ACTIVATION	BY DIV 087113		B/O
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	ASTRAGAL SEAL	5070CL	CLR	NGP
1	EA	METAL ASTRAGAL	139SP	600	NGP
1	EA	POWER SUPPLY	PS914-2RS-FA	GRY	VON

OPERATION: THE EXIT DEVICE LATCH BOLT WILL BE HELD CONTINUOUSLY RETRACTED. THE MOTION SENSORS LOCATED ON EACH SIDE OF THE DOORS WILL ACTIVATE THE OPERATORS. THE ACTIVATION CIRCUIT OF THE OPERATOR, AND THE POWER SUPPLY FOR THE EXIT DEVICE WILL BE CONNECTED TO THE FIRE ALARM PANEL TO PERMIT THE DOORS TO CLOSE AND LATCH UPON ACTIVATION.

HW SET: 46

1	EA	CONTINUOUS HINGE	SL11 HD	628	SEL
1	EA	PANIC HARDWARE	35A-NL 386NL	626	VON
1	EA	CYLINDER	RIM	626	C-R
1	EA	SURFACE CLOSER	4041 SHCUSH	689	LCN

HW SET: 47

4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	ML2057 LWA	630	C-R
1	EA	SURFACE CLOSER	4041 SCUSH	689	LCN
1	SET	SOUND SEALS	BY ACOUSTICAL DOOR MFG.		B/O
1	EA	AUTOMATIC DOOR BOTTOM	BY ACOUSTICAL DOOR MFG.		B/O
1	EA	THRESHOLD	410	AL	NGP

HW SET: 48

4	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	PASSAGE SET	ML2010 LWA	630	C-R
1	EA	SURFACE CLOSER	4041	689	LCN
1	EA	KICK PLATE	8400 10" X 34"	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	SET	SEALS	2525B	BRN	NGP
1	EA	MAGNETIC HOLD-OPEN	SEM 7850	AL	LCN

NOTE: THE ELECTROMAGNETIC DOOR HOLDERS WILL BE POWERED BY THE FIRE ALARM PANEL, AND WILL CUT POWER TO RELEASE THE DOOR UPON ACTIVATION.

End of Section

SECTION 08 71 13

AUTOMATIC DOOR OPERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Power door operators for swinging doors.

1.3 DEFINITIONS

A. Double Egress Doors: A pair of doors that simultaneously swing with the two doors moving in opposite directions with no mullion between them.

B. Double Swing Doors: A pair of doors that swing with the two doors moving in opposite directions with a mullion between them; each door functioning as a single swing door.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators, including activation and safety devices. Include operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For automatic door operators. Include plans, elevations, sections, details, and attachments to other work.
1. Indicate required clearances, method of field assembly, components, and location and size of each field connection.
2. Include locations and elevations of entrances showing activation and safety devices.
3. Wiring Diagrams: For power, signal, and activation- and safety-device wiring.

C. Samples: For each exposed product and for each color and texture specified, manufacturer's standard in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each operator for fire-rated door assemblies, signed by product manufacturer. Certify that operator is listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for use on types and sizes of labeled fire doors required.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, including activation and safety devices, to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project and who employs a certified inspector.
   1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Certified Inspector Qualifications: Certified by the AAADM.

C. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a testing agency, and marked for intended location and application.

E. Exit-Door Requirements: Comply with requirements of authorities having jurisdiction for doors with automatic door operators serving as a component of a required means of egress.

F. Preinstallation Conference: Conduct conference at Project site.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of door frames by field measurements before fabrication of exposed covers for automatic door operators.

1.9 COORDINATION

A. Coordinate size and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified together with Concrete.

B. Templates: Obtain and distribute, to the parties involved, templates for doors, frames, operators, and other work specified to be factory prepared and reinforced for installing automatic door operators. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic door operators to comply with indicated requirements.

C. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators, including activation and safety devices, with connections to power supplies and to access-control system.

D. Pneumatic System Roughing-in: Coordinate layout and installation of automatic door operators with connections to compressed-air piping systems.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty or sporadic operation of automatic door operator, including activation and safety devices.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.
   2. Warranty Period: Two years from date of Substantial Completion.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of automatic door operator Installer. Include quarterly planned and preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
   1. Engage a certified inspector to perform safety inspection after each adjustment or repair, and at end of maintenance period. Furnish completed inspection reports to Owner.
   2. Perform maintenance, including emergency callback service, during normal working hours.
   3. Include 24-hour-per-day, seven-day-per-week emergency callback service.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Besam Automated Entrance Systems, Inc.; an ASSA ABLOY Group company.
   2. DORMA Architectural Hardware.
   3. DORMA Automatics.
   4. Horton Automatics; a division of Overhead Door Corporation.
   5. KM Systems, Inc.
   6. LCN Closers; an Ingersoll-Rand company.
   7. Nabco Entrances, Inc.
   8. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
   9. Sierra Automatic Doors, Inc.
   10. Stanley Access Technologies; Division of The Stanley Works.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated, complying with standards indicated below:
   1. Sheet: ASTM B 209.
   2. Extrusions: ASTM B 221.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.

C. Expanded Aluminum Mesh: Manufacturer's standard expanded and flattened aluminum sheet in accordance with the geometry of ASTM F 1267.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.3 AUTOMATIC DOOR OPERATORS, GENERAL

A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated; and complying with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
   1. Emergency Breakaway: Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, and to return to closed position after breakaway and automatically reset.
   2. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
   3. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load as indicated on the Drawings.

B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

C. Hinges: See Section 087100 "Door Hardware" for type of hinge for each door that door operator shall accommodate.

D. Housing for Overhead Concealed Operators: Fabricated from minimum 0.125-inch- thick, extruded or formed aluminum and extending full width of door opening including door jambs to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.

E. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

F. Fire-Door Package: Consisting of UL-listed latch mechanism, power-reset box, and caution signage for fire-rated doors. Latch mechanism shall allow door to swing free during automatic operation; when fire is detected, latch actuator shall cause exit hardware to latch when door closes. Provide latch actuators with fail-secure design.

2.4 POWER DOOR OPERATORS

A. Standard: BHMA A156.10.

B. Performance Requirements:
   1. Opening Force:
      a. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails; not more than 15 lbf required to open door to minimum required width.
      b. Power-Operated Swinging Doors: Not more than 30 lbf required to manually open door if power fails.
      c. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a door to open.
   2. Entrapment Protection: Not more than 40 lbf required to prevent stopped door in the last 10 degrees of opening from moving in the direction of opening; not more than 30 lbf required to prevent stopped door from moving in direction of closing.

C. Configuration: Operator to control single swinging door and paired swinging doors.
   1. Traffic Pattern: Two way.
   2. Operator Mounting: Overhead concealed.

D. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.10.

E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controls.

G. Features:
   1. Adjustable opening and closing speed.
   2. Adjustable opening force.
   3. Adjustable back check.
   4. Adjustable hold-open time from zero to 30 seconds.
   5. Adjustable time delay.
   6. Adjustable acceleration.
   7. Adjustable limit switch.
   8. Obstruction recycle
   9. On-off/hold-open switch to control electric power to operator; key operated.

H. Exposed Finish: Finish exposed components with finish matching door and frame.

2.5 ACTIVATION AND SAFETY DEVICES

A. General: Provide activation and safety devices in accordance with BHMA standards, for condition of exposure and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.

B. Presence Proximity Sensors (interior Locations): Self-contained, infrared-scanner units; adjustable to provide detection field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

C. Push-Plate Switch (Exterior locations): Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.
   1. Configuration: Rectangular push plate with 2-by-4-inch junction box.
      a. Mounting: Surface mounted on post or as indicated on Drawings.
   2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
   3. Message: International symbol of accessibility and "Push to Open."

D. Push-Button Switch (Exterior Locations option): Momentary-contact door control switch with one red-button actuator; enclosed in nominal 2-by-4-inch junction box.
   1. Provide blue plastic cover engraved with "Press Button to Open" in white text and international symbol of accessibility.
   2. Mounting: Surface mounted on post or as indicated on Drawings.
   3. Faceplate Material: Stainless steel.

E. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.6 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.

B. Fabricate exterior components to drain water passing joints and condensation and moisture occurring or migrating within operator enclosure to the exterior.

C. Form aluminum shapes before finishing.

D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

E. Provide metal cladding, completely cladding visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.7 ACCESSORIES

A. Signage: As required by cited BHMA standard for the type of operator.
   1. Application Process: Door manufacturer's standard process.
   2. Provide sign materials with instructions for field application when operators are installed.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3 -coat fluoropolymer finish complying with AAMA 2605 and containing not less than percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.

C. Examine roughing-in for compressed-air piping systems to verify actual locations of piping connections before automatic door operator installation.

D. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install complete automatic door operators according to manufacturer's written instructions, including activation and safety devices, control wiring, and remote power units if any; connection to the building's power supply; and signage.
   1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
   2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
   3. Power Door Operator Installation Standard: BHMA A156.10.

B. Activation and Safety Devices: Install devices and wiring according to manufacturer's written instructions and cited BHMA standard for type of operator and direction of pedestrian travel. Connect activation- and safety-device wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 281300 "Access Control."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 FIELD QUALITY CONTROL

A. Inspection: Engage Installer's certified inspector to test and inspect automatic door operators and prepare test and inspection reports.
   1. Certified inspector shall test and inspect each automatic door operator to determine compliance of installed systems with applicable BHMA standards.
   2. Inspection Report: Certified inspector shall submit report in writing to Architect and Contractor within 24 hours after inspection.

B. Work will be considered defective if it does not pass tests and inspections.

3.4 ADJUSTING

A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
   1. Adjust operators on exterior doors for weathertight closure.

B. After completing installation of exposed, factory-finished automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust automatic door operators after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
1. Doors.
2. Glazed curtain walls.
3. Storefront framing.
4. Glazed entrances.
5. Interior borrowed lites
6. Fire protection glazing

B. Related Sections:
1. Division 07 Section "Joint Sealants" for installation of joint sealants installed with glazed aluminum curtain walls and for sealants to the extent not specified in this Section.
2. Division 08 Section "Hollow Metal Doors and Frames" for glazed operable opening.
3. Division 08 Section "Aluminum Framed Storefront and Entrances" for glazed aluminum storefronts and entrances.
4. Division 08 Section "Glazed Aluminum Curtain Walls" for glazed aluminum curtain walls.
5. Division 08 Section "Structural Sealant Glazed Curtain Walls" for structural sealant glazed curtain walls.
6. Division 08 Section "Decorative Film" for decorative film applied to glazing specified.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. LEED Submittals:
1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
   a. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

D. Samples for Initial Selection: For units with factory-applied finishes.

E. Fabrication Sample: Made from full-size components and including the following:
   1. Glass Type IGL-1through IGL-6
   2. Glass Type IGL-A-6a-O and IGL-A-6a-L; (If the alternate is included in the Work)
   3. Glass Type IGL-7 and IGL-7a; (If the alternate is included in the Work)
   4. Glass Type GL-1 through GL-3, and GL-4 & GL-5.
   5. Glass Type SB-1
   6. Glass Type SP-1
   7. Glass Type GL-A-5; (If the alternate is included in the Work)

1.5 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
   1. Coordinate glazing required for all mockup installation indicated for the project.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

D. Source Limitations for Glass: Obtain coated float glass and insulating glass from single source from single manufacturer for each glass type.

E. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."

G. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

H. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
   1. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites of thickness indicated.
   2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 91 percent and solar heat gain coefficient not less than 0.87.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. AFG Industries, Inc.
      b. Guardian Industries Corp.
      c. Pilkington North America
      d. PPG Industries, Inc.
      e. Viracon (Basis of Design)

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by designations in "Insulating-Glass Types" Article.

2.4 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies and NFPA 257 for window assemblies.

B. Monolithic Ceramic Glazing: Clear, ceramic flat glass; .
   1. Products: Subject to compliance with requirements, provide the following:
      a. Nippon Electric Glass Co., Ltd. (distributed by Technical Glass Products);
         1) Storefront Framing: Standard FireLite. (3/16-inch nominal thickness)
         2) Rated Door: Firelite Plus (5/16-inch nominal thickness)

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.
   3. Silicone complying with ASTM C 1115.
   4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone, or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.
   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing

stops on opposite side of glazing.

C. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C 542, black.

2.6 GLAZING SEALANTS

A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
a. BASF Building Systems; OmniPlus.
b. Bostik, Inc.; Chem-Calk 1200.
c. Dow Corning Corporation; 999-A.
d. GE Advanced Materials - Silicones; Contractors SCS1000 Construction SCS1200.
e. May National Associates, Inc.; Sil 100 GC Sil 100 GP Sil 100 WF.
f. Pecora Corporation; 860.
g. Polymeric Systems, Inc.; PSI-601.
h. Schnee-Morehead, Inc., an ITW company; SM5732 Polyglaze.
i. Tremco Incorporated; Proglaze Tremsil 200.

D. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

H. Decorative Film: refer to Section 08 87 33 Decorative Films for film to be applied to the glazing.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.10 MONOLITHIC-GLASS TYPES

A. Glass Type :
   1. Clear heat-strengthened float glass
   2. Fully tempered float glass.
   3. Thickness: 6.0 mm, unless otherwise indicated.
   4. Provide safety glazing labeling.

B. Glass Type [IGL-1]: Interior glass clear

C. Glass Type [IGL-2]: Interior glass, clear with applied film at offices

D. Glass Type [IGL-3]: Interior glass, clear with applied film at lab
   1. Film on one side only, applied to corridor side of laboratory window.

E. Glass Type [IGL-4]: Interior glass frosted

F. Glass Type [IGL-5]: Interior glass back-painted

G. Glass Type [IGL-6]: Interior glass back-painted with magnetic backing (by Skyline Vitracolor magnetic) include Mounting brackets and Anodized aluminum rail. See website:
   a. http://www.skydesign.com/products/markerglass/select-magnetic-markerglass
   1. Alternate Glass Type [IGL-A-6a-O] – sandblasted pattern glass at Office
   2. Alternate Glass Type [IGL-A-6a-L] – sandblasted pattern glass at Lab
      a. Etching on both sides of glass

H. Glass Type [IGL-7]: ¾ inch thick, clear tempered with EDE graphic film with gradient pattern applied to Breakroom side.

I. Glass Type [IGL-7A]: ¾ inch, clear tempered with Skyline etch and seal custom bar code pattern with gradient etch.

2.11 INSULATED-GLASS TYPES

A. Glass Type [GL-1]: Viracon VUE 24 – 40 Insulating Clear HS/HS vision glass
   1. ¼" (6 mm) Optiwhite HS
   2. Viracon VUE-40 #2
   3. ½" (13.2 mm) airspace – black
   4. ¼" (6 mm) Clear HS
   5. VLT: 41% (Visible Light Transmission)
   6. R OUT: 16% (Reflectance Out)
   7. Winter U: 0.28 (U-Value)
   8. Summer U: 0.25 (U-Value)
   9. SC: 0.26 (Shading Coefficient)
   10. SHGC: 0.22 (Solar Heat Gain Coefficient)
   11. LSG: 1.86 (Light to Solar Gain)

B. Glass Type [GL-2]: Viracon VUE 24 – 40 Insulating Clear HS/HS Silkscreen; vision glass with 40 % frit pattern
   1. ¼" (6 mm) Optiwhite HS
   2. Viracon VUE-40 screen #5006 #2
   3. V175 – High Opacity White Viraspan #2
   4. ½" (13.2 mm) airspace – black
   5. ¼" (6 mm) Clear HS
   6. VLT: 29% (Visible Light Transmission)
   7. R OUT: 24% (Reflectance Out)
   8. Winter U: 0.29 (U-Value)
   9. Summer U: 0.25 (U-Value)
   10. SC: 0.20 (Shading Coefficient)
   11. SHGC: 0.17 (Solar Heat Gain Coefficient)
   12. LSG: 1.71 (Light to Solar Gain)

C. Glass Type [GL-3]: Viracon VUE 24 – 40 Insulating Clear HS/HS Silkscreen
   1. ¼" (6 mm) Optiwhite HS
   2. Viracon VUE-40 #2
   3. ½" (13.2 mm) airspace – black
   4. Black silicone
   5. ¼" (6 mm) Clear HS
   6. Screen #3058 #3
   7. V1086 – Simulated Sandblast Viraspan #3

D. Glass Type [SB-1]: Viracon VUE 24 vision glass with shadow box

E. Glass Type [SP-1]: Metal spandrel panel Refer to Sections 08 44 13 “Glazed Aluminum Curtain Wall” for information regarding these spandrel panel properties.

2.12 FIRE-PROTECTION-RATED GLAZING TYPES

A. Glass Type [GL-4]: fire-rated glazing; monolithic ceramic glazing film-faced ceramic glazing

B. Glass Type [GL-5}: fire rated door glazing, monolithic ceramic glazing.

2.13 ELECTROCHROMIC TINTABLE GLASS UNITS

A. Alternate Glass Type [GL-A-5]: electrochromic, clear insulating glass (SAGE glass).
1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: Heat-strengthened float glass.
4. Interspace Content: Air.
5. Indoor Lite: Tempered float glass Ultraclear heat-strengthened float glass .
6. SAGE Coating: Pyrolytic on third surface.
7. Performance (Clear mode)
   1) Visible Light Transmittance: 62 percent minimum.
   2) Winter Nighttime U-Factor: 0.29 maximum.
   3) Summer Daytime U-Factor: 0.28 maximum.
   4) Solar Heat Gain Coefficient: 0.48 maximum.
8. Performance (Tinted mode)
   1) Visible Light Transmittance: 3.5 percent minimum.
   2) Winter Nighttime U-Factor: 0.29 maximum.
   3) Summer Daytime U-Factor: 0.28 maximum.
   4) Solar Heat Gain Coefficient: 0.09 maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 LOCK-STRIP GASKET GLAZING

A. Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system unless otherwise indicated.

3.8 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 08 87 33

DECORATIVE FILMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following products for surface application to glass.
   1. Decorative film.

B. Related Sections:
   1. Division 08 Section “Glazing” for installation and coordination of glazing not specified in this section.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. ASTM D1044 - Test for Resistance of Transparent Plastics to Surface Abrasion (Taber Abrader Test).

1.3 ACTION SUBMITTALS

A. Product Data: Submit for each product specified indicating:
   1. Physical and performance properties.
   2. Preparation and installation instructions and recommendations.
   3. Storage and handling recommendations.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Warranty: Submit sample special warranty specified in this section.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that has a minimum of 10 years of documented experience manufacturing glazing surface films similar to that used for this project.

B. Installer Qualifications: All products listed in this Section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this Section.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials in manufacturer's protective packaging.

B. Store and protect materials according to manufacturer's written recommendations to prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 SITE CONDITIONS

A. Ambient Conditions: Maintain temperature, humidity, and ventilation within limits recommended by manufacturer.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace films that fail within specified warranty period.
   1. Warranty Period: 15 years from date of original installation.
   2. Warranty coverage limited to owner of property at time of installation.
   3. Manufacturer’s obligation is limited to furnishing replacement film for any film covered by limited warranty which manufacturer determines to be defective. Manufacturer will not be liable for installation costs of replacement film or for any special, indirect, incidental or consequential damages.

PART 2 - PRODUCTS

2.1 DECORATIVE FILMS

A. Subject to compliance with requirements, provide the Basis-of-Design product indicated, or a comparable product from one of the following:
   1. Lintec Wincos UV (Basis of Design)
   2. Decorative Films, LLC.
   3. Solutia Inc. (CPFilms Inc/Vista Film).

B. Basis of Design: model E-2100 ZC
   1. Thickness: 2 mil
   2. Scratch resistant
   3. Film layers:
      a. Clear Hard Coated PET: 2 mils
      b. Permanent clear adhesive: 2 mil
      c. PET release layer

C. Digital printing to be coordinated with the manufacturer prior to final purchase of decorative film.

D. Coordinate door glazing lamination with glazing requirements included in Section 08 80 00 Glazing.

2.2 DECORATIVE FILM ACCESSORIES

A. General: Provide accessories either manufactured by or acceptable to glazing surface film manufacturer for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by glazing surface film manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements and for conditions affecting performance of glazing surface film including glass that is broken, chipped, cracked, abraded, or damaged in any way.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates thoroughly prior to installation. Prepare substrates using methods recommended by film manufacturer to achieve the best results for the substrate under project conditions.

B. Protect window frames and surrounding surfaces to prevent damage during installation.

3.3 INSTALLATION

A. Install in accordance with film manufacturer's written instructions.

B. Install film continuously, but not necessarily in one (1) continuous length. Install with no gaps or overlaps.

C. Apply film to glass per manufacturer's recommendations.

D. Remove air bubbles, blisters, and other defects. Be careful to remove "fingers" to eliminate any contamination or excess water pockets. It is crucial to remove as much water as possible during installation.

3.4 FIELD QUALITY CONTROL

A. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, wrinkles, banding, thin spots or pinholes.

B. If installed film does not meet these criteria, remove and replace with new film.

3.5 CLEANING AND PROTECTION

A. Use cleaning methods recommended by glazing surface film manufacturer.

B. Replace films that cannot be cleaned.

C. Protect installed products until completion of project.

D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION