

Montgomery College

Catherine and Isiah Leggett Math and Science Building

Takoma Park / Silver Spring Campus

DESIGN DEVELOPMENT - GMP3, GMP4

SEPTEMBER 27, 2019

Montgomery College #: FP16-077

Montgomery College Building #319

MHEC Project #CC-01-MC16-458

SMITHGROUP Project #: 12543.000



SMITHGROUP

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BMC to coordinate
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NOT APPLICABLE

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REVISION NO. 2 - GEOTECHNICAL REPORT

**The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Avenue
Takoma Park, Maryland**

Schnabel Engineering DC, Inc.
CBE License No. L22053052020

Schnabel Reference: 18C41041
June 24, 2019



Schnabel Engineering DC

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4200 Wisconsin Avenue, NW, Suite LL9 / Washington, DC / 20016

CBE License No. L22053052020

June 24, 2019

Mr. Kevin Johnson, AIA, LEED AP
SmithGroup
1700 New York Avenue NW, Suite 100
Washington, DC 20006

Subject: Project 18C41041, Revision No. 2 - Geotechnical Engineering Report, The Catherine and Isiah Leggett Building, Montgomery College, 7600 Takoma Ave, Takoma Park, Maryland

Dear Mr. Johnson:

SCHNABEL ENGINEERING DC, INC. is pleased to submit our revised geotechnical engineering report for this project. This study was performed in accordance with our proposal dated January 18, 2018, as authorized by you via email of August 5, 2018, and our Revision No. 1 proposal dated May 2, 2019. This report supersedes the final reports issued on December 11, 2018, and January 23, 2019, and the draft Revision No. 2 report issued on May 21, 2019. We appreciate the opportunity to be of service for this project. Please call us if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING DC, INC.

A handwritten signature in blue ink that reads 'J. Bentel'.

Joan Bentel, PE
Associate

Bill Khouri, PE
Principal



"Professional Certification. I hereby certify that these documents were prepared or approved by me and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 17793, Expiration Date: 5-12-2020."

MK:SO:JB:BK:is:jb

\\SEDC-FS\PROJECTS\2018\PROJECTS\18C41041 - MC MATH & SCIENCE CENTER\03-SE PRODUCTS\03-REPORTS\02-FINAL\FINAL GEOTECHNICAL REPORT_REV. 2_062419.DOCX

schnabelDC.com

T/ 202-677-4120
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REVISION NO. 2 - GEOTECHNICAL ENGINEERING REPORT
THE CATHERINE AND ISIAH LEGGETT BUILDING
TAKOMA PARK, MARYLAND

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1.0 EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation and testing conducted by Schnabel Engineering DC, Inc. (SEDC) for the proposed Catherine and Isiah Leggett Building for SmithGroup. Based on our evaluation of the subsurface conditions revealed by our field investigation and the project data furnished to us, we have developed the following summary of our major conclusions and recommendations. Detailed recommendations are presented in the body of the report.

- Ten soil test borings were advanced in the general area of the proposed building and five soil borings were advanced at proposed stormwater management locations (one of the test building borings also served as a stormwater boring, SB-05/SWM-4) in 2018. Two additional soil test borings were advanced in May 2019. The subsurface investigations revealed that the site is underlain by terrace deposits (Strata B1 and B2) overlaying residual soils (Strata C1, C2, and D). Existing fill was also encountered and extended between 1.2 ft to 6 ft below surface grades in the majority of the borings, except at borings SB-08 and SB-10. At these locations, deeper fill was present and extended 13.5 ft to 23.5 ft below surface grades, respectively.
- The subject site is currently occupied by Falcon Hall with the lowest level at predominately EL +307 (ft) and some spaces with a lowest level at EL +302 (ft), and the Science South Building with a lowest level at EL +326 (ft). Both buildings will be demolished in their entirety and the buildings' foundation systems will be completely removed. Cuts of up to about 15 ft are expected, and the majority of the fill that was encountered in the borings will be removed as part of the demolition. At boring SB-10, where fill extended to EL +302.9 (ft), the fill material is believed to be backfill of the present-day building. Boring SB-10 currently lies outside of the proposed building footprint and our recommendations have been tailored with this consideration.
- To reach the proposed lowest level of the new Catherine and Isiah Leggett Building at EL +320 (ft), up to about 15 ft to 18 ft of new compacted structural fill will need to be placed. Due to the large thickness of new fill being placed, settlement plates will need to be installed and the fill monitored to ensure that settlement has dissipated before the building can be constructed. Additional details are included herein.
- Considering a maximum column load of about 200 kips to 300 kips, we recommend the new building be supported on spread footings founded on firm natural soils of Strata B1, B2, C1, or C2 or on compacted structural fill. In areas where existing natural soil is loose/soft or existing fill material is present, these materials should be removed and replaced with compacted structural fill or lean concrete. Spread footings can be designed for an allowable soil bearing pressure of 3,000 psf as discussed in detail in the report.
- The proposed floor slabs should be supported on suitable natural soils of Strata B1, B2, C1, and C2 or compacted structural fill. A modulus of subgrade reaction, k , of 100 kcf (kips per cubic foot) should be used in the design of floor slabs.

SmithGroup
The Catherine and Isiah Leggett Building

- We evaluated the Seismic Site Class for this project according to the International Building Code (IBC) Section 1613 2015. Our analysis indicates Site Class D for this location. This Site Class was evaluated based on the Standard Penetration Test (SPT) values.
- Building walls that extend below-grade need to be designed to withstand lateral earth pressures. Additional details are provided herein.
- Subdrainage below the floor slab and behind below-grade walls will be required. Dewatering during construction will also be required. Additional details are provided herein.

We are providing this executive summary solely for purposes of overview. Any party that relies on this report must read the full report. This executive summary omits several details, any one of which could be very important to the proper application of the report.

2.0 SCOPE OF SERVICES

Our proposal dated January 18, 2018, and Revision No. 1 proposal dated May 2, 2019, defines the scope of services for this project. The scope of services includes the following:

- Advancing twelve (12) soil test borings to depths between 40 ft and 55 ft each, five soil test borings to depths between 15 ft and 16 ft each, and conducting pressuremeter testing at two (2) of the building borings.
- Conducting falling head infiltration testing at six locations.
- Preparation of a report consisting of:
 - Project and site description, including relevant information relating to nearby foundations and structures, etc.
 - A boring location plan, indicating boring locations referenced to actual physical features and proposed locations of structures.
 - Boring logs with soil/rock description, classification, and depth of fill, groundwater observations, and any other observations made during the exploration, including the ground surface elevations at boring locations.
 - An estimate of subsurface conditions and groundwater levels within the area explored.
 - Foundation requirements including a net allowable soil bearing pressure, bearing grades and estimated settlements for spread footings.
 - Recommendations for floor slab support, including a recommended modulus of subgrade reaction for use in slab design.
 - Earthwork recommendations for the construction of load-bearing fill including an assessment of site soils for use as fill, subgrade preparation, and compaction criteria.
 - Recommended Seismic Site Class in accordance with IBC 2015 for use in foundation design based on an extrapolation of data collected in the subsurface exploration.
 - Recommended static earth pressures, subdrainage and backfill requirements for basement walls, loading dock walls or retaining walls, if necessary.
 - Recommendations regarding permanent subdrainage design and installation, if necessary.
 - Recommendations regarding building area surcharging requirements due to the placement of new compacted structural fill.
 - Construction considerations related to the implementation of our recommendations.

3.0 DESCRIPTION OF SITE AND PROPOSED CONSTRUCTION

3.1 Site Description

We understand that the project will consist of constructing The Catherine and Isiah Leggett Building at the Montgomery College Takoma Park/Silver Spring Campus in Takoma Park, Maryland. The project site is bounded by Fenton Street to the south and west, Takoma Avenue to the east, and New York Avenue to the north. A Site Vicinity Map is included as **Figure 1**.

Areas to be improved are currently asphalt lots, the Falcon Hall and Science South academic buildings, tennis courts, and landscaped grass areas between academic buildings. We understand that the lowest level elevation for the Science South building is at elevation EL +326 (ft), and the lowest level elevation for Falcon Hall is at approximate elevation EL +307 (ft). Both of these buildings are believed to be supported on spread footings. Existing grades in the area of the proposed building footprint range from about EL +315 (ft) to about EL +334 (ft).

We obtained the site information from our site visits and from the information provided by your office. The topographic information was supplied by A. Morton Thomas and Associates.

3.2 Proposed Construction

The proposed building will be located along the east portion of the Takoma Park/Silver Spring Campus in the area where present-day Falcon Hall, the Science South Building, Staff Parking Lot E1, and the tennis courts are situated. We understand that existing Falcon Hall and the Science South Building will be demolished in their entirety to provide an adequate footprint for the proposed building. The new building will be 134,000 net square feet in area and will extend into the area currently occupied by Lot E1, abutting the Fenton Street campus boundary and the Science North Building.

The proposed building will be two to three levels and will have up to one level below grade with a lowest level at EL +320 (ft). Based on the existing grades, we anticipate cuts of about 2 ft to 15 ft will be required to reach the lowest level elevation. Upon demolishing Falcon Hall, with lowest level ranging between EL +307 (ft) and EL +302 (ft), compacted structural fill of up to 18 ft will need to be placed to reach the proposed lowest level of the new building. We understand that the maximum column load will be about 200 kips to 300 kips and typical column spacing will be 30 ft by 30 ft.

The lowest level elevation and building layout information was supplied by your office and the structural loading information was provided by Cagley and Associates.

4.0 SUBSURFACE EXPLORATION PROGRAM

We performed two subsurface explorations and in-situ testing to identify the subsurface stratigraphy underlying the site and to evaluate the geotechnical properties of the materials encountered. Our explorations included drilling 17 standard penetration test (SPT) borings and conducting pressuremeter testing. Additionally, falling head infiltration testing was conducted at six locations selected by your Civil Engineer. **Appendix A** contains the results of our exploration and the borings logs.

4.1 Subsurface Exploration and Field Testing

4.1.1 Test Borings

Our subcontractor, Recon Drilling, drilled 15 soil test borings under our observation between August 6, 2018, and August 14, 2018. The May 2019 borings (Boring A and Boring B) were drilled by Connelly and Associates on May 15, 2019, and May 16, 2019. The Standard Penetration Test (SPT) was performed at selected depths. Borings SB-01 through SB-10 were drilled to depths between 38.5 ft and 53.5 ft in the proposed building area. Boring A and Boring B were drilled to depths between 38.8 ft and 34.0 ft, respectively, in the proposed building area. Borings SWM-01 through SWM-06 were drilled to depths between 15 ft and 16 ft at the proposed infiltration areas.

Standard penetration testing was conducted at typical intervals from the ground surface to the bottom of each borehole. **Appendix A** includes specific observations, remarks, and logs for the borings, classification criteria, drilling methods, and sampling protocols. **Figure 2**, included at the end of this report, indicates the approximate test boring locations. Soil samples from the 2018 investigation have been disposed of. The soil samples for Boring A and Boring B will be retained for up to 45 days beyond the issuance of this report, unless you request other disposition.

4.1.2 Pressuremeter Testing

We performed four in-situ pressuremeter tests, two tests in an offset boring location adjacent to boring SB-05/SWM-04 and another two tests within boring SB-06 to evaluate the strength and deformation characteristics of soils. Details of the pressuremeter tests and test results are included in **Appendix B**. It should be noted that results for only three of the tests are included in **Appendix B**; the fourth test indicated that the material was disturbed and the test results are unreliable. **Table 4.1** below summarizes the pressuremeter tests results.

Table 4.1: Summary of Pressuremeter Tests Results

Boring Number	Pressuremeter Test Depth (ft)	Stratum	Limiting Pressure (tsf)	Pressuremeter Modulus (tsf)
SB-05/SWM-4	14	D (Disintegrated Rock)	18	308
SB-06	24	C2 (Residual)	12	86
SB-06	27.5	C2 (Residual)	12	105

4.1.3 Infiltration Testing

To evaluate the feasibility for groundwater infiltration at the site, six in-situ falling head infiltration tests were performed on August 8, 2018, and August 10, 2018, within augered probe-holes drilled adjacent to borings SWM-1 through SWM-6. The in-situ infiltration tests were performed at a depth of about 6 ft below surface grades. The in-situ infiltration test procedure included placing a solid 5-inch diameter PVC pipe in the offset probe-holes then pre-soaking the bottom of each hole by placing 24 inches of water in the bottom of the pipe for a minimum of 24 hours. After the pre-soak period, and after replacing any water that may have dropped during the pre-soak period, the infiltration tests were performed, which consisted of monitoring the drop in the water level at 1-hour intervals for 4 hours. Following each 1-hour reading, water was added to the pipe to return the water level to 24 inches. The results of the infiltration testing are summarized in **Section 5.4**.

4.2 Laboratory Testing

Select jar samples collected during drilling were submitted for laboratory testing. The results are incorporated in the generalized subsurface stratigraphy section of the report and are included in **Appendix C**.

5.0 SITE GEOLOGY AND SUBSURFACE CONDITIONS

5.1 Site Geology

The geologic stratigraphy consists of sand and clay terrace deposits overlying residual soils. Terrace deposits are typically a result of river currents. The residual soils are derived from weathering of the bedrock at the site. The parent bedrock at the site is believed to be schist of the Wissahickon Formation. Fill and probable fill was also encountered at the site and is believed to be associated with past grading and development at the site. During our exploration, we encountered the following stratigraphy:

- Stratum A: Existing Fill and Probable Fill
- Stratum B1: Terrace Group Fine-Grained Deposits
- Stratum B2: Terrace Group Coarse-Grained Deposits
- Stratum C1: Fine-Grained Residual Soil
- Stratum C2: Coarse-Grained Residual Soil
- Stratum D: Disintegrated Rock

5.2 Generalized Subsurface Stratigraphy

We characterized the following generalized subsurface stratigraphy based on our subsurface exploration included in the **Appendix A**. The strata designations do not imply continuity of materials encountered elsewhere on site but reflect the general description and characteristics of the subsurface materials at the boring locations.

Ground Cover: (Topsoil or Asphalt over Gravel Base)

Between about 2 to 4 inches of topsoil, or 5 to 12 inches of asphalt over about 6 to 7 inches of gravel base, and 8 inches of concrete, was encountered at the ground surface of the boring locations. These depths may vary at other locations at the site.

Stratum A: Fill and Probable Fill

Below the ground cover materials, the borings encountered fill and probable fill soils generally consisting of sandy lean clay, sandy silt, silty sand, silty gravel with sand, and clayey sand, containing various amounts of gravel, roots, glass fragments, rock fragments, quartz fragments, brick fragments, asphalt, mica, and organics. Fill and probable fill was encountered in all borings, except for boring SWM-6. The borings indicated that fill material extended to depths ranging between 1.2 ft and 23.5 ft below existing grades. Based on the Standard Penetration Tests (SPTs), this stratum exhibits generally variable density and consistency. Three jar samples of Stratum A were laboratory tested. One jar was tested for moisture content, Atterberg limits, and gradation. The soil sample classified as sandy LEAN CLAY (CL) with a liquid limit of 41 and a plasticity index of 18. The amount of material passing through No. 200 sieve was 50.6 percent. The other two jar samples were tested for moisture content only. Moisture contents for the three samples ranged between 9.6 percent and 17.7 percent. SPT N-values within the fill layer ranged from 2 blows per foot (bpf) to 33 bpf with the majority of the N-values between 5 bpf and 15 bpf, indicating that the soil in this stratum is generally loose to medium dense and medium stiff to stiff.

Stratum B1: Terrace Soil (Fine Grained)

Below Stratum A, and interlayered with Stratum B2 soils, the majority of the borings encountered a fine grained terrace deposit consisting of yellowish brown, yellowish red, reddish brown, red, gray, light gray, and white sandy LEAN CLAY (CL), LEAN CLAY with sand (CL), gravelly LEAN CLAY with sand (CL), sandy LEAN CLAY with gravel (CL), and sandy FAT CLAY with gravel (CH), containing trace amounts of roots, mica, gravel, and cemented sand. The thickness of this layer ranged from 2 ft to 12 ft and extended to depths of up to 23.5 ft below existing grades. The unconfined compressive strength of this stratum was measured using a pocket penetrometer. Pocket penetrometer measurements ranged from 0.5 tsf to 4 tsf. Two jar samples were laboratory tested for moisture content, Atterberg limits, and gradation. Both samples classified as LEAN CLAY with sand (CL) and exhibited liquid limits of 39 and 40, and a plasticity index of 15. The amount of material passing through the No. 200 sieve was 81.5 to 83.2 percent. The moisture contents for these samples were 12 percent and 19 percent. Based on the SPT results, this stratum exhibits generally stiff to very stiff consistency (SPT values varied from 5 bpf to 27 bpf).

Stratum B2: Terrace Soil (Coarse Grained)

Below Stratum A, and interlayered with Stratum B1, all borings, except borings SB-05/SWM-4 and SWM-5, encountered a coarse-grained terrace deposit consisting of yellowish red, yellowish brown, reddish brown, brown, light brown, white, red, gray, black, and tan poorly graded SAND with clay and gravel (SP-SC), clayey GRAVEL (GC), clayey GRAVEL with sand (GC), clayey SAND (SC), clayey SAND with gravel (SC), poorly graded GRAVEL (GP), silty SAND (SM), and poorly graded SAND with silt (SP-SM). The thickness of Stratum B2 varied between 2 ft and 21 ft and extended to depths of up to 28.5 ft below existing grades. Six jar samples of Stratum B2 were tested. Five jars were tested for moisture content, Atterberg limits, and gradation, and one jar sample was tested for moisture content only. Three soil samples classified as clayey SAND (SC) and two samples classified as clayey SAND with gravel (SC). Liquid limits varied between 34 and 39 and the plasticity indices varied between 13 and 15. The amount of material passing through No. 200 sieve was between 15.5 percent and 31.7 percent. Moisture contents for these samples ranged between 7.4 percent and 17 percent. SPT N-values varied from 6 bpf to 68 bpf. The majority of N-values were between 10 bpf and 30 bpf indicating that the majority of this stratum is firm to medium dense.

Stratum C1: Residual Soils (Fine Grained)

Below Stratum B2, and interlayered with Stratum C2, borings SB-02, SB-08, SB-10, and Boring A encountered fine grained residual soils consisting of yellowish red, yellowish brown, gray, brown, and light red sandy LEAN CLAY (CL) and sandy ELASTIC SILT (MH). The thickness of Stratum C1 was about 5 ft and extended to depths of up to 33 ft below existing grades. Pocket penetrometer measurements ranged from 0.25 tsf to 2.5 tsf. One jar sample of Stratum C1 was tested for moisture content, Atterberg limits, and gradation. The soil sample classified as sandy LEAN CLAY (CL) with a liquid limit of 49 and a plasticity index of 25. The amount of material passing through No. 200 sieve was 55.9 percent and the moisture content for the soil sample was 22.9 percent. SPT N-values for this stratum varied from 6 bpf to 56 bpf indicating that the majority of this stratum is generally medium stiff to hard. A possible boulder or rock ledge was encountered within Stratum C1 in boring SB-02 at about 27 ft below surface grade.

Stratum C2: Residual Soil (Coarse Grained)

Below Strata B1 and B2, and interlayered with Stratum C1, borings SB-01 through SB-10, Boring A, Boring B, SWM-3, and SWM-5 encountered coarse-grained residual soil consisting of brown, gray, black, yellowish brown, bluish gray, reddish brown, greenish gray, light brown, light yellowish brown, and light yellowish red silty SAND (SM), clayey SAND (SC), and sandy SILT (ML). Rock fragments were encountered within some of the soil samples obtained from Stratum C2. The thickness of this stratum varied between 2 ft and 20 ft and extended to depths of up to 43.5 ft below existing grades. Three jar samples of Stratum C2 were tested, one of these jar samples was tested for moisture only. Two of the soil samples classified as clayey SAND (SC) and exhibited liquid limits of 46 and 47 and plasticity indices of 22 and 24. The amount of material passing through No. 200 sieve was 42.3 percent and 42.4 percent. Moisture contents for the three samples ranged between 20.9 percent and 29.3 percent. The SPT N-values varied from 4 bpf to 59 bpf. The majority of N-values were between 10 bpf and 50 bpf indicating that the majority of this stratum is loose to very dense.

Stratum D: Residual (Disintegrated Rock)

Below Stratum C1 and below and interlayered with Stratum C2, borings SB-01 through SB-10, Boring A, and Boring B encountered DISINTEGRATED ROCK sampling as silty sand and sandy silt, containing varying amounts of mica and rock fragments. Stratum D extended to depths of about 34ft to about 53.5 ft below existing grades, the maximum depth of the building borings. SPT values varied from 61 bpf to 50 blows with no penetration. Based on the SPT results, this stratum is generally very dense. Auger refusal was also encountered during drilling in Stratum D.

Residual soils are derived through the in-place physical and chemical weathering of the underlying rock. Disintegrated rock is defined as residual material with SPT N-values between 60 blows per foot and refusal. Refusal is defined as an N value of 100 blows for penetration of 2 inches or less.

The soil group symbol included on the boring logs in **Appendix A** and in the above-generalized subsurface stratigraphy represents the Unified Soil Classification System (USCS) group symbols and is based on visual identification of the soil samples collected at the site. Some variation can be expected between samples visually classified and samples classified in the laboratory.

5.3 Groundwater

Groundwater was encountered during drilling at borings SB-01 through SB-07, SB-09, SB-10, Boring A, and SWM-1 at depths between 13 ft and 23.7 ft below existing grades, or between about EL +315 (ft) to EL +293.8 (ft). Upon completion of the drilling, prior to pulling augers, groundwater was observed between depths of 13.7 ft and 40 ft, or between about EL +312.5 (ft) and EL +290.7 (ft). After pulling augers, borings SB-02, SB-04, SB-08, SB-10, Boring A, and SWM-1 through SWM-6, were observed to be dry to the depth borings caved. After pulling augers, the groundwater was observed at SB-03, SB-05/SWM-4, SB-06, SB-07, and Boring B at depths between 6.8 ft and 27.9 ft or between EL +315.1 (ft) and EL +288.1 (ft). Boring sidewalls caved between depths of 1.3 ft and 33.5 ft, or between EL +326.4 (ft) and EL +288 (ft).

At borings SB-01 and SB-09, after casing was pulled, temporary, hand-slotted PVC pipe was installed in each boring. At these locations, after augers were pulled, groundwater was observed within the pipes at depths of 13.3 ft and 40.5 ft below existing grades, or between EL +319.7 (ft) and EL +279.3 (ft).

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All the 2018 boreholes and Boring A were left open and 24-hour groundwater readings were taken. Borings SB-02, SB-04, SWM-1 through SWM-3, SWM-6, and Boring A were dry to the depths of the borings sidewall cave-in, which ranged from 1.1 ft to 12.5 ft, or from about EL +326.9 (ft) to EL +318.63 (ft). After 24 hours, groundwater was observed in borings SB-03, SB-05/SWM-4, SB-06 through SB-8, SB-10, and SWM-5 between depths of 2.9 ft and 20.4 ft, or between EL +323.3 (ft) and EL +308.7 (ft). At these locations, the boring sidewalls caved at depths varying between 6.8 ft and 21.5 ft, or between about EL +315.3 (ft) to EL + 307.6 (ft).

An end of day reading was taken at Boring B and groundwater was observed at a depth of 27.9 ft, or EL +288.1 (ft). The boring sidewall cave-in was recorded at 28 ft, or at about EL + 288 (ft)

Groundwater level readings were measured in the PVC pipes at SB-01 and SB-09 between 24 hours and 72 hours after drilling was completed. The groundwater was observed at a depth of 13.5 ft or EL + 319.5 (ft) in boring SB-01, and at a depth of 15.3 ft or EL + 304.5 (ft) in boring SB-09.

All borings were backfilled after at least 24 hours of drilling using the drilling spoil. Borings drilled in asphalt areas were patched.

Groundwater in this geology typically lies a few feet above the disintegrated rock/bedrock surface. However, the presence of the terrace soils above the residual profile indicates that groundwater could be between EL +320 (ft) and EL +305 (ft). The higher readings may also be indicative of a perched groundwater condition.

The groundwater levels on the logs indicate our estimate of the hydrostatic water table at the time of our subsurface exploration. The final design should anticipate the fluctuation of the hydrostatic water table depending on variations in precipitation, surface runoff, pumping, evaporation, leaking utilities, and similar factors.

5.4 In-Situ Infiltration Test Results

To evaluate subgrades for infiltration feasibility at the site, our subcontractor drilled six soil test borings (designated as SWM-1 through SWM-6) at the site to a depth of 15 ft to 16 ft below existing grades. Following the completion of the approximate 24-hour groundwater level readings in these borings, an offset probe-hole was drilled adjacent to each of the borings to depths of about 6 ft below surface grades. A 5-inch diameter PVC pipe was placed in the offset probe-hole and about 24 inches of water was placed in the bottom of the pipe. Following the approximate 24-hour pre-soaking period, the infiltration testing was performed by personnel from our office by monitoring the drop in the water level at 1-hour intervals for a total of 4 hours. The infiltration rate at each boring location is determined as the average of the water drop observed over the 4-hour period.

The results of the in-situ infiltration testing is summarized in the table below. The testing depths were selected by the Civil Engineer.

Table 5.1: Summary of In-Situ Infiltration Test Results

Boring Number	Approximate Ground Surface Elevation (ft)	Approximate Infiltration Test Depth Below Surface (ft)	Approximate Infiltration Test Elevation (ft)	Soil Classification at Test Depth (per USCS)	Infiltration Test Rate (inch/hour)
SWM-1	EL +326.2	6.0	EL +320.2	clayey SAND with gravel (SC)	2.1
SWM-2	EL +326.4	6.0	EL +320.4	clayey SAND (SC)	1.2
SWM-3	EL +324.5	6.0	EL +318.5	clayey SAND with gravel (SC)	2.1
SWM-4	EL +315.8	6.0	EL +309.8	clayey SAND (SC)	0.14
SWM-5	EL + 315.0	6.0	EL +309.0	LEAN CLAY with sand (CL)	0.2
SWM-6	EL + 328.8	6.0	EL +322.8	clayey SAND (SC)	1.1

Per Appendix D.1 of the Maryland Department of the Environment (MDE) Stormwater Design Manual, an infiltration rate greater than 0.52 inch per hour is considered to be suitable. It should be noted, however, that the infiltration rates may vary at other locations at the site due to variable conditions of soils, compactness, gradation, etc. The design should account for such variations.

5.5 USDA Classification and Correlated Infiltration Rates

United States Department of Agriculture (USDA) classification testing was conducted on jar samples obtained from 5.0 ft to 7.0 ft at the SWM-2 and SWM-6 locations and from 6.0 ft to 8.0 ft at the SWM-1 and SWM-3 through SWM-5 locations. The lab testing results are included in **Appendix C** and summarized in the table below.

Table 5.2: USDA Textural Classification and Minimum Infiltration Rates

Boring Number	Sample Depth (ft)	USDA Textural Classification	Minimum Infiltration Rate Per Published Correlations (inches/hour)
SWM-1	6-8	SANDY LOAM	1.02
SWM-2	5-7	SANDY LOAM	1.02
SWM-3	6-8	SANDY LOAM	1.02
SWM-4	6-8	SANDY LOAM	1.02
SWM-5	6-8	SILT LOAM	0.27
SWM-6	5-7	LOAMY SAND	2.41

5.6 Seismic Site Classification

We evaluated the Seismic Site Class for this project according to the 2015 International Building Code (IBC). Our analysis indicates Site Class D for this location. This Site Class was evaluated based on SPT values.

6.0 SITE GRADING AND EARTHWORK

In order to construct the new building, the existing Falcon Hall and Science South building will need to be demolished and their foundation systems removed in their entirety. All existing fill in the new building footprint will also need to be removed. Considering the existing building lowest levels of EL +307 (ft) to EL +302 (ft) for Falcon Hall and EL +326 (ft) for the Science South building, cuts of up to 15 ft and fills of up to 18 ft will be required to reach the new building’s lowest level at EL +320 (ft). Existing fill removal should extend at least 2 ft beyond the bottom edges of the exterior footings of the building. Benching of the excavations is also recommended to provide for level placement and compaction of the backfill.

Recommendations for preparation of subgrades to receive new compacted fill, compacted fill soil requirements, placement, and compaction criteria, as well as fill settlement are presented in subsequent sections.

6.1 Preparation of Subgrades to Receive Compacted Fill

Subgrades to receive compacted structural fill for building or pavement support should be stripped of vegetation, topsoil, organic matter, and the fill soils of Stratum A. Our subsurface exploration indicated topsoil to depths of up to 5 inches below the ground surface in some locations. This depth may vary at other locations.

At the building boring locations, the highest suitable subgrade elevations where new compacted fill can be placed are presented in the table below:

Table 6.1: Estimated Elevation of Suitable Compacted Fill Subgrades

Boring Number	Estimated Elevation of Suitable Compacted Fill Subgrade (ft)
SB-01	EL +329
SB-02	EL +328
SB-03	EL +322
SB-04	EL +324
SB-05/SWM-4	EL +311
SB-06	EL +323
SB-07	EL +326
SB-08	EL +315
SB-09	EL +314
SB-10	EL + 302
Boring A	EL + 323
Boring B	EL + 315

The Geotechnical Engineer should evaluate the suitability of the fill subgrades. The stripped subgrades should be proofrolled with a loaded dump truck to evaluate the subgrade suitability for support of the compacted structural fill prior to any undercutting or initiation of fill placement. Areas that exhibit excessive pumping, weaving, or rutting should be scarified, dried and recompacted, or undercut and

replaced with compacted structural fill as recommended by the Geotechnical Engineer. Subgrade evaluation techniques complementary to proofrolling could include a combination of probing with a penetrometer, drilling hand augers, or observing test pits.

When excavation of unsuitable materials is required, it should be performed in a manner to limit disturbance of the underlying suitable material. The excavation should be performed under the observation of the Geotechnical Engineer to evaluate the required excavation depths. Groundwater is expected to be encountered during fill placement and dewatering will be required during construction.

Compacted structural fill subgrades should be kept free of ponded water. If springs or other flowing water is present at the compacted structural fill subgrade level, the Contractor should direct water to discharge beyond the fill limits. Recommendations for discharging springs should be provided by the Geotechnical Engineer.

Compacted structural fill subgrades should be free of snow, ice, and frozen soils. If snow, ice, or frozen soils are present at subgrade levels, these materials should be removed as recommended by the Geotechnical Engineer.

The existing structures present on site will need to be removed before earthwork construction. Therefore, foundations and other associated debris will be encountered during grading activities and should be completely removed from the proposed building area. Existing foundations and walls in the proposed pavement areas should be removed to at least 2 ft below the design pavement subgrade level. Existing utilities and drainage structures within the building area should be removed and replaced with compacted structural fill.

Compacted structural fill subgrades should not be steeper than about 4H:1V. If steeper slopes are present, subgrades should be benched to permit placement of horizontal lifts of fill.

6.2 Compacted Fill

Compacted structural fill and backfill in building and pavement areas should consist of material classifying as SM, SP, SW, GC, GM, GP or GW according to ASTM D2487. In addition, fill materials should exhibit Liquid Limit and Plasticity Index values of less than 40 and 15, respectively. Fill materials should not contain particles larger than 3 inches. On-site soils of Strata B2 and C2 are generally expected to meet these criteria. Part of the fill soils of Stratum A can be considered for re-use as compacted structural fill provided they are free of deleterious materials and meet the criteria above. Importation of fill should be anticipated.

Compacted structural fill should be placed in maximum 8-inch thick horizontal, loose lifts. Fill should be compacted to at least 95 percent of the maximum dry density per ASTM D698 (Standard Proctor), except that the top 12 inches in pavement areas should be compacted to at least 100 percent of the same standard. Soil moisture contents at the time of compaction should be within 3 percent of the soils' optimum moisture content.

Backfill placed in excavations, trenches, and other areas that large compaction equipment cannot access should be placed in maximum 6-inch thick lifts. Backfill should meet the material, placement, and compaction requirements outlined above.

Successful re-use of the excavated, on-site soils as compacted structural fill will depend on their natural moisture contents during excavation. Scarifying and drying of these soils should be anticipated to achieve the recommended compaction. Drying of these soils will likely result in some delays, and may not be possible during cooler, wetter weather. We recommend that the earthwork be performed during the warmer, drier times of the year.

6.3 Fill Settlement

We anticipate as much as 18 ft of fill will be placed to reach the proposed lowest level of the building. The subgrade soils are expected to settle under the weight of the proposed fill and the new building. Construction of structures and pavement in fill areas should not begin until settlement has essentially ceased. Settlement plates should be installed on the subgrade within the new building footprint prior to placing the compacted structural fill. We anticipate that settlement will take about one to three months to dissipate. Please note that areas outside of the building footprint where new compacted structural fill is planned, specifically green areas where no significant loading (vehicular or structurally-related) is anticipated, will not require monitoring with settlement plates.

Settlement plates should consist of a 24 x 24 x ½ -inch steel plate with a 2-inch steel riser pipe welded to its center. The plate should be placed on the subgrade, and the elevation of the plate and top of the riser should be recorded before fill placement. As fill operations progress, the Contractor should extend the riser pipe to remain above the fill surface. The elevation of the top of the riser should be recorded immediately before and after attaching an extension. The elevation of the riser should be recorded daily. After completion of the fill, the elevation of the top of the riser should be recorded two times a week until settlement has essentially ceased. SEDC should review the settlement readings to confirm that settlement has dissipated, prior to foundation installation.

Settlement plate readings should be taken to the nearest 0.005 ft and referenced to a benchmark well beyond the influence of the fill placed. Precautions should be taken to prevent damaging the settlement plates during fill operations. The general Contractor should furnish all labor and materials, and perform all operations needed for installation and maintenance of the settlement plates.

Grading plans should be provided to SEDC for review to see if there are any changes to our recommendations.

7.0 FOUNDATION RECOMMENDATIONS

We based our geotechnical engineering analysis on the information developed from our subsurface investigation, along with the project development plans, site plans, and the structural loading furnished to our office. As noted in **Section 6.0**, present day Falcon Hall and the Science South building will be demolished and the building foundation systems removed in their entirety. New compacted structural fill will then be placed to reach the proposed building's lowest level at EL +320 (ft). The new building will have maximum column loads of about 200 kips to 300 kips and will have typical column spacing of about 30 ft by 30 ft.

Based on the above considerations, we recommend supporting the new building on spread footings founded on new compacted structural fill or medium dense and firm natural soils of Strata B1, B2, C1, and C2. The following sections of the report provide our detailed recommendations.

7.1 Spread Footings

We consider spread footings suitable for support of the proposed building. Footings should be founded on new compacted structural fill or suitable natural soils of Strata B1, B2, C1 and C2. We recommend footings supported on these materials be designed for a net allowable soil bearing pressure of 3,000 psf. These bearing pressures provide a factor of safety against general bearing capacity failure of at least 3.0.

The above allowable soil bearing pressures may be increased by 33 percent for wind and seismic loads when used in conjunction with load combinations defined in IBC Section 1605.3.2, Alternative Basic Load Combinations for use with allowable stress design. This increase is not applicable for other allowable stress load combinations, strength design or load and resistance factor design.

Suitable subgrade elevations where new compacted structural fill can be placed are detailed in **Section 6.1**. For planning purposes, the elevation of suitable materials between borings may be considered to vary linearly between boring locations.

All footing subgrades should be observed by the Geotechnical Engineer prior to placement of concrete to verify subgrade materials are as anticipated. If groundwater is encountered during footing excavation, dewatering will be required during construction. If unsuitable soils are encountered at the design bearing grade, these soils should be removed and replaced as recommended by the Geotechnical Engineer. Unsuitable soils should be replaced with new compacted fill, open graded crushed stone such as AASHTO No. 57, or lean concrete.

Settlements of shallow foundations supported on suitable natural soils are not expected to exceed about 1 inch. Differential settlements between similarly loaded footings are not expected to exceed about half this value.

Column and wall footings should be at least 24 and 16 inches wide, respectively, for shear considerations. Exterior footings should be founded at least 2.5 ft below final exterior grades for frost protection. Interior footings may be founded at nominal depths below the floor slabs. Where bearing grades between adjacent footings vary, the slope between the bottom edges of adjacent footings should not be steeper than 1.5H:1V. When available, SEDC should be allowed to review the design foundation drawings.

8.0 FLOOR SLAB RECOMMENDATIONS

The proposed floor slabs should be supported on suitable natural soils of Strata B1, B2, C1, and C2 or compacted structural fill. A modulus of subgrade reaction, k , of 100 kcf should be used in the design of floor slabs. The recommended modulus value is for a 1-ft-square plate. Some slab design software may consider different definitions of k for input. The Structural Engineer should contact our office if their software considers a different definition of k .

A 4-inch crushed stone or washed gravel capillary moisture barrier should underlie floor slabs on grade. Moisture barrier material should consist of AASHTO No. 57 crushed stone. The Contractor should compact the stone in place with at least two passes of suitable vibratory compaction equipment. A 10-mil polyethylene liner should be installed over the crushed stone layer as a vapor barrier and to prevent concrete intrusion into the stone. Floor-slab subgrades should be observed and approved by the Geotechnical Engineer prior to placing the washed gravel or crushed stone base.

The Contractor should compact floor slab subgrades before placing moisture barrier materials to repair any disturbance that may occur due to construction operations. Since floors will be slab-on-grade, utility excavations should be backfilled with compacted structural fill as defined in this report.

9.0 RETAINING STRUCTURE RECOMMENDATIONS

The proposed structure includes basement walls. Recommendations for the design of these walls are presented in the following sections. If loading docks or retaining walls are planned, these locations should be made known to us and recommendations can be provided.

9.1 Below-Grade Walls

The building below-grade walls must be designed to resist lateral earth pressures developed from the surrounding soil, backfill, and surcharge loads. We recommend an average fluid pressure of $50H$ (psf), where H is the height of the wall in feet, for the design of below-grade walls to account for soil pressures. The recommended equivalent fluid pressure assumes a horizontal backfill. The horizontal pressure from surcharges, if applicable, will be 0.42 times the vertical surcharge using a uniform pressure distribution in addition to the equivalent fluid pressure provided above.

A diagram illustrating the design of earth pressure recommendations on below-grade walls is included as **Figure 3**. The pressures shown are expected to develop from surrounding soils and/or backfill retained by below-grade walls. Hydrostatic pressures are not included in the recommended lateral earth pressure, as foundation drains should be installed as discussed below. Any surcharge adjacent to the walls should be considered in the evaluation of lateral earth pressure as shown on the diagram. Any backfill placed along the back of the walls should meet the compaction requirements for backfill against below-grade or site retaining walls as detailed below.

9.2 Backfill for Below-Grade Walls

Backfill materials for walls should consist of material classifying as SM or more granular according to ASTM D2487. In addition, fill materials should exhibit Liquid Limit and Plasticity Index values of less than 40 and 15, respectively. This classification includes open-graded crushed stone such as AASHTO No. 57 crushed stone. Free-draining backfill should be placed in the zone extending from the base of the wall upwards at 45 degrees.

The Contractor should place backfill in maximum 8-inch thick loose lifts and compact each lift to at least 95 percent of maximum dry density according to ASTM D698 (Standard Proctor). The Contractor should place crushed stone backfill in maximum 12-inch thick lifts, and compact each lift using suitable vibratory equipment. Only light hand-operated equipment should be used to compact backfill against walls. The Structural Engineer of Record should approve the size of the compaction equipment.

10.0 SUBDRAINAGE RECOMMENDATIONS

Subdrainage below the floor slab and behind below-grade walls will be required. Dewatering during construction will also be required as discussed in **Section 11.3**.

10.1 Subdrainage for Below-Grade Walls

Earth pressure recommendations provided in this report do not include hydrostatic pressure since subdrainage will be provided behind the basement walls. If the excavation is sloped, subdrainage should consist of perimeter subdrains located on top of the wall footing, next to the wall. Subdrains should consist of 4-inch slotted, corrugated polyethylene tubing according to ASTM F405, surrounded by at least 4 inches of filter drainage material. A drainage geotextile should wrap around the drainage material. Subdrains should drain by gravity to an outlet, sump, or storm sewer.

For sloped and sheeting and shoring excavations, geocomposite drainage panels consisting of Miradrain G100N or equivalent should be installed continuously on all basement walls. Drainage panels should be placed along the entire wall face to within 1.5 ft of the finished grade. The Contractor should bind the edges of the panels with drainage geotextile to limit the potential for soil intrusion into the drainage system.

Wall subdrainage may be provided using weepholes. Weepholes should be 3 inches in diameter and should be installed on 8-ft centers. A filter plug consisting of at least one cubic foot of drainage filter material wrapped in drainage geotextile should be placed behind each weephole.

Drainage filter material should consist of AASHTO No. 78 aggregate. Drainage geotextile should consist of a non-woven geotextile such as Mirafi 140N, or equivalent fabric.

10.2 Basement Subdrainage

Based on the groundwater level readings taken during the subsurface investigation, groundwater is anticipated to be at about the same elevation of the proposed lowest level. Therefore, we recommend installing a permanent subdrainage system to maintain groundwater levels below the lowest level floor slab elevations. In addition to the perimeter subdrains for the walls discussed above, the subdrainage system should include an underfloor drainage blanket and a series of interior underslab subdrains. Recommended subdrainage system details are shown on **Figure 4**.

The drainage blanket should consist of a 4-inch thick layer of drainage filter material placed beneath the floor slab. Since this layer is part of the subdrainage system, the drainage filter material should be protected from the inclusion of non-filter materials.

Interior underslab subdrains should be constructed on a maximum spacing of 40-ft centers and connected to headers at both ends of the subdrain. Subdrains should consist of 4-inch diameter, corrugated, slotted, polyethylene pipe according to ASTM F405. Slot widths should not exceed $\frac{1}{8}$ inch. Drainage pipes should be surrounded by at least 4 inches of drainage filter material on sides and bottom and 2 inches of drainage filter material on top. The drainage filter material should be wrapped with non-woven drainage geotextile. Pipe inverts should be set at least 10 inches below the bottom of the floor slab.

The subdrainage system should drain by gravity to a sump pit installed in the lowest level, where drainage can be discharged by pumping. For preliminary design, we recommend a pump capacity of about 30 gallons per minute be considered. We recommend that the pump be located in areas closest to the deepest excavation of the building. The final pump should be sized based on the results of field measurements during construction. A redundant pump system should be provided. Also, a backup power supply or non-electrical backup pump should be incorporated into the system.

Elevator pits and other portions of the structure that extend below the subdrainage system should be water-proofed and designed to resist full hydrostatic pressure. In occupied spaces, installation of both waterproofing and subdrainage will provide the best coverage.

The design and construction of a subdrainage system is not foolproof. System failures may occur due to various causes. Periodic maintenance, including flushing, and possible chemical treatment to flush out soil particles and remove mineral or bacterial deposits that may restrict flow in the pipes will be required. Adequate cleanouts should be included in the subdrainage system design to permit access to the entire system. Generally, cleanouts will also be located at upstream ends of laterals and at critical intersections. The subdrain system should be laid out to provide redundant flow paths where possible.

Subdrainage requirements have been prepared to assist in the design of a subdrainage system for this project. These recommendations are based on the subsurface and groundwater data reviewed herein. If substantially different groundwater flow quantities are encountered during construction or if the lowest floor levels are changed, we should be contacted so that we may evaluate effects on the recommendations given herein. Construction plans should depict the entire subdrainage system, including sump pumps and cleanout locations and the layout of interior collection or trunk lines. Our office can prepare subdrainage system design drawings upon request.

11.0 CONSTRUCTION CONSIDERATIONS

11.1 Site Grading and Earthwork

The test boring data indicate the approximate depth of topsoil and fill based on our visual identification procedures. Drying and reworking of the soils are likely to be difficult during periods of wet months. We recommend that the earthwork phases of this project be performed during the warmer, drier times of the year to limit the potential for disturbance of on-site soils.

Traffic on stripped or undercut subgrades should be limited to reduce disturbance of underlying soils. Also, using lightweight, track-mounted dozer equipment for stripping will limit the disturbance of underlying soils, and may reduce the undercut volume needed. The Contractor should provide site drainage to maintain subgrades free of water and to avoid saturation and disturbance of the subgrade soils before placing compacted structural fill, pavement base course or moisture barrier material. This will be important during all phases of the construction work. The Contractor should be responsible for reworking of subgrades and compacted structural fill that were initially considered suitable but were later disturbed by equipment and/or weather.

11.2 Foundations

11.2.1 Spread Footings

The Contractor should exercise care during excavation for spread footings so that as little disturbance as possible occurs at the foundation level. The Contractor should carefully clean loose or soft soils from the bottom of the excavation before placing concrete. A Geotechnical Engineer from our firm should observe actual footing subgrades during construction to evaluate whether subgrade soils meet the requirements as recommended in this report.

Footing subgrades needing undercut may be concreted at the elevation of undercut or backfilled to the original design subgrade elevation with new compacted structural fill, an open-graded crushed stone such as AASHTO No. 57 stone, or lean concrete. Concreting should take place the same day as the excavation of footings.

11.3 Construction Dewatering

The site geology consists of relatively low-permeability lenses and layers of finer grained soil zones separated by higher permeability lenses and layers of granular materials. Most site groundwater flow will come from saturated higher permeability layers and so-called "perched water zones" where groundwater rests on or in higher elevation lower-permeability materials. In addition, nodules, layers, and lenses of iron oxide cemented soils may be present that can have a weak rock-like consistency. The iron oxide zones may be in well-defined layers or may be erratically present both vertically and horizontally through the soil profile. These layers can act to perch water. Deeper permeable zones may also be present that have higher water pressure than the overlying saturated materials, which can result in "artesian" water conditions. This could cause soils in the excavation to soften and lose strength if not properly dewatered.

A deep-well dewatering system is typically used to dewater these sites. Dewatering by deep-wells will typically not fully dewater the site. Trenching and sumping from inside the excavation to collect perched water and site runoff is required in virtually all excavations and may be extensive depending on the amount of perched water. In some locations, deep-wells and trenching and sumping cannot sufficiently dewater all areas and well points may be required to lower the groundwater to allow site construction to progress. Precipitation and seasonal variation in groundwater levels will also impact the amount and depth of groundwater encountered and the extent and amount of dewatering and water control measures that must be taken.

Lower-permeability zones that can produce perched water conditions may not be readily evident from the boring logs. This is because thin, lower permeability layers may not be disclosed by the industry standard drilling and sampling processes that sample on 5-ft vertical intervals.

Dewatering at the site should be completed by a competent dewatering contractor with at least 5 years of experience in the region. Groundwater levels should be maintained at least 4 ft below the lowest excavation levels. Sufficient time must be allowed in the construction schedule for the dewatering contractor to install wells, begin well operation and pump wells to lower groundwater levels to the required elevation.

11.4 Subdrainage

The Contractor should exercise care when placing and backfilling subdrainage pipe to avoid damage to the subdrainage system during installation.

11.5 Engineering Services During Construction

The engineering recommendations provided in this report are based on the information obtained from the subsurface exploration and laboratory testing. However, conditions on the site may vary between the discrete locations observed at the time of our subsurface exploration. The nature and extent of variations between borings may not become evident until during construction.

To account for this variability, we should provide professional observation and testing of subsurface conditions revealed during construction as an extension of our engineering services. These services will also help in evaluating the Contractor's conformance with the plans and specifications. Because of our unique position to understand the intent of the geotechnical engineering recommendations, retaining Schnabel for these services will allow us to provide consistent service throughout the project construction.

12.0 GENERAL SPECIFICATION RECOMMENDATIONS

An allowance should be established to account for possible additional costs that may be required to construct earthwork and foundations, as recommended in this report. Additional costs may be incurred for a variety of reasons including variation of soil and rock conditions between borings, wet on-site soils, groundwater, etc. The project specifications should indicate the contractor's responsibility for providing adequate site drainage during construction. Inadequate drainage could lead to disturbance of soils by construction traffic, which could result in the need to undercut disturbed soils.

This report may be made available to prospective bidders for informational purposes. We recommend that the project specifications contain the following statement:

Schnabel Engineering DC, Inc. has prepared this geotechnical engineering report for this project. This report is for informational purposes only and is not part of the contract documents. The opinions expressed represent the Geotechnical Engineer's interpretation of the subsurface conditions, tests, and the results of analyses conducted. Should the data contained in this report not be adequate for the Contractor's purposes, the Contractor may make, before bidding, independent exploration, tests, and analyses. This report may be examined by bidders at the office of the Owner, or copies may be obtained from the Owner at nominal charge.

The contract documents should include the boring data provided in **Appendix A**.

Additional data and reports prepared by others that could have an impact upon the contractor's bid should also be made available to prospective bidders for informational purposes.

13.0 LIMITATIONS

We based the analyses and recommendations submitted in this report on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during construction.

This report has been prepared to aid in the evaluation of this site and to assist in the design of the project. It is intended for use concerning this specific project. We based our recommendations on information on the site and proposed construction as described in this report. Substantial changes in loads, locations, or grades should be brought to our attention so we can modify our recommendations as needed. We would appreciate an opportunity to review the plans and specifications as they pertain to the recommendations contained in this report, and to submit our comments to you based on this review.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project. No other representation, express or implied, is included or intended, and no warranty or guarantee is included or intended in this report, or other instrument of service.

FIGURES

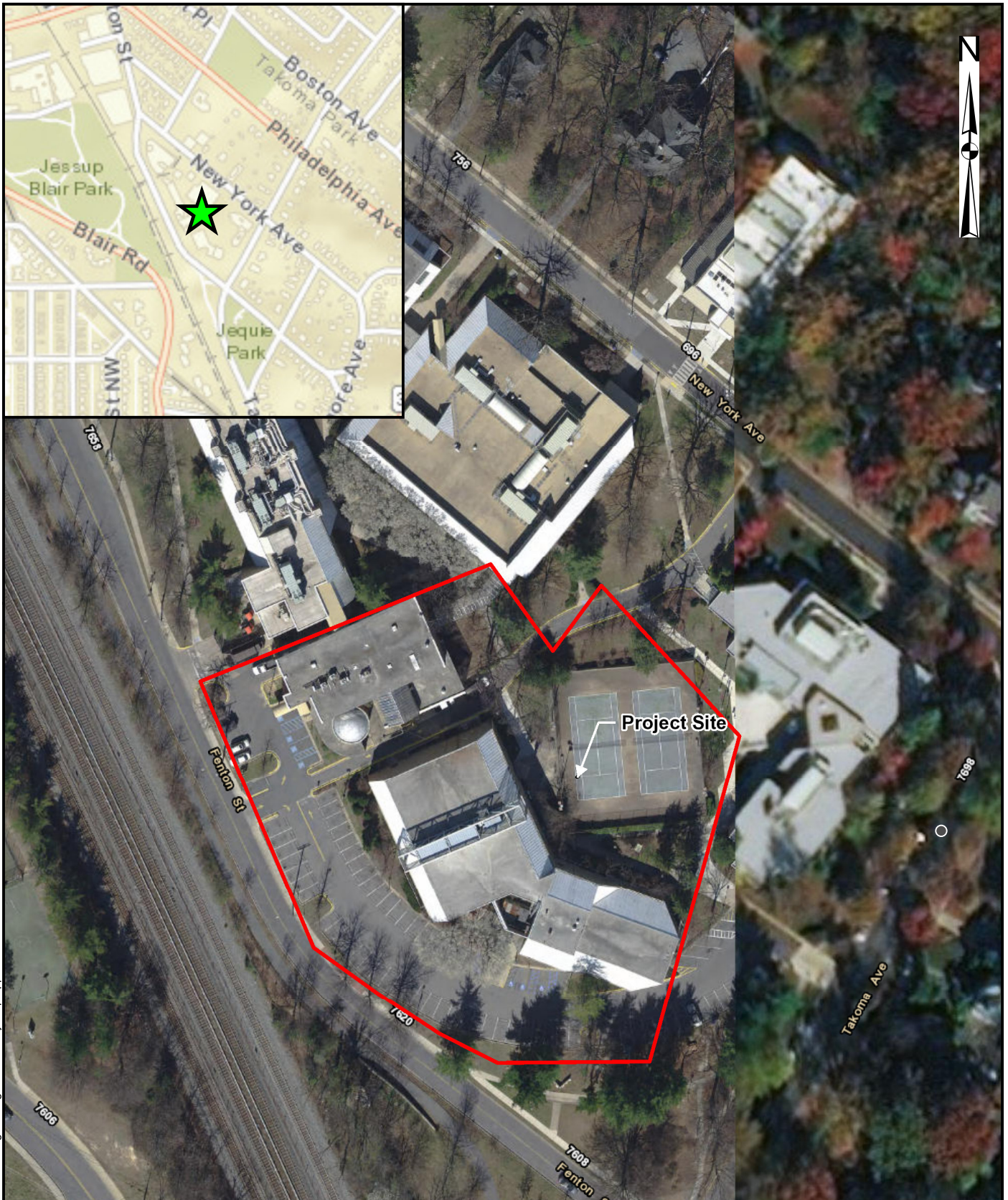
Figure 1: Site Vicinity Map

Figure 2: Approximate Boring Location Plan

Figure 3: Lateral Earth Pressure Diagram for Design of Below-Grade Walls

Figure 4: Subdrainage Detail

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 Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri
 China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the
 GIS User Community

NOT TO SCALE



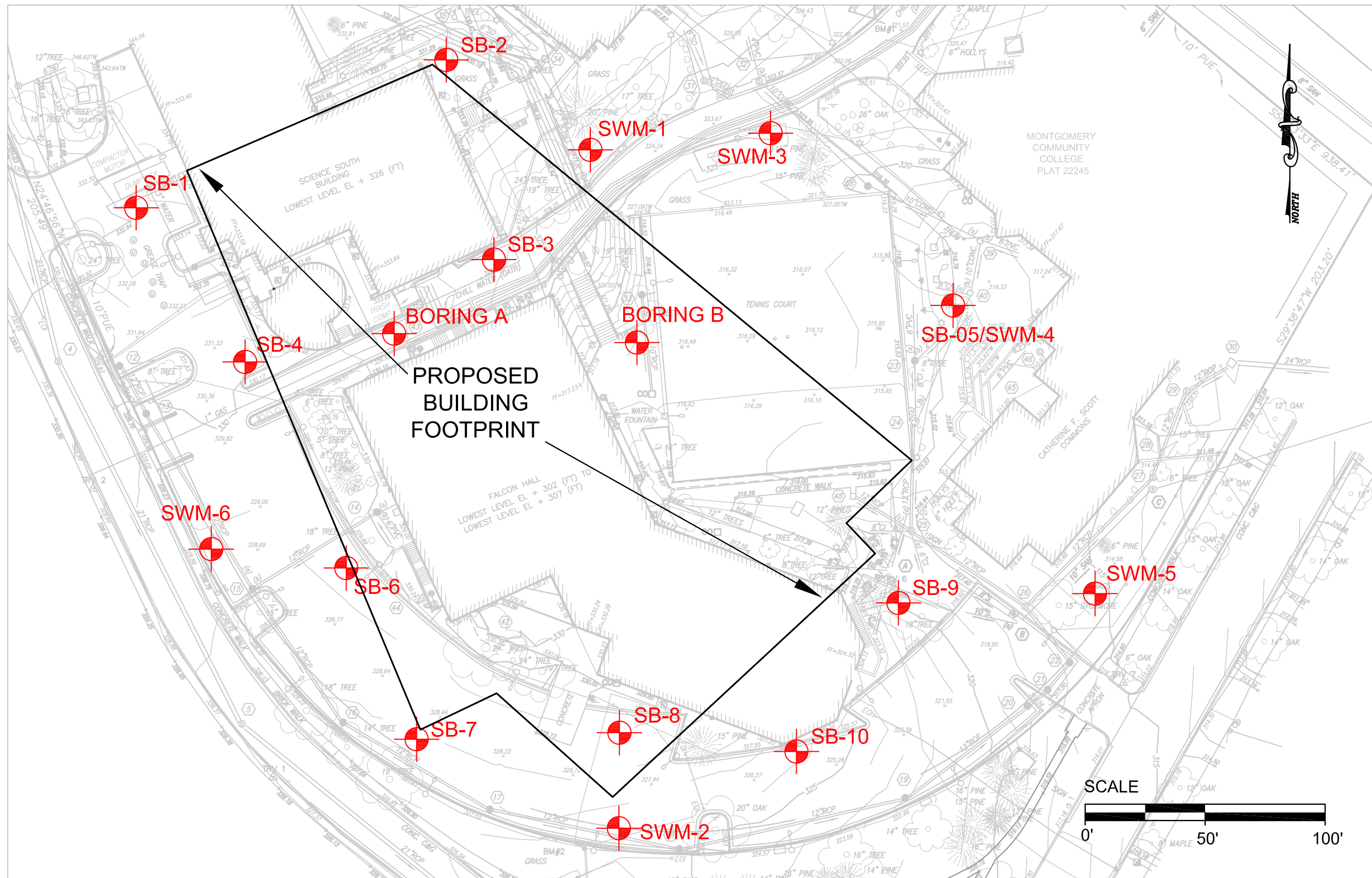
THE CATHERINE AND ISIAH LEGGETT BUILDING
 MONTGOMERY COLLEGE
 TAKOMA PARK, MARYLAND
 18C41041

SITE VICINITY
 MAP


FIGURE 1

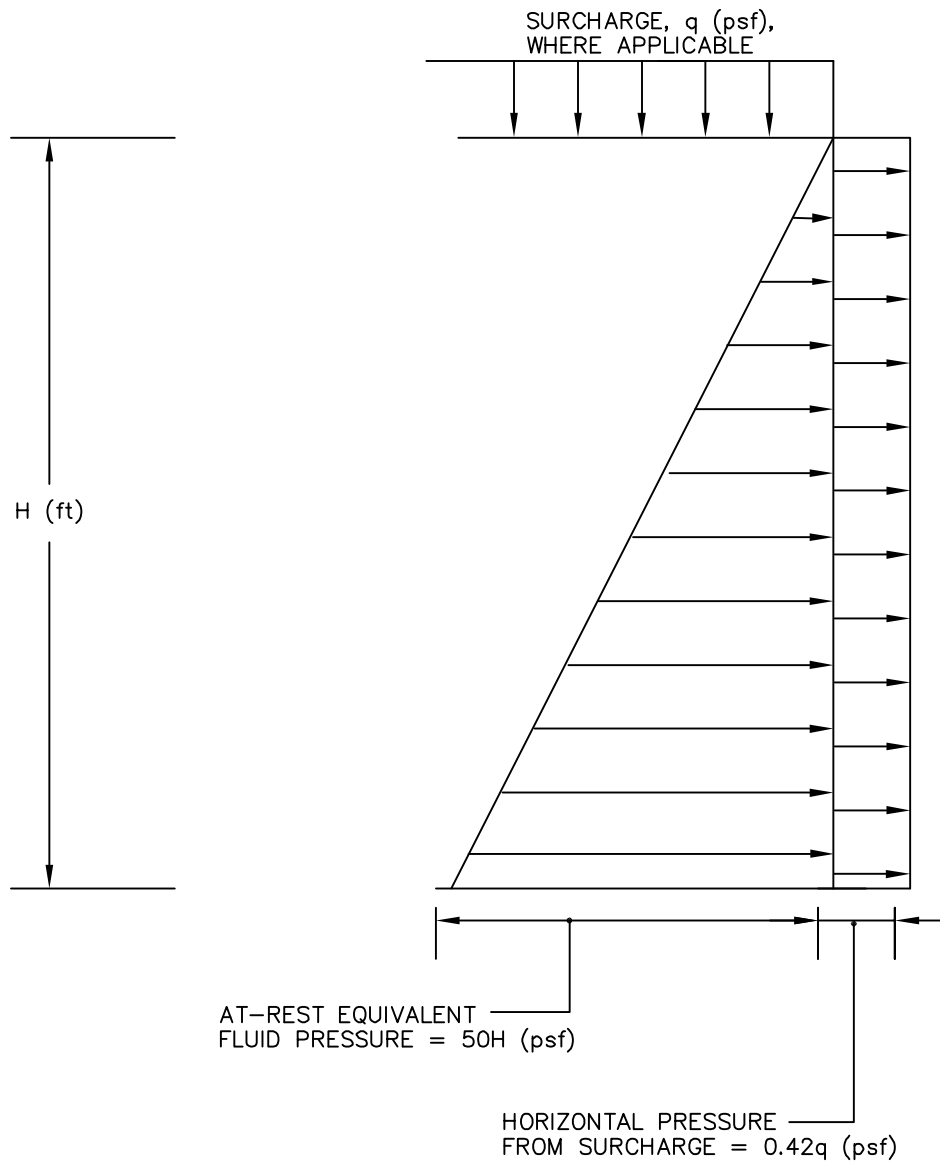
LEGEND

 APPROXIMATE SEDC BORING LOCATION

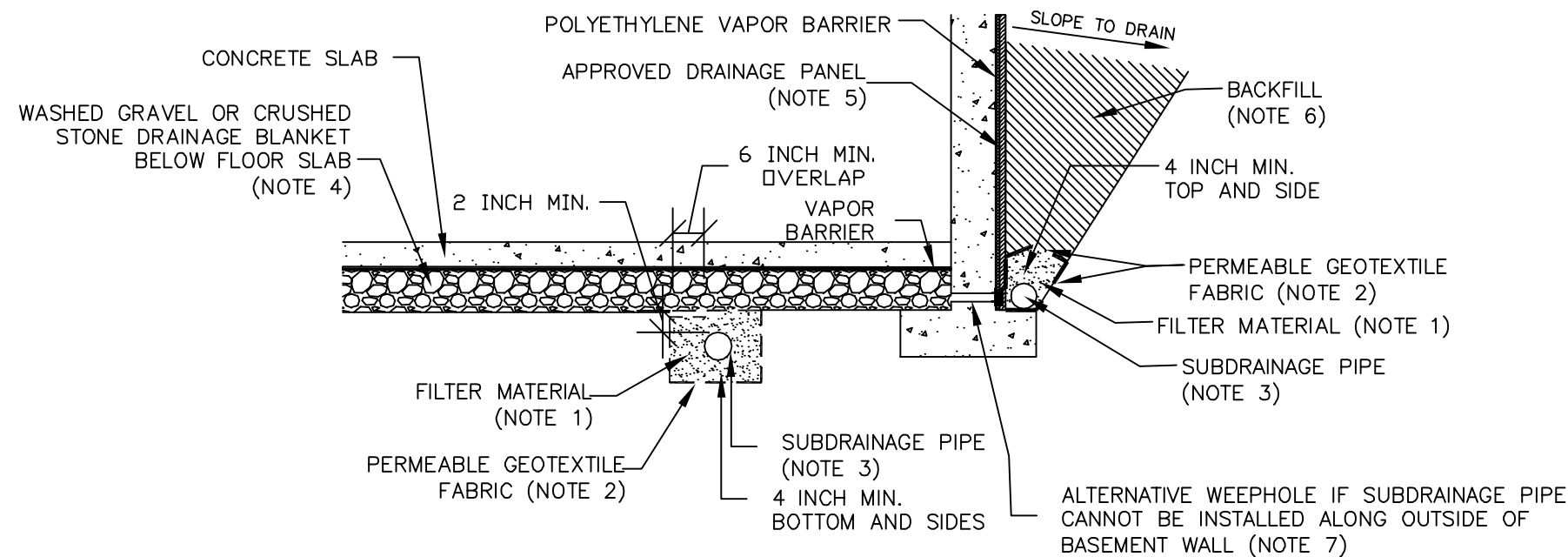
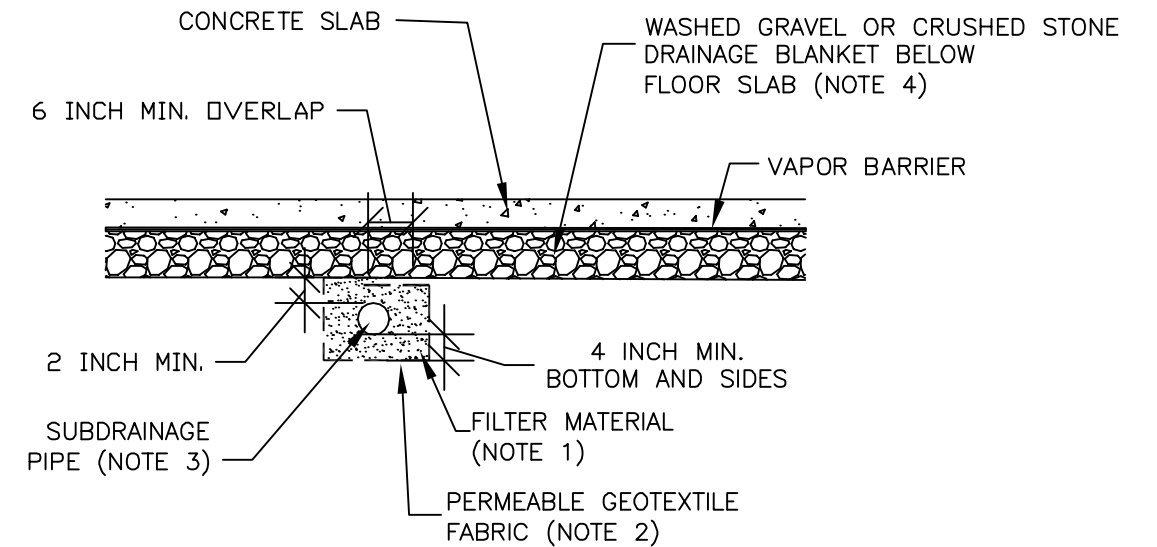
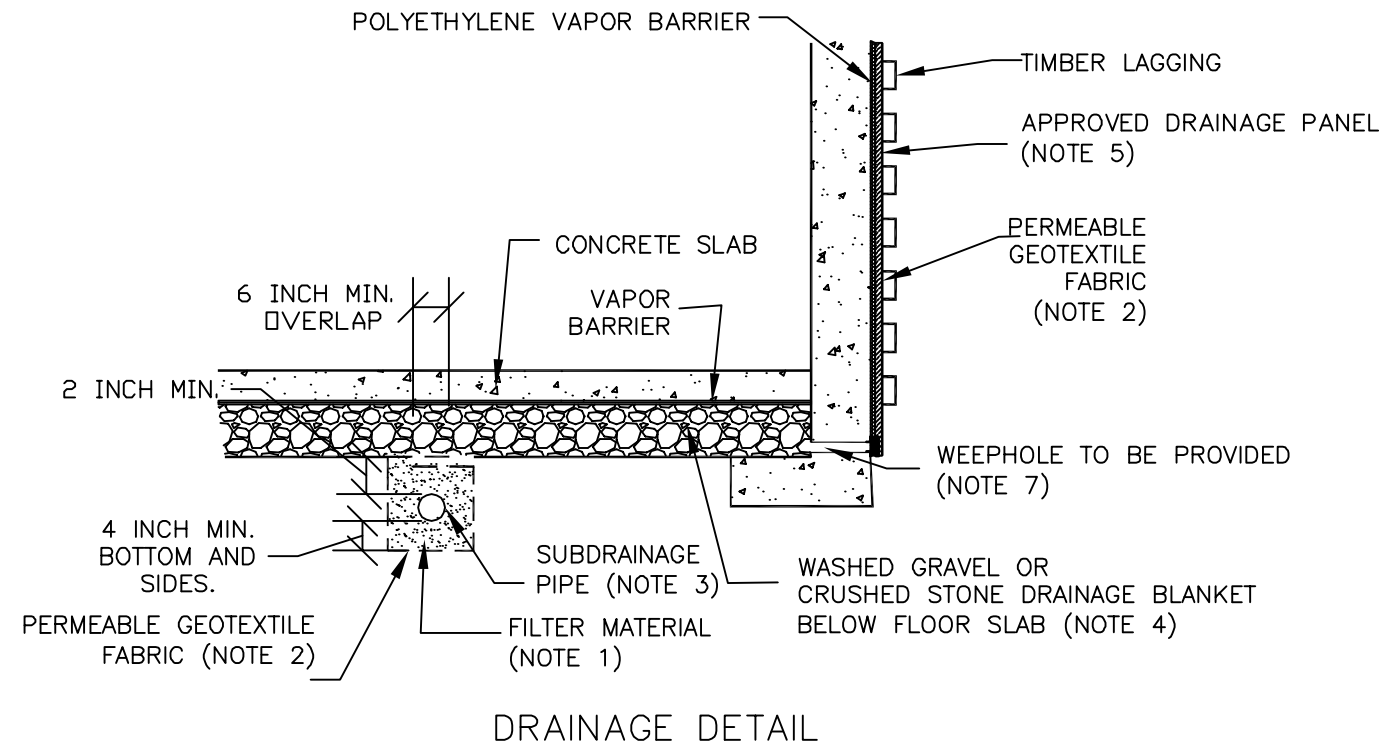


BASE PLAN PROVIDED BY A. MORTON THOMAS AND ASSOCIATES, INC.

	THE CATHERINE AND ISIAH LEGGETT BUILDING MONTGOMERY COLLEGE TAKOMA PARK, MARYLAND	APPROXIMATE BORING LOCATION PLAN	DRAWN BY: M. KHACHAN	APPROXIMATE SCALE: AS SHOWN
		PROJECT NO. 18C41041 FIGURE 2	REVIEWED BY: J. BENTEL	DATE: MAY 2019




- NOTES:
 1) EARTH PRESSURE DIAGRAM SHOWN ASSUMES FULL DRAINAGE OF HYDROSTATIC PRESSURE AS A SUBDRAINAGE SYSTEM SHOULD BE UTILIZED.



FOUNDATION DRAIN NOTES

1. FILTER MATERIAL GRADATION SHOULD SATISFY REQUIREMENTS FOR AASHTO NO.78 COARSE AGGREGATE.
2. PERMEABLE FABRIC SHOULD HAVE EQUIVALENT OPENING SIZE NOT LARGER THAN THE NO. 70 U.S. STANDARD SIEVE SIZE.
3. SUBDRAINAGE PIPING SHOULD BE 4 INCH DIAMETER SLOTTED CORRUGATED POLYETHYLENE (P.E. TUBING) ACCORDING TO ASTM F-405 WITH MAXIMUM 1/8 INCH SLOT WIDTH FOR AT LEAST THE LOWER 120° SECTOR. PIPING SHOULD BE INSTALLED TO OUTLET INTO A STORM SEWER OR SUMP WITH A PUMP.
4. WASHED GRAVEL OR CRUSHED STONE DRAINAGE BLANKET SHOULD SATISFY GRADATION REQUIREMENTS FOR AASHTO NO.57 STONE AND BE AT LEAST 4 INCHES THICK.
5. APPROVED DRAINAGE PANEL SHOULD SATISFY MINIMUM THICKNESS OR FLOW CAPACITY REQUIREMENTS AS DETERMINED BY THE GEOTECHNICAL ENGINEER. GEOTEXTILE FILTER CLOTH SHOULD BE PLACED SUCH THAT IT IS IN CONTACT WITH THE SOIL BACKFILL OR EXCAVATION SHEETING.
6. BACKFILL MATERIAL TO MEET REQUIREMENTS IN PROJECT SPECIFICATIONS.
7. WEEPHOLES WHEN USED TO BE PROVIDED AT MAXIMUM SPACING OF 8 FEET ON CENTER ALONG BASE OF WALL. WEEPHOLES SHALL CONSIST OF 3 INCH I.D. SOLID POLYETHYLENE PIPE.
8. DRAINREAT™ SHALL BE USED FOR CONNECTION BETWEEN WEEPHOLE AND DRAINAGE BOARD AS SHOWN ON DETAIL. INSTALLATION TO BE DONE IN ACCORDANCE WITH MANUFACTURERS RECOMENDATIONS.

	THE CATHERINE AND ISIAH LEGGETT BUILDING MONTGOMERY COLLEGE TAKOMA PARK, MARYLAND		DRAWN BY: M. KHACHAN	FIGURE NUMBER: 4	SUBDRAINAGE DETAILS
			REVIEWED BY: B. KHOURI	DATE: DECEMBER 2018	PROJECT NUMBER: 18C41041

APPENDIX A

SUBSURFACE EXPLORATION DATA

Subsurface Exploration Procedures (1 sheet)
General Notes for Subsurface Exploration Logs (1 sheet)
Identification of Soil (1 sheet)
Boring Logs, SB-01 through SB-10, SWM-1 through SWM-6, Boring A, and Boring B (30 sheets)

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SUBSURFACE EXPLORATION PROCEDURES

Test Borings – Hollow Stem Augers

The borings are advanced by turning an auger with a center opening of 2¼ or 3¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger by standard methods after removal of the plug. Usually, no water is introduced into the boring using this procedure.

Standard Penetration Test Results

The Standard Penetration Test (SPT) is performed in the borings at regular depth intervals to collect soil samples. The numbers in the Sampling Data column of the boring logs represent SPT results. Each number represents the blows needed to drive a 2-inch O.D., 1⅝-inch I.D. split-spoon sampler 6 inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first 6 inches are considered a seating interval. The total of the number of blows for the second and third 6-inch intervals is the SPT “N value.” The Standard Penetration Test is performed according to ASTM D1586.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Temporary PVC Pipe

Temporary PVC pipe was installed in boring SB-01 and SB-09 by inserting a hand-slotted, 1¼-inch PVC pipe in each of these borings. After obtaining 24-hour groundwater level readings, these pipes were removed and the boreholes were backfilled with soil spoils.

Boring Locations and Elevations

Boring locations were staked by A. Morton Thomas and Associates (AMT). Coordinates and elevations were provided to us by AMT. Approximate boring locations are shown on **Figure 2**. Ground surface elevations are indicated on the boring logs. Locations and elevations should be considered no more accurate than the methods used to determine them.

GENERAL NOTES FOR SUBSURFACE EXPLORATION LOGS

1. Numbers in sampling data column next to Standard Penetration Test (SPT) symbols indicate blows required to drive a 2-inch O.D., 1½-inch I.D. sampling spoon 6 inches using a 140-pound hammer falling 30 inches. The Standard Penetration Test (SPT) N value is the number of blows required to drive the sampler 12 inches, after a 6-inch seating interval. The Standard Penetration Test is performed in general accordance with ASTM D1586.
2. Visual classification of soil is in accordance with terminology set forth in "Identification of Soil." The ASTM D2487 group symbols (e.g., CL) shown in the classification column are based on visual observations.
3. Estimated water levels indicated on the logs are only estimates from available data and may vary with precipitation, porosity of the soil, site topography, and other factors.
4. Refusal at the surface of rock, boulder, or other obstruction is defined as an SPT resistance of 50 blows for 1 inch or less of penetration.
5. The logs and related information depict subsurface conditions only at the specific locations and at the particular time when drilled or excavated. Soil conditions at other locations may differ from conditions occurring at these locations. Also, the passage of time may result in a change in the subsurface soil and water level conditions at the subsurface exploration location.
6. The stratification lines represent the approximate boundary between soil and rock types as obtained from the subsurface exploration. Some variation may also be expected vertically between samples taken. The soil profile, water level observations and penetration resistances presented on these logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.
7. Key to symbols and abbreviations:



S-1, SPT
5+10+1

Sample No., Standard Penetration Test
Number of blows in each 6-inch increment

LL	Liquid Limit
MC	Moisture Content (percent)
PL	Plastic Limit
%Passing#200	Percent by weight passing a No. 200 Sieve

IDENTIFICATION OF SOIL

I. DEFINITION OF SOIL GROUP NAMES (ASTM D2487)

SYMBOL GROUP NAME

Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels – More than 50% of coarse fraction retained on No. 4 sieve Coarse, ¾" to 3" Fine, No. 4 to ¾"	Clean Gravels Less than 5% fines	GW	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with fines More than 12% fines	GM	SILTY GRAVEL
	Sands – 50% or more of coarse Fraction passes No. 4 sieve Coarse, No. 10 to No. 4 Medium, No. 40 to No. 10 Fine, No. 200 to No. 40	Clean Sands Less than 5% fines	SW	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	SM	SILTY SAND
SC			CLAYEY SAND	
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays – Liquid Limit less than 50 Low to medium plasticity	Inorganic	CL	LEAN CLAY
			ML	SILT
		Organic	OL	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays – Liquid Limit 50 or more Medium to high plasticity	Inorganic	CH	FAT CLAY
			MH	ELASTIC SILT
		Organic	OH	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color and organic odor	PT	PEAT	

II. DEFINITION OF SOIL COMPONENT PROPORTIONS (ASTM D2487)

			Examples
Adjective Form	GRAVELLY SANDY	>30% to <50% coarse-grained component in a fine-grained soil	GRAVELLY LEAN CLAY
	CLAYEY SILTY	>12% to <50% fine grained component in a coarse-grained soil	SILTY SAND
"With"	WITH GRAVEL WITH SAND	>15% to <30% coarse-grained component in a fine-grained soil	FAT CLAY WITH GRAVEL
	WITH GRAVEL WITH SAND	>15% to <50% coarse-grained component in a coarse-grained soil	POORLY GRADED GRAVEL WITH SAND
	WITH SILT WITH CLAY	>5% to <12% fine grained component in a coarse-grained soil	POORLY GRADED SAND WITH SILT

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS	Unified Soil Classification Symbols are shown above as group symbols. A dual symbol "-" indicates the soil belongs to two groups. A borderline symbol "/" indicates the soil belongs to two possible groups.
FILL	Man-made deposit containing soil, rock and often foreign matter.
PROBABLE FILL	Soils which contain no visually detected foreign matter but which are suspect with regard to origin.
DISINTEGRATED ROCK (DR)	Residual materials with a standard penetration resistance (SPT) between 60 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.
PARTIALLY WEATHERED ROCK (PWR)	Residual materials with a standard penetration resistance (SPT) between 100 blows per foot and refusal. Refusal is defined as an SPT of 100 blows for 2" or less penetration.
BOULDERS & COBBLES	Boulders are considered rounded pieces of rock larger than 12 inches, while cobbles range from 3 to 12-inch size.
LENSES	0 to ½-inch seam within a material in a test pit.
LAYERS	½ to 12-inch seam within a material in a test pit.
POCKET	Discontinuous body within a material in a test pit.
MOISTURE CONDITIONS	Wet, moist or dry to indicate visual appearance of specimen.
COLOR	Overall color, with modifiers such as light to dark or variation in coloration.

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/9/18 **Finished:** 8/10/18
Location: See Location Plan

Ground Surface Elevation: 333± (ft) **Total Depth:** 43.9 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/9	---	18.0'	---	---	
Completion	8/10	---	Dry	---	---	
Casing Pulled	8/10	---	13.3'	---	PIPE	
After Drilling	8/13	---	13.5'	---	PIPE	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.5	Asphalt; 6 inches		332.5					
1.0	GRAVEL BASE; 6 inches		332.0					
	PROBABLE FILL, sampled as sandy lean clay; moist, yellowish red, contains gravel, contains roots	FILL		A		S-1, SS 5+5+7 REC=18", 100%		
3.5	SANDY LEAN CLAY; moist, yellowish red, yellowish brown, and red, estimated 5-10% gravel	CL	329.5		5	S-2, SS 3+4+5 REC=18", 100%	PP = 3.50 tsf	
6.0	LEAN CLAY WITH SAND; moist, yellowish brown, gray, and red	CL	327.0	B1		S-3, SS 3+4+7 REC=18", 100%	LL = 39 PL = 24 MC = 19.0% % Passing #200 = 83.2 PP = 1.50 tsf	
8.5	POORLY GRADED SAND WITH CLAY AND GRAVEL; moist, yellowish red and white	SP-SC	324.5		10	S-4, SS 6+6+11 REC=18", 100%		
13.5	CLAYEY GRAVEL WITH SAND; moist, yellowish brown and white	GC	319.5	B2	15	S-5, SS 12+13+14 REC=18", 100%		
18.5	SILTY SAND; moist, light yellowish brown and gray, estimated 30-45% mica	SM	314.5		20	S-6, SS 23+10+8 REC=18", 100%		
23.5	SANDY SILT; moist, light yellowish red and gray, estimated 30 - 45% mica, estimated <5% rock fragments	ML	309.5	C2		S-7, SS 8+8+8 REC=18", 100%		

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-01**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
	Change: gray, streaks of black	ML		C2	30	S-8, SS 5+7+10 REC=18", 100%		
33.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, gray and black, streaks of yellowish brown, estimated 15-25% mica		299.5		35	S-9, SS 16+35+38 REC=18", 100%		
	Change: streaks of tan and yellowish red, estimated < 5% mica	DR		D	40	S-10, SS 37+50/5" REC=11", 100%		
43.9	Change: estimated 30 - 45% mica Bottom of Boring at 43.9 ft.		289.1			S-11, SS 50/5" REC=5", 100%		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: W. Rodas
Schnabel Representative: M. Khachan
Equipment: CME 550 ATV
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/13/18 **Finished:** 8/14/18
Location: See Location Plan

Ground Surface Elevation: 331± (ft) **Total Depth:** 38.5 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered ∇	8/14	---	17.0'	---	---
Completion	8/14	---	Dry	---	---
Casing Pulled	8/14	---	Dry	---	12.5'
End of Day	8/14	---	Dry	---	12.5'

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.3	Topsoil; 3 inches PROBABLE FILL, sampled as sandy silt; moist, light brown, contains roots	FILL	330.9	A		S-1, SS 9+7+5 REC=16", 89%		
2.5	CLAYEY GRAVEL; moist, yellowish red, white, and brown	GC	328.6			S-2, SS 11+20+23 REC=18", 100%		
5.0	CLAYEY SAND WITH GRAVEL; moist, yellowish red and white	SC	326.1	5		S-3, SS 6+8+14 REC=18", 100%		
8.5	CLAYEY GRAVEL WITH SAND; moist, reddish brown Change: mottles of yellowish brown	GC	322.6	B2	10	S-4, SS 11+16+12 REC=18", 100%		
					15	S-5, SS 11+14+16 REC=18", 100%		
18.5	POORLY GRADED GRAVEL; moist, white	GP	312.6		20	S-6, SS 15+11+9 REC=1", 6%		Poor Recovery
23.5	SANDY LEAN CLAY; wet, yellowish brown and gray, estimated 10-15% mica	CL	307.6	C1		S-7, SS 19+26+30 REC=2", 11%	PP =NA tsf	

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-02**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	SANDY SILT; moist, yellowish red, brown and black, estimated 30-45% mica	CL	302.6	C1	30	S-8, SS 20+20+20 REC=2", 11%		Possible Boulder or Rock Ledge at 27 ft
		ML		C2				
33.5	DISINTEGRATED ROCK, sampled as sandy silt with gravel; moist, black, gray, olive and white, estimated 50-100% rock fragments, estimated 5-10% mica	DR	297.6	D	35	S-9, SS 50/2" REC=1", 50%		
38.5								

Bottom of Boring at 38.5 ft.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/10/18 **Finished:** 8/10/18
Location: See Location Plan

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/10	---	21.0'	---	---	▽
Completion	8/10	---	16.3'	---	---	▽
Casing Pulled	8/10	---	11.1'	---	20.9'	▽
After Drilling	8/13	---	2.9'	---	12.7'	▽

Ground Surface Elevation: 326± (ft) **Total Depth:** 48.5 ft

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		325.8					
1.0	GRAVEL BASE; 7 inches		325.2					
	FILL, sampled as silty sand; moist, olive brown and brown, contains gravel and mica	FILL		A		S-1, SS 6+4+4 REC=18", 100%	MC = 17.7%	
3.5	SANDY LEAN CLAY; dry to moist, yellowish red and red	CL	322.7	B1	5	S-2, SS 4+5+7 REC=18", 100%	PP = 0.50 tsf	
6.0	CLAYEY SAND; moist, yellowish red, yellowish brown and red		320.2			S-3, SS 7+7+7 REC=18", 100%	MC = 17.0%	
	Change: WITH GRAVEL; yellowish red, yellowish brown, red, and gray	SC		B2	10	S-4, SS 4+4+4 REC=18", 100%		
13.5	SANDY SILT; moist, yellowish brown to yellowish red with mottles of gray and white, estimated 30-45% mica		312.7			S-5, SS 3+4+5 REC=18", 100%	MC = 23.3%	
	Change: reddish brown	ML		C2	20	S-6, SS 7+11+11 REC=18", 100%		
23.5	CLAYEY SAND; moist, yellowish red and yellowish brown with mottles of gray and red and with streaks of black, estimated	SC	302.7			S-7, SS 4+7+8 REC=18", 100%	LL = 47 PL = 23 MC = 29.3%	

(continued)



TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-03**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	15-25% mica	SC	297.7				% Passing #200 = 42.4 PP = 1.50 tsf	
	SANDY SILT; moist, yellowish brown with streaks of yellowish red and black, estimated 5-10% mica			C2	30	S-8, SS 7+8+12 REC=18", 100%		
	Change: gray, black, and light greenish gray, estimated < 5% quartz fragments, estimated 15-25% mica	ML			35	S-9, SS 18+22+28 REC=18", 100%		
	Change: bluish gray with mottles of black				40	S-10, SS 18+18+27 REC=18", 100%		
43.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, gray and black with olive streaks, estimated 15-25% mica	DR	282.7	D	45	S-11, SS 50/5" REC=5", 100%		
48.5			277.7					

Bottom of Boring at 48.5 ft.
Boring offset 5 ft to the south to avoid concrete. The offset borings has the same elevation as the original location.
Spoon Refusal at 48.5 ft.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: W. Rodas
Schnabel Representative: M. Khachan
Equipment: CME 550 ATV
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/14/18 **Finished:** 8/14/18
Location: See Location Plan
Ground Surface Elevation: 331± (ft) **Total Depth:** 51.0 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/14	---	17.5'	---	---
Completion	8/14	---	40.0'	---	---
Casing Pulled	8/14	---	Dry	---	5.0'
End of Day	8/14	---	Dry	---	5.0'

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		330.3					
1.0	GRAVEL BASE; 7 inches		329.7					
	FILL, sampled as sandy silt; moist, brown and black, contains gravel, mica, brick, and organics	FILL		A		S-1, SS 4+4+4 REC=18", 100%		
3.5	PROBABLE FILL, sampled as sandy silt; moist, tan	FILL	327.2		5	S-2, SS 2+12+21 REC=18", 100%		
6.0	SANDY LEAN CLAY; moist, yellowish brown and yellowish red	CL	324.7	B1		S-3, SS 5+7+7 REC=18", 100%	PP = 2.25 tsf	
8.5	CLAYEY SAND; moist, yellowish brown, and red	SC	322.2	B2	10	S-4, SS 3+5+6 REC=18", 100%		
13.5	LEAN CLAY WITH SAND; moist, light gray, streaks of yellowish brown	CL	317.2	B1	15	S-5, SS 3+5+6 REC=18", 100%	PP = 2.25 tsf	
18.5	CLAYEY GRAVEL WITH SAND; wet, yellowish brown, mottles of white	GC	312.2	B2	20	S-6, SS 5+7+12 REC=10", 56%		
23.5	SANDY SILT; moist, yellowish brown, estimated 30-45% mica	ML	307.2	C2		S-7, SS 2+3+3 REC=18", 100%		

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-04**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
	Change: yellowish brown, black, and gray	ML			30	S-8, SS 8+9+10 REC=18", 100%		
	Change: yellowish red with streaks of black				35	S-9, SS 8+12+13 REC=18", 100%		
38.5	SILTY SAND; moist, bluish gray, black and yellowish red, estimated 30-45% mica	SM	292.2		40	S-10, SS 7+11+17 REC=18", 100%		
43.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, black, bluish gray and olive, estimated 30-45% mica, estimated 10-15% rock fragments and quartz fragments	DR	287.2	D	45	S-11, SS 15+31+50/5" REC=17", 100%		
	Change: estimated 50-100% rock fragments				50	S-12, SS 50/0.5" REC=0.5", 100%		
51.0	Bottom of Boring at 51.0 ft. Spoon Refusal at 51.0 ft.		279.7			S-13, SS 50/0" REC=0"		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19



Project: The Catherine and Isiah Leggett Building
 Montgomery College
 7600 Takoma Ave, Takoma Park, Maryland

Boring Number: SB-05/SWM-4
Contract Number: 18C41041
Sheet: 1 of 2

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: W. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/6/18 **Finished:** 8/6/18
Location: See Location Plan
Ground Surface Elevation: 316± (ft) **Total Depth:** 48.7 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/6	---	21.0'	---	---	
Completion	8/6	---	10.9'	---	---	
Casing Pulled	8/6	---	6.8'	---	7.2'	
After Drilling	8/7	---	4.6'	---	7.3'	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.2	Topsoil; 2 inches		315.6	A		S-1, SS 2+2+6+8 REC=10", 42%		
2.0	FILL, sampled as sandy lean clay with gravel; moist, brown, gray, and white, contains brick fragments and roots	FILL	313.8			S-2, SS 2+3+2+3 REC=20", 83%	PP = 0.50 tsf	
	SANDY LEAN CLAY; moist, yellowish brown and gray, estimated < 5% gravel	CL		B1		S-3, SS 2+3+4+6 REC=24", 100%	PP = 0.75 tsf	
	Change: estimated 15-25% gravel				5			
6.0	CLAYEY SAND; moist, light whitish gray, estimated 50 - 100% mica	SC	309.8			S-4, SS 3+2+2+3 REC=18", 75%	LL = 46 PL = 24 MC = 20.9% % Passing #200 = 42.3	
8.0	SANDY SILT; moist, yellowish brown and whitish gray, estimated 30 - 45% mica, est 10-15% rock fragments	ML	307.8			S-5, SS 2+2+2+3 REC=24", 100%		
10.0	SILTY SAND; moist, yellowish brown and light gray with streaks of yellowish red, estimated 30-45% mica	SM	305.8	C2		S-6, SS 1+2+3+8 REC=24", 100%		
	Change: brown and yellowish red					S-7, SS 10+19+30+40 REC=24", 100%		
	Change: brown and reddish brown, estimated 10-15% rock fragments				15	S-8, SS 18+20+34+50/5" REC=23", 100%		
15.5	DISINTEGRATED ROCK, sampled as silty sand; moist, brown and reddish brown, estimated 15-25% mica, estimated 15-25% rock fragments	DR	300.3	D		S-9, SS 34+50/4" REC=10", 100%		
	Change: brown and grayish brown, with streaks of black and mottles of yellowish red				20	S-10, SS 50/6" REC=6", 100%		
	Change: brown, gray, olive brown and black							

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: SB-05/SWM-4
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
30	Change: moist to wet, brown, yellowish red, yellowish brown, and gray, estimated < 5% mica, no rock fragments		267.2	D	32+50/4"	S-11, SS REC=10", 100%		
35	Change: gray, brown, yellowish red, and black, estimated 15-25% mica, estimated 5-10% rock fragments				50/6"	S-12, SS REC=6", 100%		
40					50/5"	S-13, SS REC=5", 100%		
45	Change: gray, estimated 50 - 100% rock fragments				50/2"	S-14, SS REC=2", 100%		
48.7	Change: olive and bluish gray, no rock fragments				50/2"	S-15, SS REC=2", 100%		
Bottom of Boring at 48.7 ft.								

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME 550 ATV
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/13/18 **Finished:** 8/13/18
Location: See Location Plan
Ground Surface Elevation: 329± (ft) **Total Depth:** 43.6 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/13	---	23.5'	---	---	
Completion	8/13	---	38.5'	---	---	
Casing Pulled	8/13	---	27.5'	---	30.7'	
After Drilling	8/14	---	14.7'	---	19.5'	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		329.0					
1.0	GRAVEL BASE; 7 inches		328.4					
	FILL, sampled as sandy lean clay; moist, brown, black, and gray, contains brick fragments, contains gravel and asphalt	FILL		A		S-1, SS 7+8+8 REC=18", 100%		
3.5	LEAN CLAY WITH SAND; dry to moist, yellowish brown	CL	325.9	B1	5	S-2, SS 2+3+3 REC=18", 100%	PP = 0.75 tsf	
6.0	SILTY SAND; dry to moist, yellowish brown	SM	323.4			S-3, SS 12+17+12 REC=18", 100%		
8.5	CLAYEY SAND WITH GRAVEL; moist, yellowish brown and yellowish red	SC	320.9	B2	10	S-4, SS 5+5+7 REC=18", 100%		
13.5	GRAVELLY LEAN CLAY WITH SAND; moist, yellowish brown, gray, and red	CL	315.9	B1	15	S-5, SS 5+5+10 REC=18", 100%	PP = 2.00 tsf	
						S-6, SS 7+4+4 REC=0", 0%		No Recovery
22.0	SANDY SILT; moist, yellowish brown, light red, and gray, estimated 30-45% mica Change: yellowish brown, black, gray, estimated 15-25% mica	ML	307.4	C2		S-7, SS 7+7+8 REC=18", 100% S-8, SS 7+10+15 REC=18", 100%		Pressurimeter Test conducted at 24

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-06**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
	Change: yellowish brown, gray, and black, estimated 15-25% mica	ML		C2		S-9, SS 7+10+14 REC=18", 100%		ft.
	Change: yellowish red, mottles of gray					S-10, SS 11+14+17 REC=18", 100%		
	Change: bluish gray and black				30	S-11, SS 9+14+18 REC=18", 100%		
33.5	DISINTEGRATED ROCK, sampled as silty sand with gravel; moist, black and olive, estimated 15-25% rock fragments, estimated 5-10% mica	DR	295.9	D		S-12, SS 50/2" REC=2", 100%		Pressurimeter Test conducted at 27.5 ft.
					35			
					40	S-13, SS 50/1" REC=1", 100%		
43.6	Change: estimated 50-100% rock fragments		285.8			S-14, SS 50/1" REC=1", 100%		
Bottom of Boring at 43.6 ft.								

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/9/18 **Finished:** 8/9/18
Location: See Location Plan

Ground Surface Elevation: 328± (ft) **Total Depth:** 43.5 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/9	---	18.5'	---	---	
Completion	8/9	---	Dry	---	---	
Casing Pulled	8/9	---	16.0'	---	33.5'	
After Drilling	8/10	---	13.8'	---	19.7'	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.5	Asphalt; 6 inches		327.5	A				
1.0	GRAVEL BASE; 6 inches		327.0					
1.8	FILL, sampled as sandy lean clay; moist, brown and black, contains gravel, contains brick fragments	FILL	326.2			S-1, SS 2+2+2 REC=18", 100%		
	SANDY LEAN CLAY; moist, yellowish brown Change: mottles of yellowish red, estimated < 5% roots, estimated < 5% gravel	CL		5		S-2, SS 4+6+7 REC=18", 100%	PP = 4.00 tsf	
6.0	LEAN CLAY WITH SAND; moist, yellowish red, red, and gray, estimated <5% gravel Change: no gravel	CL	322.0	B1		S-3, SS 4+5+6 REC=18", 100%	PP = 2.00 tsf	
					10		S-4, SS 4+5+8 REC=18", 100%	PP = 3.00 tsf
13.5	CLAYEY SAND; moist, yellowish red, yellowish brown, and red, estimated 5-10% gravel	SC	314.5		15	S-5, SS 4+5+5 REC=18", 100%		
18.5	CLAYEY GRAVEL WITH SAND; wet, light yellowish brown, white, black, and gray	GC	309.5	B2		S-6, SS 7+8+5 REC=3", 17%		
23.5	SANDY SILT; moist, yellowish red, and gray, estimated 30-45% mica	ML	304.5		C2		S-7, SS 2+3+7 REC=18", 100%	

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-07**
Contract Number: 18C41041
Sheet: 2 of 2


DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
30	Change: yellowish brown, yellowish red, and gray, estimated 30-45% mica	ML		C2	30	S-8, SS 8+15+20 REC=18", 100%		
33.5	DISINTEGRATED ROCK, sampled as silty sand; moist, black and gray, estimated 15-25% rock fragments		294.5		35	S-9, SS 50/2" REC=2", 100%		
40	Change: estimated 50-100% rock fragments	DR		D	40	S-10, SS 50/1" REC=1", 100%		
43.5	Bottom of Boring at 43.5 ft. Spoon Refusal at 43.5 ft.		284.5			S-11, SS 50/0" REC=0"		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/7/18 **Finished:** 8/8/18
Location: See Location Plan

Ground Surface Elevation: 329± (ft) **Total Depth:** 53.5 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/8	---	None	---	---
Completion	8/8	---	Dry	---	---
Casing Pulled	8/8	---	Dry	---	29.3'
After Drilling 	8/9	---	20.4'	---	21.5'

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		328.7					
1.0	GRAVEL BASE; 7 inches		328.1					
	FILL, sampled as silty sand; moist, olive brown, gray, and black, contains gravel, mica	FILL				S-1, SS 3+10+12 REC=18", 100%		
3.5	FILL, sampled as sandy lean clay with gravel; moist, yellowish brown, contains mica		325.6		5	S-2, SS 4+3+3 REC=18", 100%		
	Change: gray, black, and olive brown, contains brick fragments			A		S-3, SS 2+3+4 REC=18", 100%	LL = 41 PL = 23 MC = 14.5% % Passing #200 = 50.6	
	Change: yellowish brown	FILL			10	S-4, SS 3+1+3 REC=10", 56%		
13.5	CLAYEY SAND; moist, yellowish brown, red and tan	SC	315.6	B2	15	S-5, SS 7+7+8 REC=18", 100%		
18.5	LEAN CLAY WITH SAND; moist, yellowish brown, light gray, and red, estimated <5% gravel	CL	310.6	B1	20	S-6, SS 4+7+9 REC=18", 100%	PP = 2.50 tsf	
23.5	SANDY LEAN CLAY; moist, light brown, gray, and light red, estimated 30-45% mica	CL	305.6	C1		S-7, SS 3+3+3 REC=18", 100%	LL = 49 PL = 24 MC = 22.9%	

(continued)



TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-08**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	SANDY SILT; moist, yellowish red and yellowish brown with mottles of light gray and black, esimated 15-25% mcia	CL	300.6	C1			% Passing #200 = 55.9 PP = 1.50 tsf	
	Change: gray, black, and brown with streaks of yellowish red, estimated 30-45% mica	ML		C2	30	S-8, SS 5+7+12 REC=18", 100%		
					35	S-9, SS 6+11+13 REC=18", 100%		
38.5	DISINTEGRATED ROCK, sampled as silty sand; moist, black and gray, estimated 30 - 45% mica		290.6		40	S-10, SS 50/6" REC=6", 100%		
	Change: dry to moist, estimated 50 - 100% rock fragments	DR		D	45	S-11, SS 50/1" REC=1", 100%		
					50	S-12, SS 50/1" REC=1", 100%		
53.5	Bottom of Boring at 53.5 ft.		275.5			S-13, SS 50/0.5" REC=0.5", 100%		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/7/18 **Finished:** 8/7/18
Location: See Location Plan
Ground Surface Elevation: 320± (ft) **Total Depth:** 52.6 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/7	---	26.0'	---	---	
Completion	8/7	---	23.7'	---	---	
Casing Pulled	8/7	---	40.5'	---	PIPE	
After Drilling	8/8	---	15.3'	---	PIPE	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.3	Topsoil; 3 inches FILL, sampled as sandy silt with gravel; moist, brown, contains roots Change: yellowish brown and brown	FILL	319.6	A		S-1, SS 2+3+3 REC=10", 56%		
5.0	SANDY LEAN CLAY; moist, yellowish brown, estimated 5-10% gravel, estimated < 5% roots	CL	314.8	B1	5	S-2, SS 7+11+12 REC=18", 100%	MC = 9.6%	
8.5	CLAYEY SAND; moist, yellowish brown, yellowish red, and gray, estimated 5-10% gravel	SC	311.3	B2	10	S-3, SS 2+3+5 REC=18", 100%	PP = NA tsf	
13.5	CLAYEY SAND; moist, yellowish brown, yellowish red, and gray, estimated 5-10% gravel	SC	311.3	B2	10	S-4, SS 4+9+11 REC=18", 100%	LL = 39 PL = 25 MC = 14.7% % Passing #200 = 27.5	
18.5	SANDY LEAN CLAY; moist, white, gray, and yellowish brown, estimated 5-10% gravel	CL	306.3	B1	15	S-5, SS 3+4+5 REC=18", 100%	PP = 1.25 tsf	
23.5	SILTY SAND WITH GRAVEL; moist to wet, light brown, yellowish brown, and gray, estimated 30-45% mica, estimated 15-25% quartz fragment and and quartz gravel	SM	301.3	C2	20	S-6, SS 3+7+5 REC=18", 100%		
23.5	SILTY SAND; moist, yellowish brown and reddish brown, estimated 15 - 25% mica	SM	296.3			S-7, SS 7+9+11 REC=18", 100%		

(continued)



TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SB-09**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	DISINTEGRATED ROCK, sampled as silty sand; moist, bluish gray and black, estimated 30-45% mica, estimated 5-10% rock fragments	SM	291.3	C2	30	S-8, SS 19+30+44 REC=18", 100%		
	Change: olive gray, yellowish brown, and black				35	S-9, SS 29+40+50 REC=18", 100%		
	Change: gray and black, estimated 15 - 25% rock fragments				40	S-10, SS 30+45+50/4" REC=16", 100%		
	Change: brown and gray	DR		D	45	S-11, SS 50/2" REC=2", 100%		
	Change: yellowish brown, yellowish red, gray, and black, estimated 15-25% mica				50	S-12, SS 32+25+27 REC=18", 100%		
52.6	Change: brown, gray, and black, estimated 50-100% rock fragments Bottom of Boring at 52.6 ft.		267.2			S-13, SS 50/1" REC=1", 100%		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/9/18 **Finished:** 8/9/18
Location: See Location Plan
Ground Surface Elevation: 326± (ft) **Total Depth:** 43.8 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/9	---	23.7'	---	---	
Completion	8/9	---	35.4'	---	---	
Casing Pulled	8/9	---	Dry	---	18.1'	
After Drilling	8/10	---	9.6'	---	11.1'	

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		326.0					
1.0	GRAVEL BASE; 7 inches		325.4					
	FILL, sampled as clayey sand with gravel; moist, gray and brown, contains quartz fragments, mica and rock fragments	FILL				S-1, SS 3+7+4 REC=6", 33%		
3.5	FILL, sampled as sandy silt; moist, brown, gray, and black, contains gravel, rock fragments and mica	FILL	322.9		5	S-2, SS 1+2+3 REC=5", 28%		
	Change: olive brown and gray	FILL				S-3, SS 3+4+4 REC=18", 100%		Potential Chemical Odor
8.5	FILL, sampled as sandy lean clay; moist, brown and black, contains gravel, mica, glass fragments, and organics	FILL	317.9		10	S-4, SS 2+2+2 REC=18", 100%		
	Change: yellowish brown and gray	FILL		A		S-5, SS 1+2+4 REC=8", 44%		
15		FILL			15			
18.5	PROBABLE FILL, sampled as clayey gravel; moist, yellowish brown and white	FILL	307.9		20	S-6, SS 1+2+3 REC=4", 22%		
23.5	CLAYEY SAND; moist, yellowish brown and yellowish red, streaks of white	SC	302.9	B2		S-7, SS 2+3+3 REC=18", 100%		

(continued)

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	ELASTIC SILT WITH SAND; moist to wet, yellowish brown with streaks of yellowish red, estimated 10-15% mica	SC	297.9	B2	30	S-8, SS 5+8+12 REC=18", 100%	PP = 2.50 tsf	
33.5	SANDY SILT; moist, black and bluish gray, estimated 30 - 45% mica	MH	292.9	C1	35	S-9, SS 12+18+25 REC=18", 100%		
38.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, black, bluish gray, and brown, estimated 30-45% mica, estimated 10-15% rock fragments	ML	287.9	C2	40	S-10, SS 16+31+47 REC=18", 100%		
43.8	Change: brown and gray Bottom of Boring at 43.8 ft.	DR	282.7	D		S-11, SS 50/3" REC=3", 100%		

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/8/18 **Finished:** 8/8/18
Location: See Location Plan
Ground Surface Elevation: 326± (ft) **Total Depth:** 15.8 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/8	---	13.0'	---	---	
Completion	8/8	---	13.7'	---	---	
Casing Pulled	8/8	---	Dry	---	4.5'	
After Drilling	8/9	---	Dry	---	4.1'	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS	
					DEPTH	DATA			
0.3	Topsoil; 4 inches		325.9	A		S-1, SS 2+3+2+3 REC=24", 100%	LL = 36 PL = 23 MC = 7.4% % Passing #200 = 15.5		
2.0	FILL, sampled as sandy lean clay; moist, yellowish brown, contains roots and gravel	FILL	324.2			S-2, SS 3+4+5+9 REC=24", 100%			
	CLAYEY SAND; moist, yellowish brown and red, estimated 5 - 10% gravel, estimated <5% roots	SC		5	S-3, SS 3+8+14+16 REC=24", 100%				
	Change: WITH GRAVEL; yellowish red, yellowish brown and white					S-4, SS 9+12+16+21 REC=18", 75%			
6.0	CLAYEY SAND WITH GRAVEL; moist, yellowish brown and yellowish red	SC	320.2	B2	10	S-5, SS 8+12+16+16 REC=3", 13%			
									S-6, SS 6+8+12+16 REC=18", 75%
	Change: yellowish brown								S-7, SS 9+11+13+10 REC=14", 58%
						15			S-8, SS 4+5+16+50/4" REC=20", 91%
15.8			310.4						

Bottom of Boring at 15.8 ft.
Offset 4 ft to the east and auger probed for infiltration testing. PVC pipe installed to 6.0 ft.

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/6/18 **Finished:** 8/6/18
Location: See Location Plan
Ground Surface Elevation: 326± (ft) **Total Depth:** 15.0 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/6	---	None	---	---
Completion	8/6	---	Dry	---	---
Casing Pulled	8/6	---	Dry	---	10.0'
After Drilling	8/6	---	Dry	---	2.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Asphalt; 5 inches		326.1					
1.0	GRAVEL BASE; 7 inches		325.5					
	FILL, sampled as sandy silt with gravel; moist, brown, contains roots and asphalt	FILL		A		S-1, SS 2+3+3+3 REC=20", 83%		
3.0	PROBABLE FILL, sampled as clayey sand with gravel; moist, yellowish brown and dark red	FILL	323.5			S-2, SS 1+1+3+4 REC=18", 75%		
5.0	CLAYEY SAND; moist, yellowish red and yellowish brown, estimated < 5% roots, estimated < 5% gravel		321.5		5	S-3, SS 1+3+7+9 REC=18", 75%	LL = 34 PL = 21 MC = 13.3% % Passing #200 = 31.7	
	Change: no roots, no gravel	SC				S-4, SS 7+8+10+11 REC=24", 100%		
	Change: estimated < 5% thin, light gray clay seams			B2	10	S-5, SS 7+8+9+9 REC=24", 100%		
11.0	POORLY GRADED SAND WITH SILT; moist, yellowish red and yellowish brown		315.5			S-6, SS 4+6+7+7 REC=24", 100%		
	Change: yellowish brown and gray	SP-SM				S-7, SS 4+5+6+6 REC=24", 100%		
15.0			311.5		15			

Bottom of Boring at 15.0 ft.
 Offset 5 ft to the west and auger probed for infiltration testing. PVC pipe installed to 6.0 ft.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19



Project: The Catherine and Isiah Leggett Building
 Montgomery College
 7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **SWM-3**
Contract Number: 18C41041
Sheet: 1 of 1

Contractor: Recon Drilling
 Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/8/18 **Finished:** 8/8/18
Location: See Location Plan
Ground Surface Elevation: 324± (ft) **Total Depth:** 16.0 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/8	---	None	---	---
Completion	8/8	---	Dry	---	---
Casing Pulled	8/8	---	Dry	---	1.3'
After Drilling	8/9	---	Dry	---	1.1'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.4	Topsoil; 4 inches		324.1			S-1, SS 2+3+4+4 REC=18", 75%		
2.0	FILL, sampled as clayey sand with gravel; moist, dark brown and reddish brown, contains brick fragments and roots	FILL	322.5	A		S-2, SS 6+5+6+11 REC=24", 100%		
4.0	FILL, sampled as sandy lean clay with gravel; moist, yellowish brown, contains roots	FILL	320.5			S-3, SS 3+12+15+18 REC=12", 50%	PP = 3.50 tsf	
6.0	SANDY LEAN CLAY WITH GRAVEL; moist, dark yellowish brown and yellowish red	CL	318.5	B1	5	S-4, SS 3+5+12+21 REC=14", 58%	LL = 35 PL = 21 MC = 10.5% % Passing #200 = 26.3	
	Change: yellowish red and white	SC				S-5, SS 12+11+11+19 REC=24", 100%		
10.0	CLAYEY SAND WITH GRAVEL; moist, yellowish red and yellowish brown	SC	314.5	B2	10	S-6, SS 6+15+8+10 REC=24", 100%		
12.0	SANDY SILT; moist, yellowish brown and gray, estimated 30 - 45% mica	ML	312.5			S-7, SS 4+4+4+5 REC=18", 75%		
						S-8, SS 2+4+5+5 REC=24", 100%		
16.0			308.5	C2	15			

Bottom of Boring at 16.0 ft.
 Offset 5 ft to the east and auger probed for infiltration testing. PVC pipe installed to 6.0 ft.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/7/18 **Finished:** 8/7/18
Location: See Location Plan
Ground Surface Elevation: 315± (ft) **Total Depth:** 16.0 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/7	---	None	---	---
Completion	8/7	---	Dry	---	---
Casing Pulled	8/7	---	Dry	---	7.2'
After Drilling	8/8	---	6.0'	---	6.8'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.3	Topsoil; 3 inches		314.8			S-1, SS 2+1+1+3 REC=20", 83%		
2.0	FILL, sampled as sandy lean clay; moist, brown, contains roots	FILL	313.0	A		S-2, SS 1+3+3+8 REC=24", 100%	PP = 2.40 tsf	
	SANDY LEAN CLAY; moist, yellowish brown with mottles of light gray, estimated < 5% gravel	CL			5	S-3, SS 7+7+9+11 REC=24", 100%	PP = 2.50 tsf	
6.0	Change: estimated <5% roots							
	LEAN CLAY WITH SAND; moist, yellowish brown with mottles of light gray and yellowish red, no roots	CL	309.0	B1		S-4, SS 3+4+7+9 REC=24", 100%	LL = 40 PL = 25 MC = 12.0% % Passing #200 = 81.5	
	Change: gray, yellowish brown, and reddish brown, estimated 10-15% gravel, estimated <5% mica					S-5, SS 4+7+9+11 REC=24", 100%	PP = 3.50 tsf PP = 3.50 tsf	
10.0	SANDY FAT CLAY WITH GRAVEL; moist, whitish brown, yellowish gray, brown, and red, estimated <5% mica	CH	305.0		10	S-6, SS 4+5+9+11 REC=10", 42%	PP =NA tsf	
						S-7, SS 3+3+5+5 REC=0", 0%		No Recovery
14.0	SILTY SAND; moist, yellowish brown, estimated 5 - 10% mica	SM	301.0	C2	15	S-8, SS 5+4+5+6 REC=12", 50%		
16.0			299.0					

Bottom of Boring at 16.0 ft.
Offset 5 ft to the north east and auger probed for infiltration testing. Pipe installed to 6.0 ft.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME-45B (Truck)
Method: 2-1/4" I.D. Hollow Stem Auger
Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/8/18 **Finished:** 8/8/18
Location: See Location Plan
Ground Surface Elevation: 329± (ft) **Total Depth:** 15.0 ft

Groundwater Observations					
	Date	Time	Depth	Casing	Caved
Encountered	8/8	---	Ne	---	---
Completion	8/8	---	Dry	---	---
Casing Pulled	8/8	---	Dry	---	2.5'
After Drilling	8/9	---	Dry	---	2.0'

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0.5	Asphalt; 6 inches		328.4					
1.0	GRAVEL BASE; 6 inches		327.9					
	CLAYEY SAND; moist, yellowish brown, estimated <5% gravel	SC				S-1, SS 9+9+9+9 REC=24", 100%	LL = 37 PL = 22 MC = 11.1% % Passing #200 = 28.3	
	Change: yellowish brown and yellowish red					S-2, SS 5+7+9+12 REC=24", 100%		
	Change: yellowish brown and light reddish brown				5	S-3, SS 3+8+9+11 REC=24", 100%		
7.0	CLAYEY GRAVEL WITH SAND; moist, yellowish red, yellowish brown, and white	GC	321.9	B2		S-4, SS 9+14+13+14 REC=24", 100%		
	Change: yellowish brown and white					S-5, SS 6+14+15+18 REC=6", 25%		
	Change: yellowish brown, white, and gray				10	S-6, SS 6+12+30+50/5" REC=12", 50%		
	Change: yellowish brown and white					S-7, SS 32+12+12+12 REC=14", 58%		
15.0			313.9		15			

Bottom of Boring at 15.0 ft.
Boring was offset 9 ft North from the original location due to electrical lines above the original location, and a sewer line 5 ft from the original location. No elevation change.
Infiltration boring was offset 4 ft to the north. Pipe installed to 6.0 ft.

Contractor: Recon Drilling
Leesburg, Virginia
Contractor Foreman: U. Rodas
Schnabel Representative: M. Khachan
Equipment: CME 550 ATV
Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Auto Hammer (140 lb)
Dates Started: 8/13/18 **Finished:** 8/13/18
Location: See Location Plan

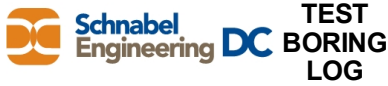
Ground Surface Elevation: 316± (ft) **Total Depth:** 15.0 ft

Groundwater Observations						
	Date	Time	Depth	Casing	Caved	
Encountered	8/8	---	10.5'	---	---	
Completion	8/8	---	7.9'	---	---	
Casing Pulled	8/8	---	7.8'	---	11.0'	

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
0 - 8.5	No SPT samples were collected. Augered to 8.5 ft.							
8.5	SILTY SAND; moist, whitish gray, contains 50-100% mica	SM	307.3	C2	9.5 - 10.0	S-1, SS 4+4+3 REC=9", 50%	PP = 0.50 tsf	Pressurmeter Test conducted at 10.5 ft.
10.0	Change: yellowish brown, with mottles of black, contains 15-25% mica				10.0 - 10.5	S-2, SS 1+1+3 REC=18", 100%	PP = 0.50 tsf	
13.5	DISINTEGRATED ROCK, sampled as silty sand; moist, yellowish red, brown, and black, estimated 30-45% mica, estimated 15-25% rock fragments	DR	302.3	D	13.0 - 13.5	S-3, SS 15+25+34 REC=18", 100%		
15.0	Bottom of Boring at 15.0 ft.		300.8		14.5 - 15.0	S-4, SS 21+30+31 REC=18", 100%		

SB-05 (PMT) is a pressuremeter test boring that was drilled 3 ft to the SW of the original SB-05/SWM-4 boring location, and at the same ground elevation.

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19



Project: The Catherine and Isiah Leggett Building
 Montgomery College
 7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **Boring A**
Contract Number: 18C41041
Sheet: 1 of 2

Contractor: Connelly and Associates, Inc.
 Frederick, Maryland

Contractor Foreman: Josh Lewis

Schnabel Representative: M. Khachan

Equipment: Acker Scout Rig

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Manual

Dates Started: 5/15/19 **Finished:** 5/15/19

Location: See Location Plan

Ground Surface Elevation: 329± (ft) **Total Depth:** 38.8 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered ▽	5/15	---	20.0'	---	---
Completion ▼	5/15	---	22.0'	---	---
Casing Pulled	5/15	---	Dry	---	4.0'
After Drilling	5/16	---	Dry	---	4.0'

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
1.0	Asphalt; 12 inches (no gravel base)							
	FILL, sampled as silty sand; moist, yellowish brown, gray, black, and white, contains gravel and mica	FILL	327.5			S-1, SS 1+2+2+3 REC=18", 75%		
3.0	FILL, sampled as sandy lean clay; moist, olive brown, contains mica and gravel	FILL	325.5	A		S-2, SS 11+3+3+4 REC=8", 33%		
5.0	SANDY LEAN CLAY; moist, yellowish brown, yellowish red, and red, estimated <5% cemented sand	CL	323.5	B1	5	S-3, SS 3+4+7+8 REC=16", 67%	PP = 1.75 tsf	
7.0	CLAYEY SAND WITH GRAVEL; moist, yellowish brown, yellowish red, and white, estimated <5% mica, estimated 5-10% cemented sand	SC	321.5			S-4, SS 5+7+9+15 REC=24", 100%		
9.0	CLAYEY GRAVEL WITH SAND; moist, yellowish brown with mottles of yellowish red and gray, estimated 20-30% quartz gravel	GC	319.5		10	S-5, SS 27+32+36+37 REC=24", 100%		
13.5	CLAYEY SAND WITH GRAVEL; moist, yellowish brown and yellowish red	SC	315.0	B2	15	S-6, SS 18+23+27 REC=4", 22%		
18.5	SILTY SAND; moist, yellowish brown with speckles of light tan, estimated 10-15% mica	SM	310.0	C2	20	S-7, SS 15+22+21 REC=8", 44%		
23.5	SANDY LEAN CLAY; very moist to wet, yellowish brown, estimated 10-15% mica, estimated 5-10% rock fragments	CL	305.0	C1		S-8, SS 15+21+28 REC=11", 61%	PP = 0.25 tsf	

(continued)



Schnabel Engineering DC
TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
Montgomery College
7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **Boring A**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	DISINTEGRATED ROCK, sampled as silty sand; moist, yellowish brown and gray, estimated 10-15% mica	CL	300.0	C1	30	S-9, SS 21+50/6" REC=12", 100%		
33.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, yellowish brown, yellowish red, black and white, estimated 10-15% mica	DR	295.0	D	35	S-10, SS 50/2" REC=2", 100%		
38.5 38.8	DISINTEGRATED ROCK, sampled as silty sand; moist, gray, black, and greenish gray, estimated 10-15% mica	DR	290.0 289.7			S-11, SS 50/4" REC=4", 100%		

Bottom of Boring at 38.8 ft.
Boring was backfilled with spoils and asphalt was patched .
PP= pocket penetrometer (unconfined compressive strength).

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19



Project: The Catherine and Isiah Leggett Building
 Montgomery College
 7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **Boring B**
Contract Number: 18C41041
Sheet: 1 of 2

Contractor: Connelly and Associates, Inc.
 Frederick, Maryland

Contractor Foreman: Josh Lewis

Schnabel Representative: S. Offutt

Equipment: Acker Scout Rig

Method: 2-1/4" I.D. Hollow Stem Auger

Hammer Type: Manual

Dates Started: 5/16/19 **Finished:** 5/16/19

Location: See Location Plan

Ground Surface Elevation: 316± (ft) **Total Depth:** 34.0 ft

Groundwater Observations

	Date	Time	Depth	Casing	Caved
Encountered	5/16	---	None	---	---
Completion	5/16	---	Dry	---	---
Casing Pulled	5/16	---	27.9'	---	28.0'
End of Day	5/16	---	27.9'	---	28.0'

TEST BORING LOG 18C41041 GINT LOGS.GPJ SCHNABEL DATA TEMPLATE 2008_07_06.GDT 5/21/19

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING		TESTS	REMARKS
					DEPTH	DATA		
0.7	Concrete; 8 inches		315.7	A				
1.2	FILL, sampled as silty gravel with sand; moist, yellowish brown with mottles of brown	FILL	315.2	B1		S-1, SS 3+5+21+30 REC=24", 100% SS	PP = 4.00 tsf	
3.0	SANDY LEAN CLAY; moist, yellowish brown with mottles of brown, estimated 5-10% gravel, estimated <5% mica	CL	313.4			S-2, SS 10+13+14+7 REC=18", 75%		
5.0	CLAYEY GRAVEL WITH SAND; moist, brown, yellowish brown, and reddish brown	GC	311.4	B2	5	S-3, SS 18+13+12+10 REC=18", 75%	PP = NA tsf	
	CLAYEY SAND WITH GRAVEL; moist, yellowish brown and light brown	SC						
7.0	SANDY SILT; moist, yellowish brown and light brown with speckles of gray, estimated 5-10% rock fragments, estimated 5-10% mica	ML	309.4	C2		S-4, SS 10+18+24+36 REC=24", 100%		
9.0	DISINTEGRATED ROCK, sampled as sandy silt; moist, yellowish brown and yellowish red, streaks of black, estimated <5% mica	DR	307.4	D	10	S-5, SS 16+26+37+50/4" REC=23", 105%		
13.5	SANDY SILT; moist, yellowish brown, mottles of red and gray, estimated 5-10% mica	ML	302.9	C2	15	S-6, SS 8+13+18 REC=18", 100%		
18.5	DISINTEGRATED ROCK, sampled as sandy silt; moist, bluish gray with mottles of dark gray, estimated 5-10% mica, estimated 5-10% quartz fragments	DR	297.9	D	20	S-7, SS 17+27+34 REC=18", 100%		
	Change: olive, yellowish brown, reddish brown, and black					S-8, SS 28+50/4" REC=10", 100%		

(continued)



TEST BORING LOG

Project: The Catherine and Isiah Leggett Building
 Montgomery College
 7600 Takoma Ave, Takoma Park, Maryland

Boring Number: **Boring B**
Contract Number: 18C41041
Sheet: 2 of 2

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOL	ELEV (ft)	STRATUM	SAMPLING DATA		TESTS	REMARKS
					DEPTH	DATA		
28.5	DISINTEGRATED ROCK, sampled as silty sand; moist, gray with mottles of white, estimated 20-30% rock fragments	DR	287.9	D	30	S-9, SS 50/2" REC=2", 100%		
34.0		DR				S-10, SS 50/1" REC=1", 100%		
Change: 50-100% rock fragments			282.4			S-11, SS 50/0" REC=0"		
<p>Bottom of Boring at 34.0 ft. Boring was backfilled with spoils and concrete was patched. Auger and spoon refusal at 34.0 ft. PP= pocket penetrometer (unconfined compressive strength). NA= reading could not be obtained from sample.</p>								

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APPENDIX B

IN-SITU TEST RESULTS

Pressuremeter Test Method (1 sheet)
Pressuremeter Test Curves (3 sheets)

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PRESSUREMETER TEST METHOD

Brief Description of the Pressuremeter Test

The test is performed in a borehole with a short cylindrical metal probe covered with a rubber membrane. The probe is inflated with water under pressure from a surface control apparatus. Pressure is increased in steps and deformations are recorded. The procedure represents a load test on the walls of the borehole. Volume changes for a particular loading step are recorded at 30 seconds and one minute after load application.

Results of Pressuremeter Tests

The tests furnish information relating to the undrained shear strength and deformation characteristics of the material. Results provide a basis to predict bearing capacity and settlement of foundations.

The result of the test is the Pressuremeter curve. The curve shows a volume increase of the probe versus the pressure applied considering readings at the end of each loading step. This curve also represents the deformation of the soil under lateral radial stresses. The initial portion represents the adjustments of the probe to the borehole and to the restoration of the original horizontal pressures. The straight-line portion of the curve that follows is the elastic deformation of the soil and can be measured by the slope of the line, resulting in the Pressuremeter Modulus E_P . This modulus is evaluated for each test and is shown in units of tons per square foot. The Pressuremeter Modulus is similar to the Modulus of Elasticity except it is measured in the horizontal direction. Rheological corrections for isotropy are necessary in most soils to obtain elasticity in the vertical direction.

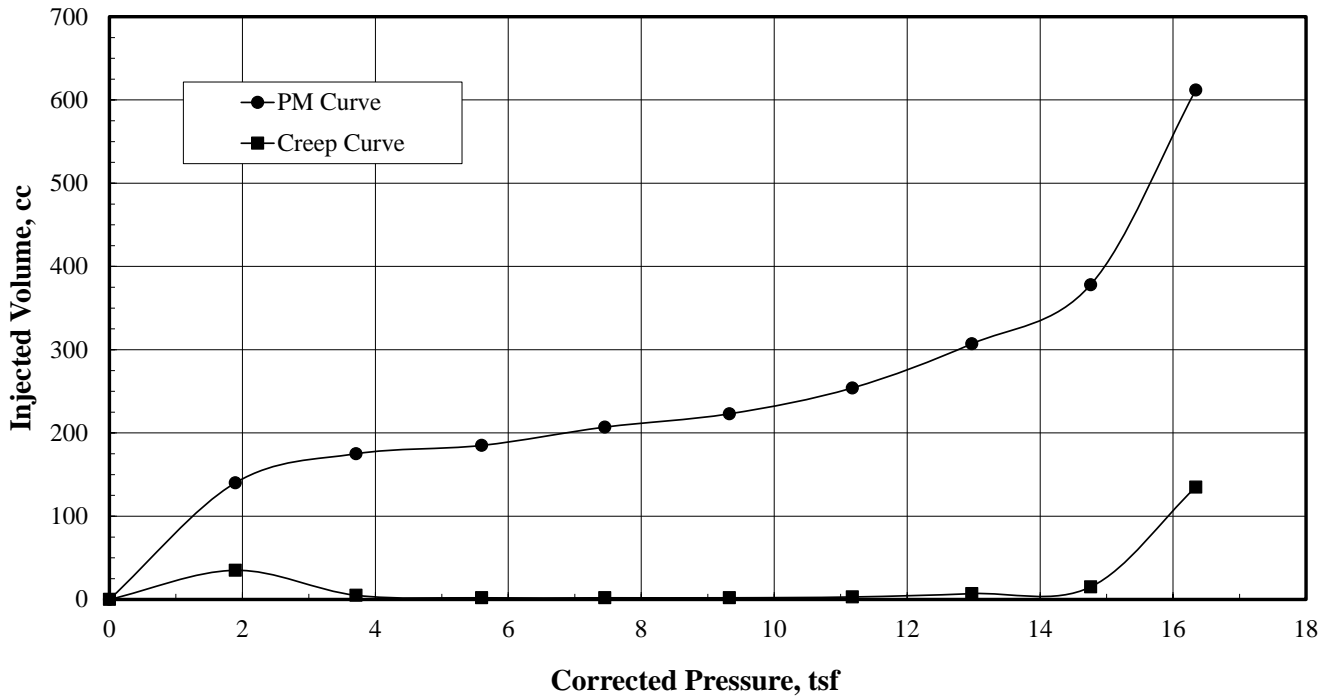
After the straight-line portion, the Pressuremeter curve shows an increased rate of deformation in the range of plastic deformations, and the curve approaches a limit pressure where no further loading is necessary to cause continuous volume change. This pressure is estimated as the vertical asymptote of the Pressuremeter curve and is presented as the Limit Pressure in units of tons per square foot.

Schnabel Engineering

Pressuremeter Test Results

Project Name: Montgomery Coll. Math and Sci. Bldg.	Schnabel Rep.: M.S.
Location: Takoma Park, Maryland	Date: 8/13/2018
Contract No.: 18C41041	

Pressuremeter Test Curves



Pressuremeter Test Data

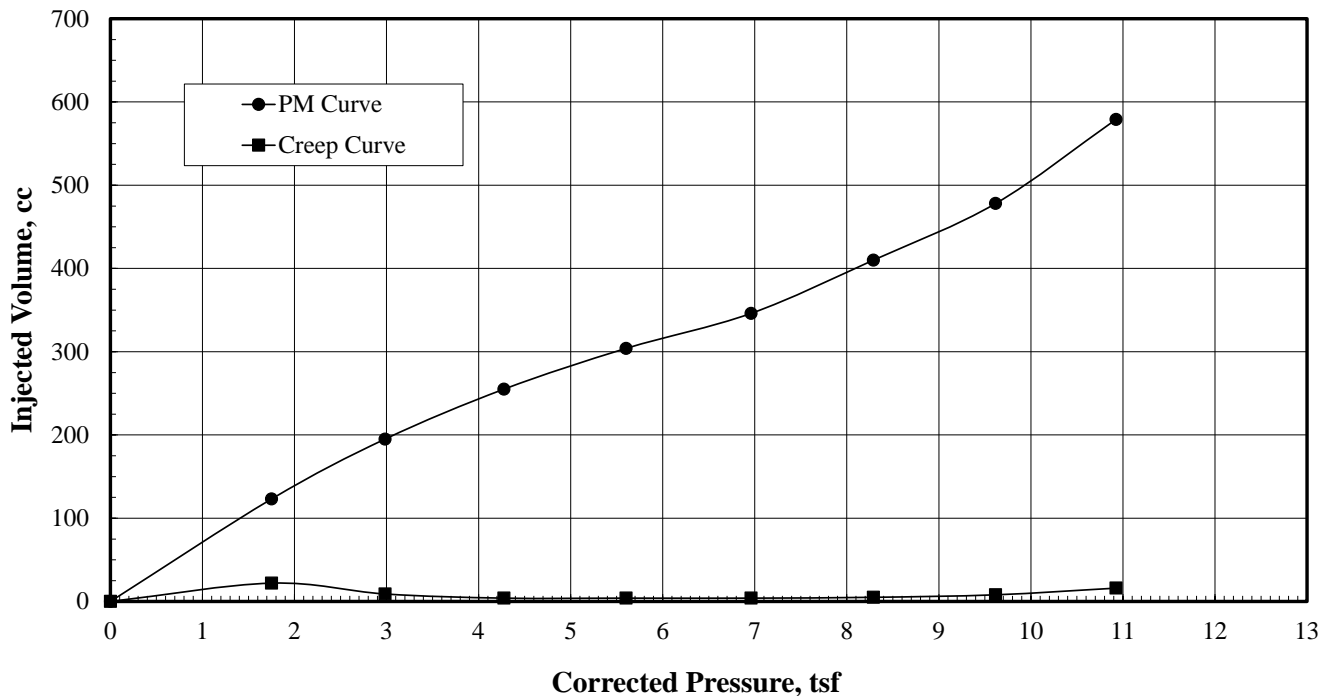
Boring No.: SB-5	Ground Surface Elevation: 315.8 ft
Test No.: 2	Test Elevation: 301.8 ft
Test Depth: 14	Ground Water Elevation: 307.8 ft
Soil Description: Sandy Silt, orangish brown, wet, contains mica and rock fragments (Disintegrated Rock)	
Geology: Residual	Soil Classification: ML
N-Value: 61	
Pressuremeter Modulus: 308 tsf	
Estimated Limit Pressure: 18 (Visual Estimate Only)	

Schnabel Engineering

Pressuremeter Test Results

Project Name: Montgomery Coll. Math and Sci. Bldg.	Schnabel Rep.: M.S.
Location: Takoma Park, Maryland	Date: 8/13/2018
Contract No.: 18C41041	

Pressuremeter Test Curves



Pressuremeter Test Data

Boring No.: SB-7	Ground Surface Elevation: 329.4 ft
Test No.: 3	Test Elevation: 305.4 ft
Test Depth: 24	Ground Water Elevation: 305.9 ft

Soil Description: Sandy Silt, whitish gray, wet, contains mica

Geology: Residual	Soil Classification: ML
N-Value: 25	

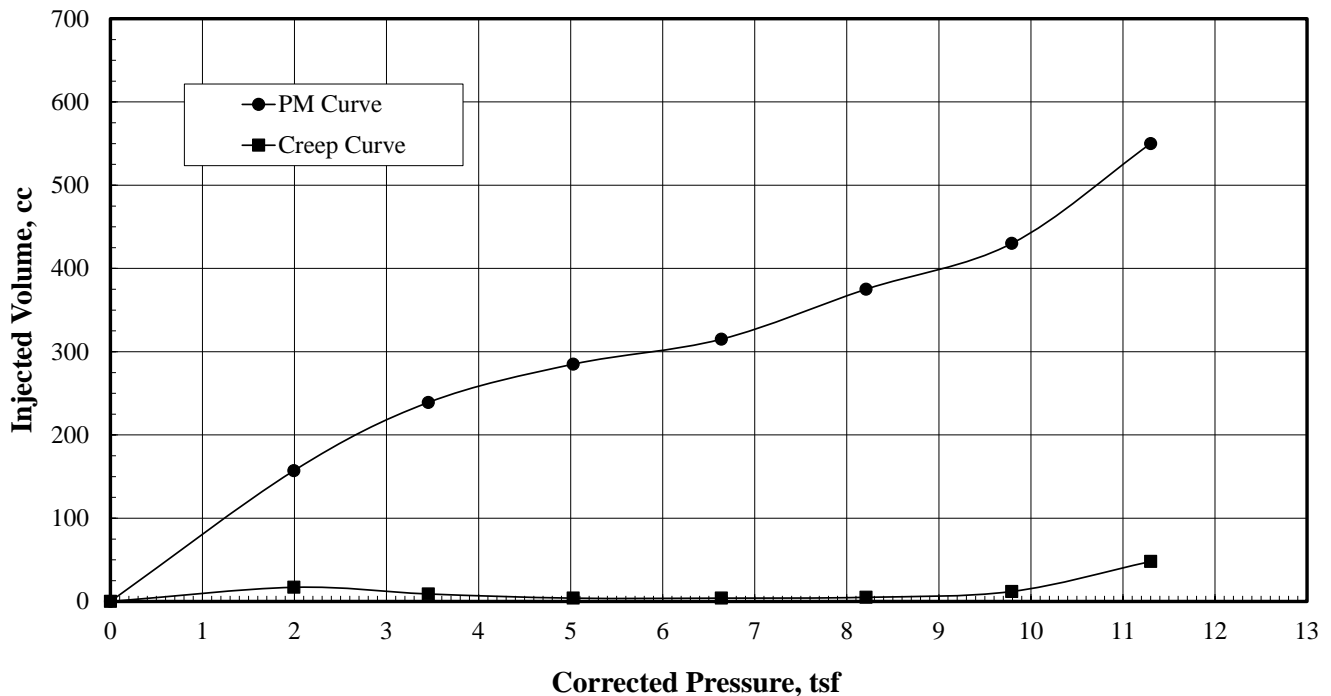
Pressuremeter Modulus: 86 tsf
Estimated Limit Pressure: 12 (Visual Estimate Only)

Schnabel Engineering

Pressuremeter Test Results

Project Name: Montgomery Coll. Math and Sci. Bldg.	Schnabel Rep.: M.S.
Location: Takoma Park, Maryland	Date: 8/13/2018
Contract No.: 18C41041	

Pressuremeter Test Curves



Pressuremeter Test Data

Boring No.: SB-7	Ground Surface Elevation: 329.4 ft
Test No.: 4	Test Elevation: 301.9 ft
Test Depth: 27.5	Ground Water Elevation: 305.9 ft

Soil Description: Sandy Silt, whitish gray, wet, contains mica

Geology: Residual	Soil Classification: ML
N-Value: 31	

Pressuremeter Modulus: 105 tsf
Estimated Limit Pressure: 13 (Visual Estimate Only)

APPENDIX C

SOIL LABORATORY TEST DATA

Summary of Laboratory Tests (1 sheet)

Grain Size Distribution (3 sheets)

Atterberg Limits' Results (1 sheet)

USDA Classification (6 sheets)

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CLIENT The Catherine and Isiah Leggett Building **PROJECT NAME** The Catherine and Isiah Leggett Building

PROJECT NUMBER 18C41041 **PROJECT LOCATION** The Catherine and Isiah Leggett Building

Borehole	Depth(ft)	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	Saturation (%)	%<#200 Sieve	Classification	Water Content (%)	Dry Density (pcf)	Void Ratio
SB-1	6-7.5	39	24	15	4.75		83	CL	19.0		
SB-3	1-2.5								17.7		
SB-3	6-7.5								17.0		
SB-3	13.5-15								23.3		
SB-3	23.5-25	47	23	24	4.75		42	SC	29.3		
SB-8	6-7.5	41	23	18	9.5		51	CL	14.5		
SB-8	23.5-25	49	24	25	4.75		56	CL	22.9		
SB-9	2.5-4								9.6		
SB-9	8.5-10	39	25	14	4.75		27	SC	14.7		
SWM-1	6.0-8.0	36	23	13	37.5		16	SC	7.4		
SWM-2	5.0-7.0	34	21	13	9.5		32	SC	13.3		
SWM-3	6.0-8.0	35	21	14	19		26	SC	10.5		
SWM-4	6.0-8.0	46	24	22	19		42	SC	20.9		
SWM-5	6.0-8.0	40	25	15	2		82	CL	12.0		
SWM-6	5.0-7.0	37	22	15	2		28	SC	11.1		

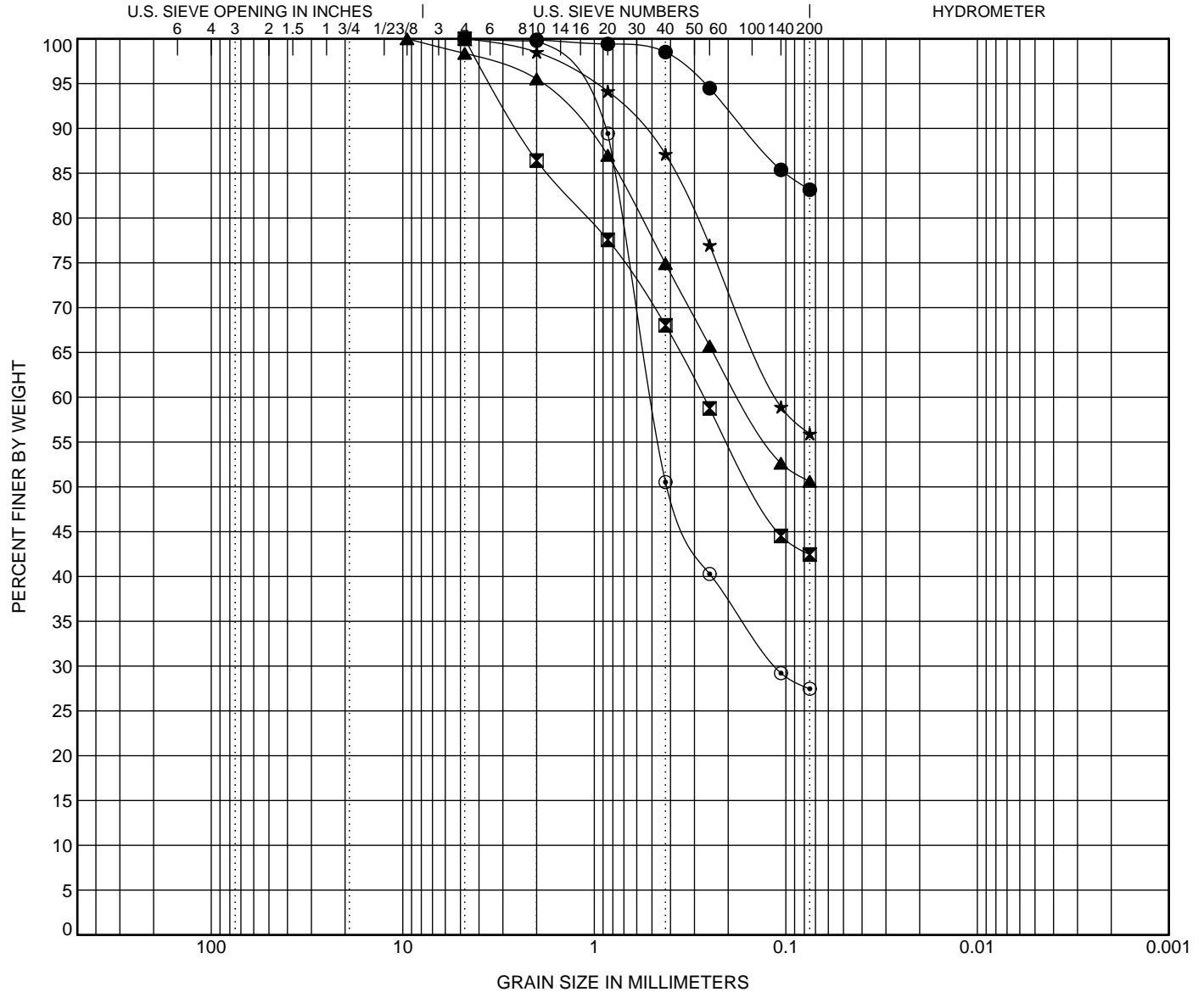
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CLIENT The Catherine and Isiah Leggett Building

PROJECT NAME The Catherine and Isiah Leggett Building

PROJECT NUMBER 18C41041

PROJECT LOCATION The Catherine and Isiah Leggett Building



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SAMPLE No.	DEPTH(ft)	Classification	LL	PL	PI	Cc	Cu
● SB-1	6-7.5	LEAN CLAY with SAND(CL), A-6(13)	39	24	15		
■ SB-3	23.5-25	CLAYEY SAND(SC), A-7-6(6)	47	23	24		
▲ SB-8	6-7.5	SANDY LEAN CLAY(CL), A-7-6(6)	41	23	18		
★ SB-8	23.5-25	SANDY LEAN CLAY(CL), A-7-6(11)	49	24	25		
⊙ SB-9	8.5-10	CLAYEY SAND(SC), A-2-6(0)	39	25	14		

SAMPLE No.	DEPTH(ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SB-1	6-7.5	4.75				0.0	16.8	83.2	
■ SB-3	23.5-25	4.75	0.269			0.0	57.6	42.4	
▲ SB-8	6-7.5	9.5	0.172			1.6	47.8	50.6	
★ SB-8	23.5-25	4.75	0.112			0.0	44.1	55.9	
⊙ SB-9	8.5-10	4.75	0.503	0.113		0.0	72.5	27.5	

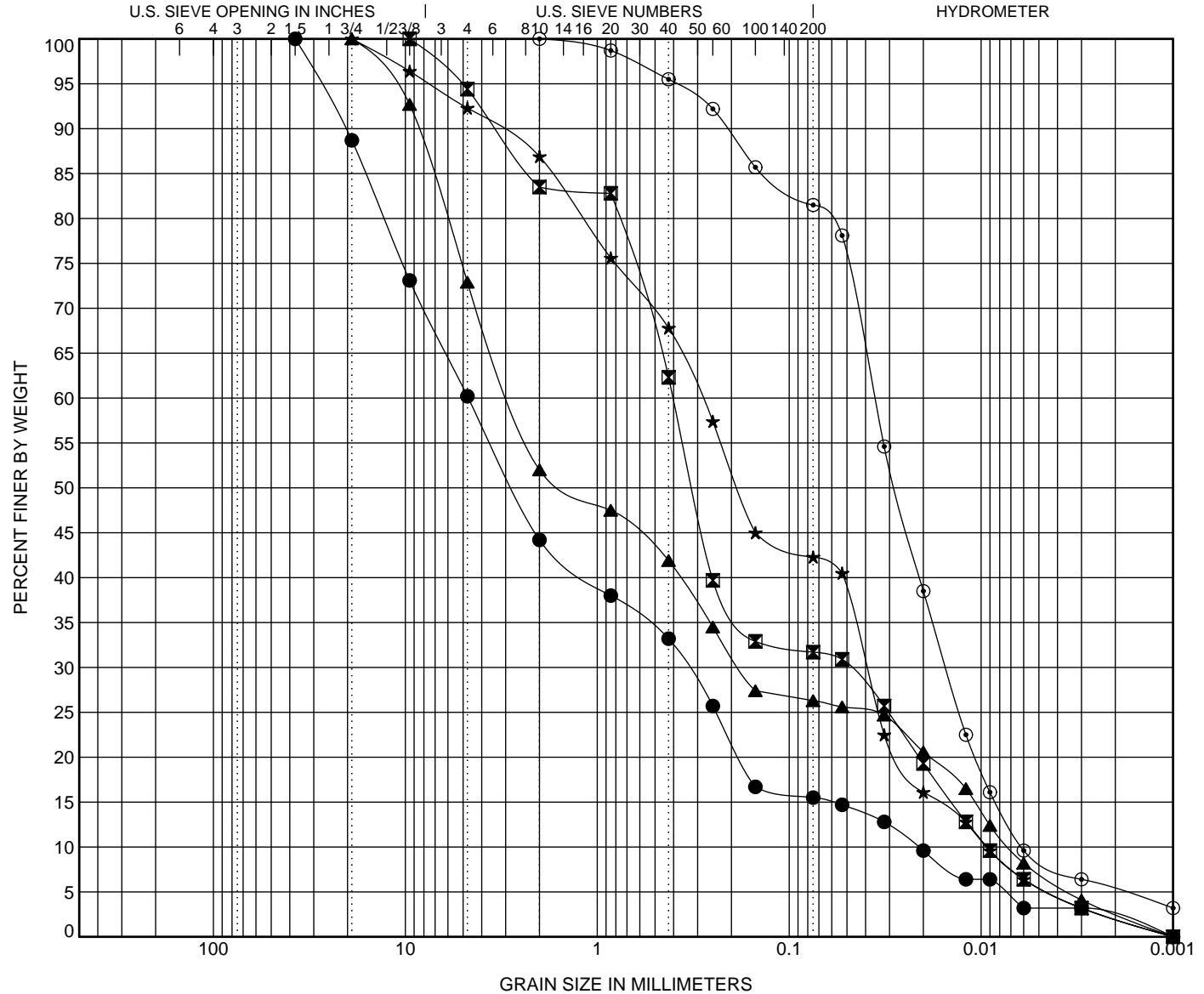
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CLIENT The Catherine and Isiah Leggett Building

PROJECT NAME The Catherine and Isiah Leggett Building

PROJECT NUMBER 18C41041

PROJECT LOCATION The Catherine and Isiah Leggett Building



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SAMPLE No.	DEPTH(ft)	Classification	LL	PL	PI	Cc	Cu
● SWM-1	6.0-8.0	CLAYEY SAND with GRAVEL(SC), A-1-b(0)	36	23	13	1.15	221.54
■ SWM-2	5.0-7.0	CLAYEY SAND(SC), A-2-6(1)	34	21	13	0.63	43.16
▲ SWM-3	6.0-8.0	CLAYEY SAND with GRAVEL(SC), A-2-6(0)	35	21	14	1.65	390.13
★ SWM-4	6.0-8.0	CLAYEY SAND(SC), A-7-6(5)	46	24	22	0.59	30.60
○ SWM-5	6.0-8.0	LEAN CLAY with SAND(CL), A-6(13)	40	25	15	1.05	5.84

SAMPLE No.	DEPTH(ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SWM-1	6.0-8.0	37.5	4.699	0.339	0.021	39.8	44.7	12.3	3.2
■ SWM-2	5.0-7.0	9.5	0.403	0.049	0.009	5.6	62.7	26.1	5.6
▲ SWM-3	6.0-8.0	19	2.785	0.181	0.007	27.1	46.6	19.2	7.1
★ SWM-4	6.0-8.0	19	0.285	0.039	0.009	7.7	50.0	36.7	5.6
○ SWM-5	6.0-8.0	2	0.036	0.015	0.006	0.0	18.5	72.7	8.8

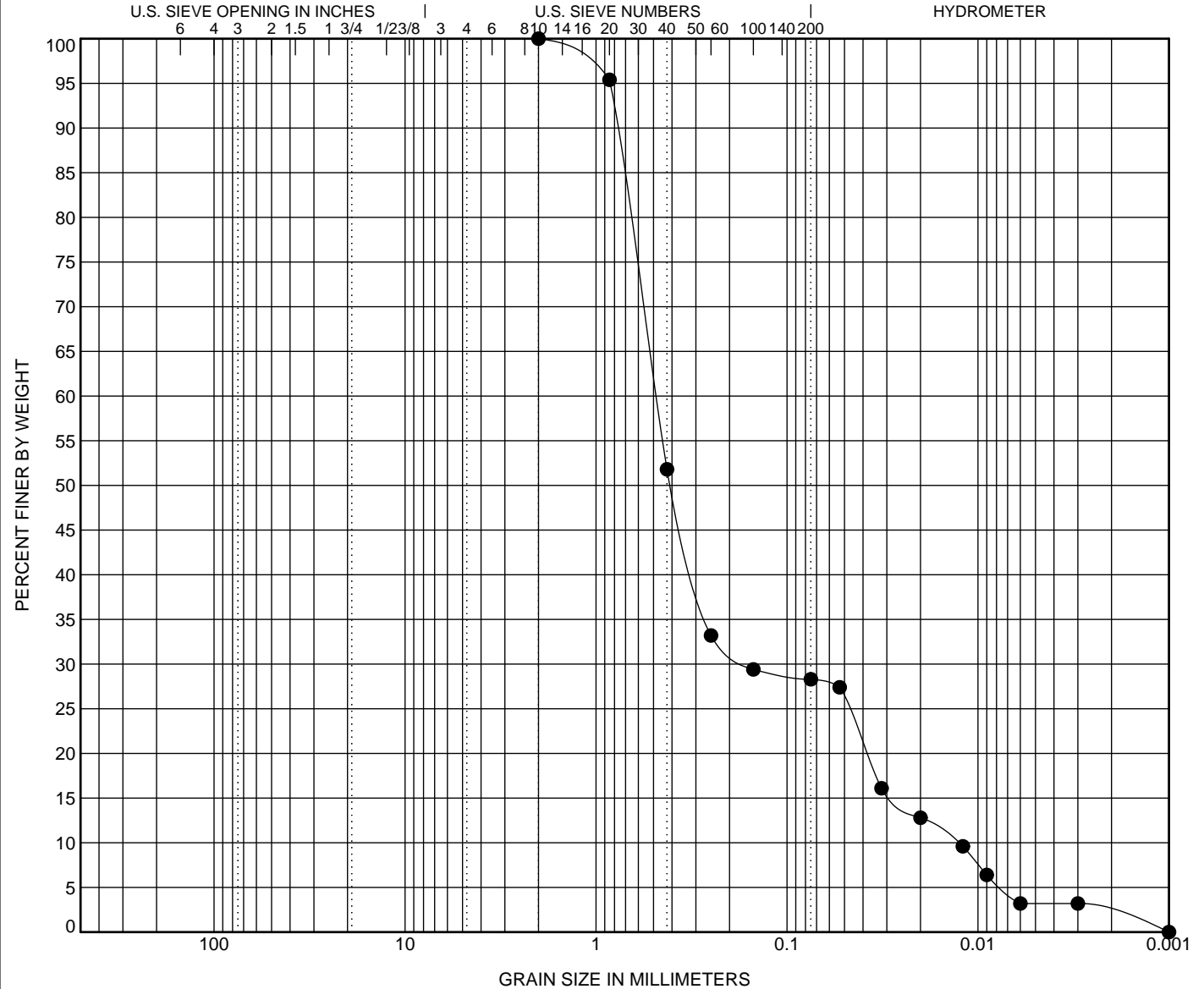
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CLIENT The Catherine and Isiah Leggett Building

PROJECT NAME The Catherine and Isiah Leggett Building

PROJECT NUMBER 18C41041

PROJECT LOCATION The Catherine and Isiah Leggett Building



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SAMPLE No.	DEPTH(ft)	Classification	LL	PL	PI	Cc	Cu
● SWM-6	5.0-7.0	CLAYEY SAND(SC), A-2-6(1)	37	22	15	4.27	37.85

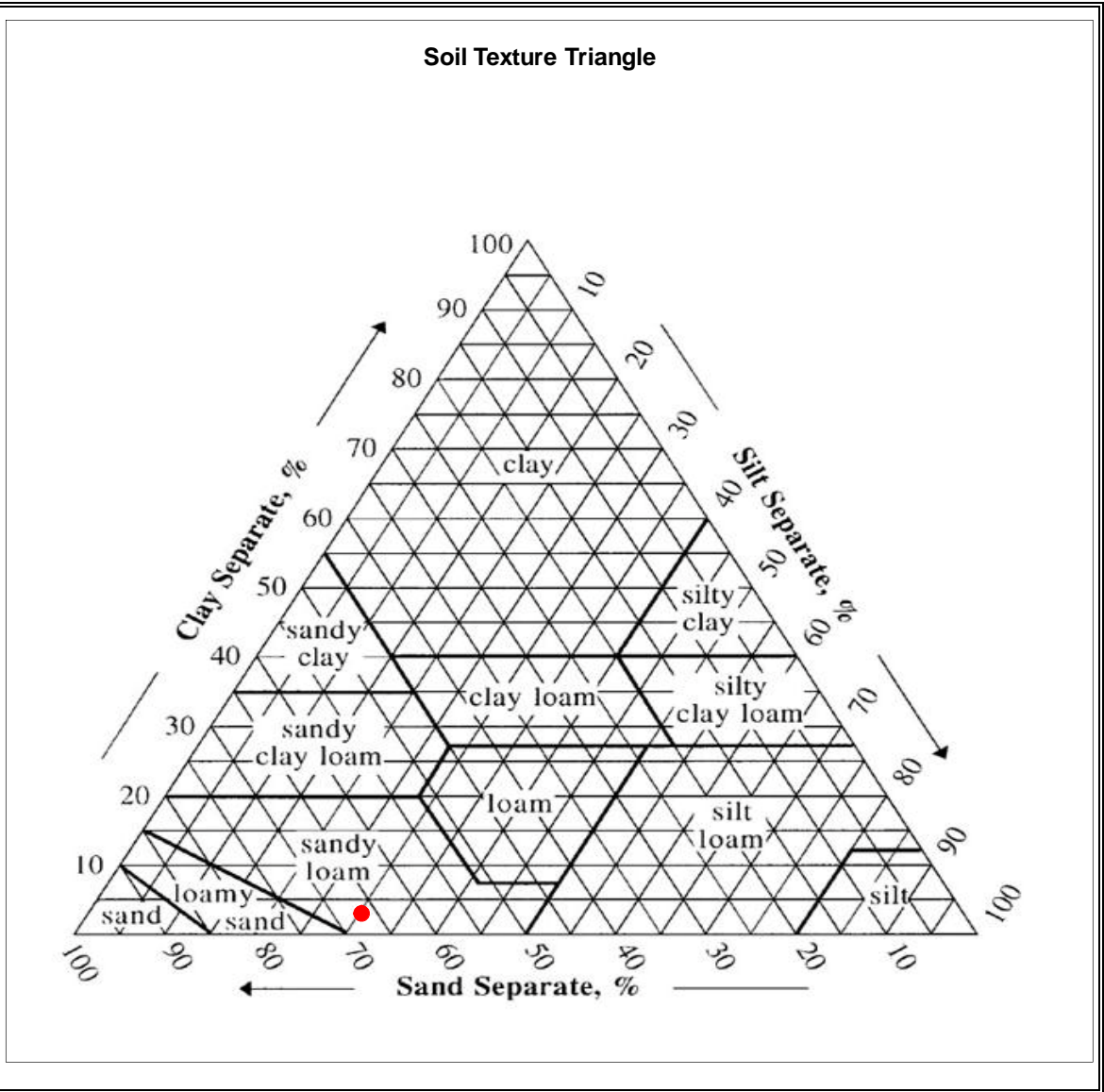
SAMPLE No.	DEPTH(ft)	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● SWM-6	5.0-7.0	2	0.484	0.163	0.013	0.0	71.7	25.1	3.2

GRAIN SIZE - GINT STD. US LAB.GDT - 9/3/18 17:08 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\THE CATHERINE AND ISIAH LEGGETT BUILDING.GPJ

USDA Soil Classification	Sandy Loam
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Minimum Infiltration Rate (iph)	1.02
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Hydrologic Soil Grouping	B
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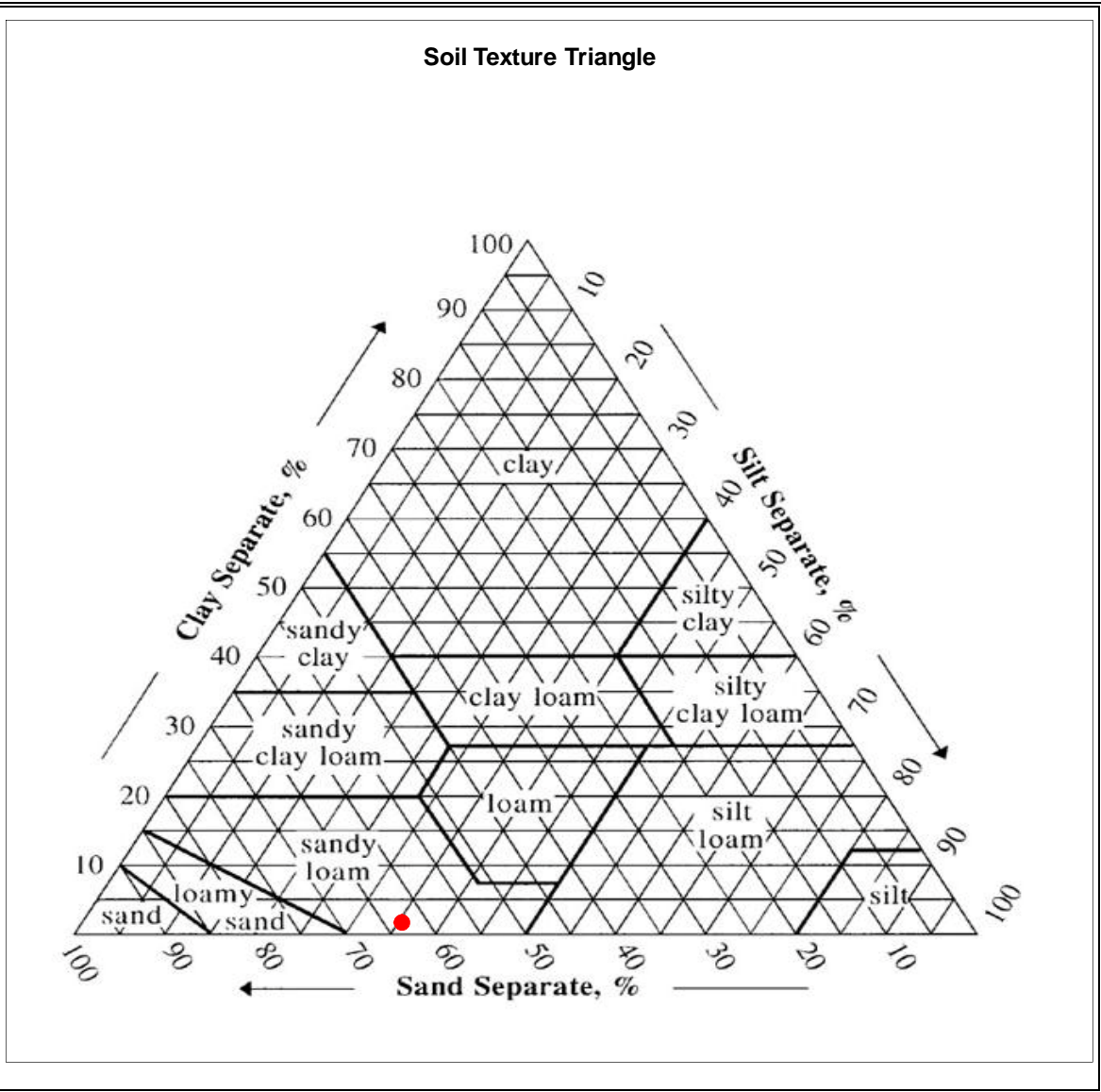
Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-1	6-8	66.7%	30.6%	2.7%	Sandy Loam

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

USDA Soil Classification	Sandy Loam
---------------------------------	------------

Minimum Infiltration Rate (iph)	1.02
--	------

Hydrologic Soil Grouping	B
---------------------------------	---



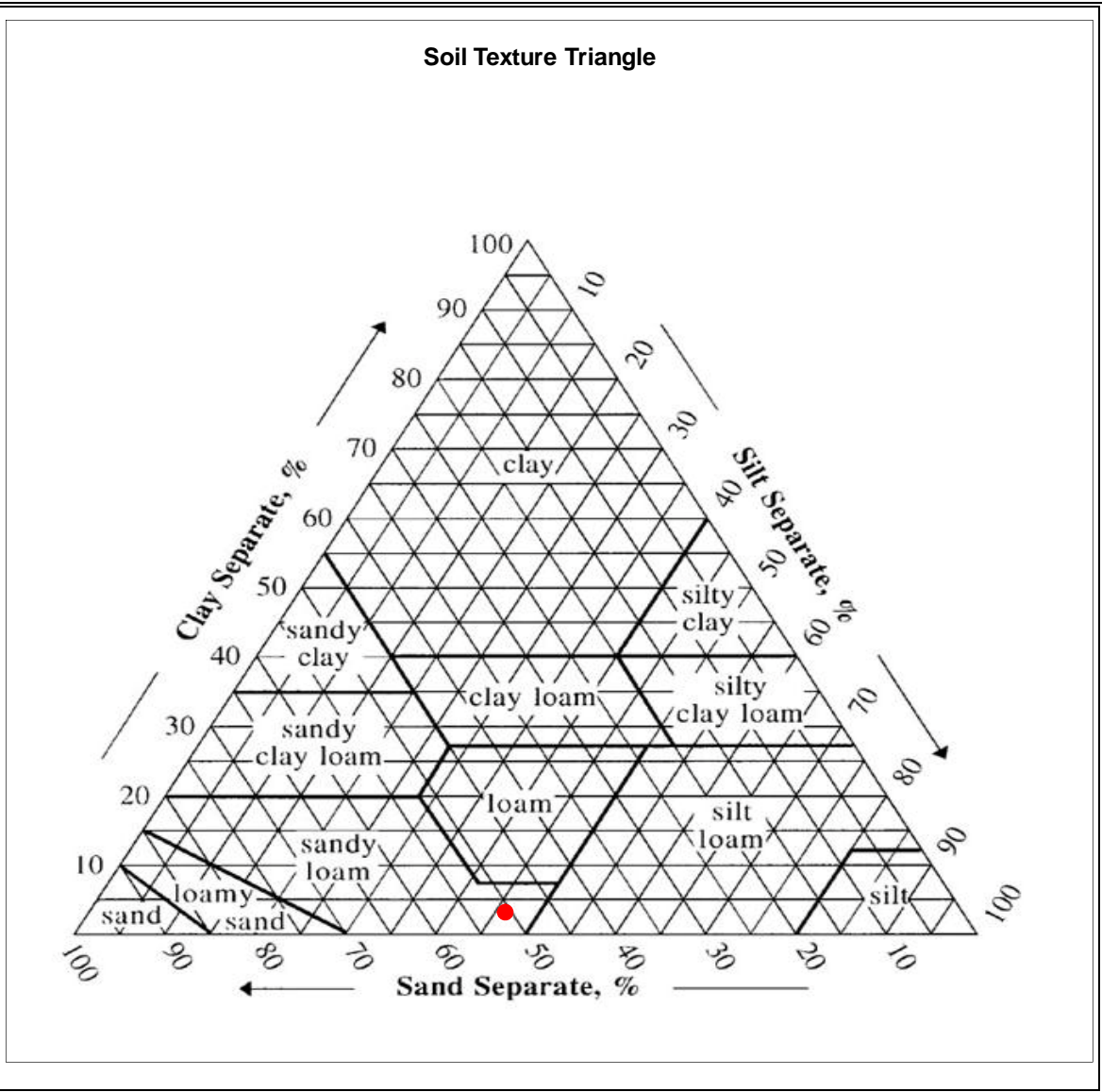
Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-2	5-7	62.9%	35.6%	1.4%	Sandy Loam

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

USDA Soil Classification	Sandy Loam
---------------------------------	------------

Minimum Infiltration Rate (iph)	1.02
--	------

Hydrologic Soil Grouping	B
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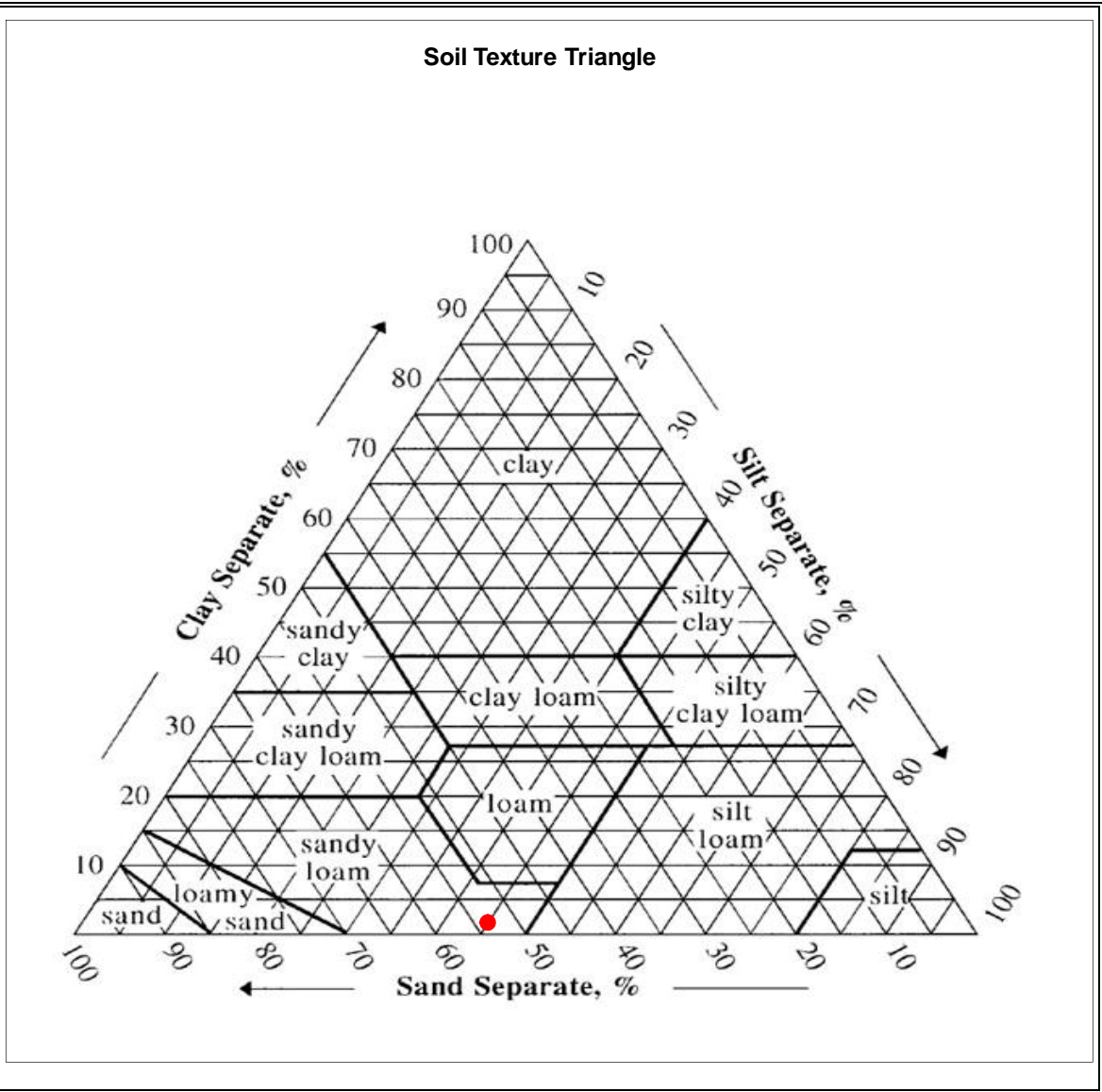
Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-3	6-8	50.7%	46.4%	2.9%	Sandy Loam

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

USDA Soil Classification	Sandy Loam
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Minimum Infiltration Rate (iph)	1.02
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Hydrologic Soil Grouping	B
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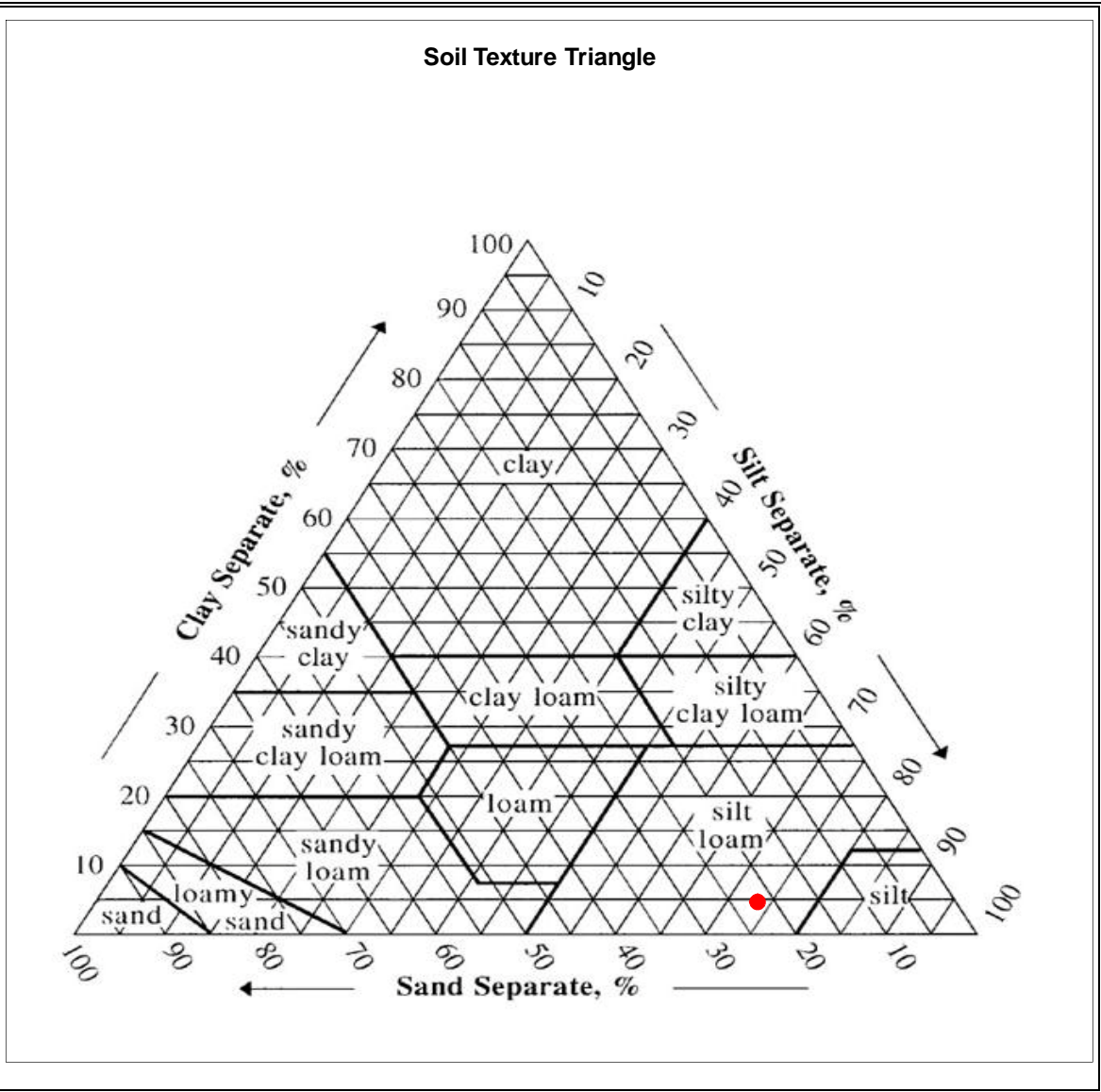
Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-4	6-8	53.4%	45.2%	1.4%	Sandy Loam

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

USDA Soil Classification	Silt Loam
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Minimum Infiltration Rate (iph)	0.27
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Hydrologic Soil Grouping	C
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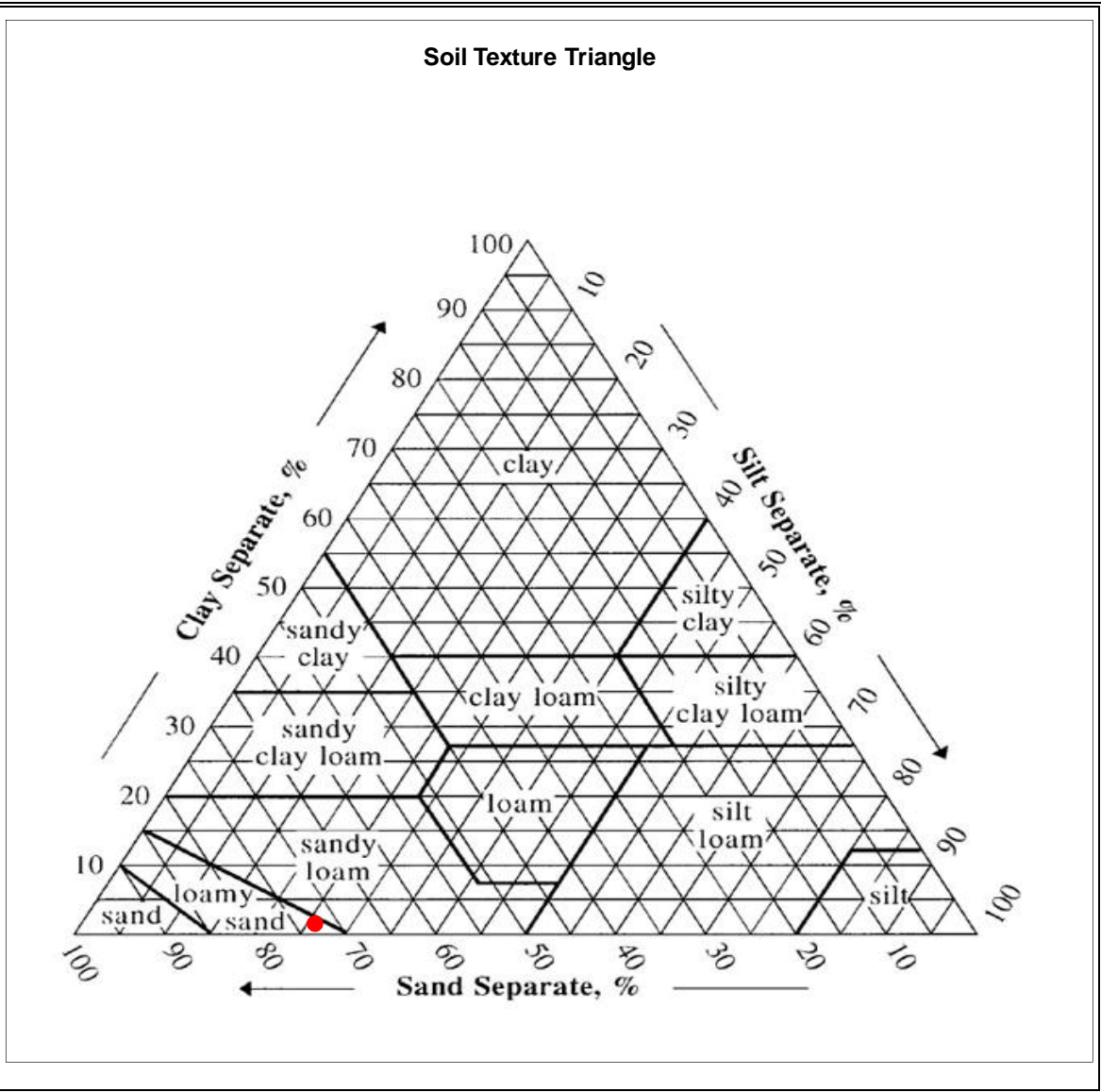
Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-5	6-8	21.9%	73.7%	4.4%	Silt Loam

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

USDA Soil Classification	Loamy Sand
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Minimum Infiltration Rate (iph)	2.41
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Hydrologic Soil Grouping	A
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Boring No.	Depth (ft.)	USDA Soil Percentages (corrected for gravel)			Classification
		Sand	Silt	Clay	
SWM-6	5-7	72.6%	26.2%	1.2%	Loamy Sand

Client:	The Catherine and Isiah Leggett Building
Project Name:	The Catherine and Isiah Leggett Building
Project No.:	18C41041
Location:	The Catherine and Isiah Leggett Building
Date:	9/1/18

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SECTION 011000 - SUMMARY

Review Div. 1 for Owner participation in decisions and approvals, and how roles for different parts of the team are called out in the spec. Since Contractor and CM are the same entity, the terms are sometimes used incorrectly. Some references to the CM look like they should refer to the Owner or Owner's Rep.

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. Project information.
 2. Work covered by Contract Documents.
 3. Access to site.
 4. Work restrictions.
 5. Specification and Drawing conventions.
- B. Related Requirements:
1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 PROJECT INFORMATION

- A. Project Identification: LEGGETT BUILDING.
1. Project Location: Montgomery College, Takoma Park, Silver Spring Campus, 7600 Takoma Avenue, Takoma Park, MD 20912.
- B. Owner: MONTGOMERY COLLEGE.
1. Owner's Representative: Sandra Filippi.
- C. Architect: SMITHGROUP INC.; KEVIN JOHNSON.
- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. Civil: A. Morton Thomas and Associates; Mike Wychulis
 2. Landscape: Mahan Rykiel Associates, Inc.; Steve Kelly
 3. Structural: Cagley & Associates; Daniel Camp
 4. Technology: SpeXsys; Jeff Cohen
 5. Lighting: MCLA; Scott Guenther
 6. Acoustics: Acoustical Design Collaborative Ltd.; Neil Shade
 7. Elevator: Vertran; Graydon Ripley III
 8. Planetarian: Bowen Technovations; Jeff Bowen
 9. Green House: Winandy Greenhouse Company, Inc.; Michael Doherty
 10. Hardware: Erbschloe Consulting Services, Inc.; Frank Erbschloe
 11. Signage: PHGD; Patricia Hord
 12. Cost: Forella Group LLC; R. Israel Aguero
 13. Air Entrainment: RWDI; Analene Belanger
 14. Geotechnical: Schnabel; Bill Khouri
- E. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. Commissioning Agent: <Insert name and contact information for consultant>. <Insert title of design discipline> has prepared the following portions of the Contract Documents:
 - a. To Be Determined
 - b. <Insert description of scope of service for other Owner consultant>.
- F. Construction Manager: Barton Malow Company; David Coleman, Paul Grossman.
1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and Barton Malow Company, according to a separate contract between Owner and Construction Manager.

Lisa Thomas for Construction
Phase

2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.

- G. Web-Based Project Software: Project software administered by Architect will be used for purposes of managing communication and documents during the construction stage.
 1. See Section 013100 "Project Management and Coordination." for requirements for establishing administering and using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:
 1. Work to include new construction and other Work indicated in the Contract Documents.
 2. The work will be phased and submitted in multiple Guaranteed Maximum Price (GMP) packages.
 3. Any clarifications, or exclusions, or any other language that makes assumptions, or changes, or excludes the scope described in the contract documents must be brought to the attention of the owner and design team in writing as formal notice for each item. Formal notice must be given prior to any review or acceptance of clarifications on GMP packages. If formal notice is not received, the contractor is obligated to provide the work excluded at no additional cost to owner.
 4. Any clarifications, or exclusions, or any other language from subcontractors that makes assumptions or changes, or excludes the scope described in the contract documents must be brought to the attention of the owner and design team in writing as formal notice for each item. If formal notice is not received, the contractor is obligated to provide the work excluded at no additional cost to owner.
- B. Type of Contract:
 1. Project will be constructed under a single prime contract.

1.5 ACCESS TO SITE

- A. General: Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 1. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
 2. Driveways, Walkways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

- B. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7 a.m. to 5 p.m., Monday through Friday, unless otherwise indicated.
 - 1. Weekend Hours: Coordinate weekend work hours with Owners representative..
 - 2. Hours for Utility Shutdowns: Coordinate with Owner and Construction manager.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
 - 1. Notify Owner not less than five days in advance of proposed utility interruptions.
 - 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 - 1. Notify Owner not less than fivedays in advance of proposed disruptive operations.
 - 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Nonsmoking Building: Smoking is not permitted.
- F. Restricted Substances: Use of tobacco products and any other controlled substances on Project site is not permitted.
- G. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.
 - 1. Maintain list of approved screened personnel with Owner's representative.

1.7 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
 - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
 - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard.
 - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 012100 - ALLOWANCES

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 governing allowances.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
 - 4. Contingency allowances.
 - 5. Testing and inspecting allowances.
- C. Related Requirements:
 - 1. Section 012200 "Unit Prices" for procedures for using unit prices, including adjustment of quantity allowances when applicable.
 - 2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Allowance is a quantity of work or dollar amount established in lieu of additional requirements, used to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.

1.4 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.5 ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.6 INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.
- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 UNIT-COST ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.9 QUANTITY ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.10 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.

1.11 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.
 - 2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
 - 3. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
 - 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
 - 1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.
 - 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. To Be Determined

END OF SECTION

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SECTION 012200 - UNIT PRICES

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 unit prices.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Unit price is a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: To Be Determined.

END OF SECTION

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SECTION 012300 - 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 by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner 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 alternates 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. Execute accepted alternates under the same conditions as other work of the Contract.
- C. 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. Alternate # 1: PV Panels
 - 1. Base Bid: provide pathway for PV installation, space in the main switchboard for future back feed capable feeder breakers, and the backfeed capable utility connection with PEPCO as shown in documents
 - 2. Add Alternate: Provide 50kW PV array, associated components and inverters, conductors, backfeed capable circuit breakers and metering.
- B. Alternate # 2: Chandeliers in double height Stem Forum
 - 1. Base Bid: provide lighting as shown in lighting drawings
 - 2. Add Alternate: remove (20) P7c fixtures and replace with (25) DP1 fixtures - Moooi: Randon Light Large White Finish
- C. Alternate # 3: Skylights:
 - 1. Base Bid: provide skylights as shown in documents
 - 2. Alternate: provide 2 additional skylights and framing

- D. Alternate #4: Concourse and Lobbies Flooring
1. Base Bid: provide Resilient Tile flooring RT1 and RT2 as shown in drawings.
 2. Add alternate: replace RT1 and RT2 shown in drawings with TER1 and TER2 as indicated in finish legend on A9/1/1.
 3. Deduct alternate: replace RT1 and RT2 shown in drawings with VCT1 and VCT2 as indicated in finish legend on A9/1/1.
- E. Alternate # 5: Chemistry and Biology Labs Flooring
1. Base Bid: provide Sealed Concrete SC1 as indicated in drawings
 2. Alternate: provide Resilient Rubber Sheet RF1 as indicated in finish legend on A9.1.1
- F. Alternate # 6: Elevator Cabs Finish
1. Base Bid: provide cab finishes as specified in elevator specification.
 2. Alternate: provide manufacturer standard cab finishes.
- G. Alternate # 7: Elevators
1. Base Bid: provide custom elevators as specified in elevator specification.
 2. Alternate: provide manufacturer standard elevators by Otis or TK.
- H. Alternate # 8: Stem Forum 030, Concourse 191 and Pre-function 192 Ceiling
1. Base Bid: provide deck mounted acoustical panels AP and gypsum wrapped beams as indicated in drawings.
 2. Alternate: Provide acoustical Baffles AB as indicated in finish legend A9.1.1 instead of AP panels. Do not wrap beams. Paint exposed deck and services white.
- I. Alternate # 8: Acoustical wall panels in Stem forum
1. Base Bid: Provide painted drywall as shown in drawings
 2. Alternate: provide fabric wrapped acoustical panels on 50% of wall in elevations 1/A7.2.1 and 2/A7.2.1.
- J. Alternate # 9: Site retaining wall cladding
1. Base Bid: provide retaining wall as detailed on 5/L201.
 2. Alternate: provide retaining wall as detailed on 2/L201.
- K. Alternate # 10: West elevation punched openings
1. Base Bid: provide punched openings as indicated in documents.
 2. Alternate: At vision units, add operable, continuously hinged, and gasketed aluminum window frame with 1/2" laminated glazing.
- L. Alternate # 11: Underground Piping Extension
1. Base Bid: As shown on plans, 8 lines terminate at vault (see Civil for vault location)
 2. Add Alternate: Provide additional 100 ft of piping and a second vault to push location of future connection to edge of project site
- M. Alternate # 12: Controls Spec
1. Base Bid: Control specifications updated to include 3 manufacturers agreed to by College
 2. Add Alternate: Sole-source controls work through Reliable Controls by Pritchett
- N. Alternate # 13: Double-Walled Ductwork
1. Base Bid: No double-walled ductwork, provide construction and insulation as specified
 2. Add Alternate: Provide double-walled ductwork and flanged joint construction for all insulated ductwork
- O. Alternate # 14: Chilled Water / Hot Water Pumping
1. Base Bid: Provide dedicated primary and secondary pumping systems as shown on plans for CHW and HHW
 2. Deduct Alternate: Remove primary pumping systems (typ of 4) and increase HP on secondary pumps by 10 HP (typ of 4)
 3. Note, in future the secondary pumps would need to be replaced for optimal operating point

END OF SECTION

SECTION 012500 - 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 substitutions.
- B. Related Requirements:
 - 1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Proposed Products List and Substitution Requests:
 - 1. Intent:
 - 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 the list of the products proposed for installation. Include the name of the manufacturer for each product and, where applicable, the name of Subcontractor.
 - 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.
- B. Substitution Requests Accompanying the Proposed Products List:
 - 1. A request for substitution will be considered, subject to the following requirements:
 - a. 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.
 - b. 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. See Section 012510 "Substitution Request Form." Submit in number of copies specified for proposed product list.
 - c. The substitution request is submitted at the time the proposed products list is submitted. A request submitted after the time set for submittal of the proposed products list is subject to automatic rejection.
 - 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.
- C. Substitution Requests After Proposed Products List:
1. 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.
 2. 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 be considered under one of the following conditions:
 - a. 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.
 - b. 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. 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
- D. A request for substitution forwarded by the Contractor means that Contractor:
1. Has investigated the proposed substitution.
 2. Has determined that the substitution is equal to or superior in quality and serviceability (performance) to the product specified in the Contract Documents.
 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.
- E. A request for a substitution will not 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 major revision of the Contract Documents in order to accommodate the substitution.
 3. The substitution request is substantially incomplete.

- F. Architect's Review of Proposed Products List and Substitution Requests:
1. The Architect will review properly submitted proposed products list and accompanying substitution requests.
 2. The Architect 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.
 - b. A substitution will not be considered accepted by the Owner until it has been documented by Change Order.
 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.
- G. Product List and Substitution Request Format:
1. Product List: Provide PDF of the list..
 2. Substitution Requests: Provide PDF of requests.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
1. 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:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. 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.
- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.
1. 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:

- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
- c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
- d. Substitution request is fully documented and properly submitted.
- e. Requested substitution will not adversely affect Contractor's construction schedule.
- f. Requested substitution has received necessary approvals of authorities having jurisdiction.
- g. Requested substitution is compatible with other portions of the Work.
- h. Requested substitution has been coordinated with other portions of the Work.
- i. Requested substitution provides specified warranty.
- j. 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 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012510 - SUBSTITUTION REQUEST FORM

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

This substitution request is governed by the provisions of Section 012500.

- 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
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PROPOSED SUBSTITUTION:

Reason for Substitution:

General Description:

The accompanying attachments, per 012500, 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 012500.

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

Note: Owner's Acceptance of substitution request is not valid until documented through addendum or contract modification.

END OF DOCUMENT

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SECTION 012600 - CONTRACT MODIFICATION 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 handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue through Construction Manager supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect Construction Manager will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect Construction Manager are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Architect.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect Construction Manager.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Architect Construction Manager will issue a Change Order for signatures of Owner and Contractor .

COs are issued by the college

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012900 - 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. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 2. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

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. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
 - 1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the schedule of values to Architect through Construction Manager at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
 - 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 - 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 - 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
 - 1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's Project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 - 2. Arrange schedule of values consistent with format of AIA Document G703 or EJCDC Document C-620.
 - 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.

- e. Name of supplier.
- f. Change Orders (numbers) that affect value.
- g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
4. 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 the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
7. Purchase Contracts: Provide a separate line item in the schedule of values for each purchase contract. Show line-item value of purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
8. Overhead Costs: Include total cost and proportionate share of general overhead and profit for each line item.
9. Overhead Costs: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
10. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
11. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and Construction Manager and paid for by Owner.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Payment Application Times: Submit Application for Payment to Architect by the 15th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- D. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor shall be acceptable to Construction Manager and Owner. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 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.

and Owner
simultaneously

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 Owner-requested project acceleration.
- F. 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 Owner, and consent of surety to payment for 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. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Construction Manager by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. 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. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.

- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, 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 Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, 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 taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum.
 4. Evidence that claims have been settled.
 5. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 6. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012973 - SCHEDULE OF VALUES

CONTINUATION SHEET AIA DOCUMENT G703 (Instructions on reverse side) PAGE OF PAGES

AIA Document G702, APPLICATION AND CERTIFICATE FOR PAYMENT, APPLICATION NO.:
containing Contractor's signed Certification, is attached. APPLICATION DATE:
In tabulations below, amounts are stated to the nearest dollar. PERIOD TO:
Use Column I on Contracts where variable retainage for line items may apply. ARCHITECT'S PROJECT NO.:

A ITEM NO.	B DESCRIPTION OF WORK	C SCHEDULED VALUE	D WORK COMPLETED		E THIS PERIOD	F MATERIALS PRESENTLY STORED (NOT IN D OR E)	G TOTAL COMPLETED AND STORED TO DATE (D + E + F)	H BALANCE TO FINISH (C - G)	I RETAINAGE (IF VARIABLE) RATE)
			FROM PREVIOUS APPLICATION (D + E)	THIS PERIOD					
<div style="border: 2px solid black; padding: 10px; width: fit-content; margin: 0 auto;"> <p>EXAMPLE</p> <p>This is a facsimile of the AIA document and is not intended for use.</p> </div>									

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

END OF SECTION

SECTION 013100 - 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 on Project including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Digital project management procedures.
 - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Construction Manager, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.
- C. 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.
- D. Newforma Info Exchange Server (NIX): The Info Exchange Server is a Web-enabled server that enables internal project team members to easily and securely exchange project files with external project team members (and vice-versa) using a website. It provides email notifications, reminders, and a history log (audit trail) for all posted file transfers.
 - 1. Confirm whether another web enabled server will be requested.

1.4 INFORMATIONAL SUBMITTALS

- A. 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, telephone number, and email address 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.
- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections 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. Coordination: Each contractor shall cooperate with Project coordinator who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections 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 with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. 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.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors and direction of Project coordinator to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
 - b. Coordinate the addition of trade-specific information to coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
 - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.

- e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - f. Indicate required installation sequences.
 - g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 2. Plenum Space: Indicate subframing for support of ceiling, raised access floor, and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 8. Fire-Protection System: Show the following:
 - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
 9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
 2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
 3. BIM File Incorporation: Construction Manager will incorporate Contractor's coordination drawing files into BIM established for Project.
 - a. Construction Manager will perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
 4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

- a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
- b. Digital Data Software Program: Drawings are available in AutoDesk Revit 2019.
- c. Contractor shall execute a data licensing agreement in the form of AIA Document C106 .

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Project number.
 3. Date.
 4. Name of Contractor.
 5. Name of Architect and Construction Manager.
 6. RFI number, numbered sequentially.
 7. RFI subject.
 8. Specification Section number and title and related paragraphs, as appropriate.
 9. Drawing number and detail references, as appropriate.
 10. Field dimensions and conditions, as appropriate.
 11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 12. Contractor's signature.
 13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in PDF format.
- D. Architect's and Construction Manager's Action: Architect and Construction Manager will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect or Construction Manager after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Architect's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect or Construction Manager of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect and Construction Manager in writing within 10 days of receipt of the RFI response.

Is Construction Manager the correct term here? who does it refer to ? Owner's rep?

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 - 1. Project name.
 - 2. Name and address of Contractor.
 - 3. Name and address of Architect and Construction Manager.
 - 4. RFI number including RFIs that were returned without action or withdrawn.
 - 5. RFI description.
 - 6. Date the RFI was submitted.
 - 7. Date Architect's and Construction Manager's response was received.
 - 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 - 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's and Construction Manager's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect and Construction Manager within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

I think this is incorrect and should be BIM 360

- A. Architect's Digital Data Files: See Section 013300 "Submittal Procedures."
- B. Web-Based Project Software: Use web-based file server for purposes of managing RFI's, Submittals and File Transfers until Final Completion.
- C. Web-Based Project Software: Use Architect's web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
 - 1. Web-based Project software site includes, at a minimum, the following features:
 - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
 - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
 - c. Document workflow planning, allowing customization of workflow between project entities.
 - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
 - e. Track status of each Project communication in real time, and log time and date when responses are provided.
 - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
 - g. Processing and tracking of payment applications.
 - h. Processing and tracking of contract modifications.
 - i. Creating and distributing meeting minutes.
 - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
 - k. Management of construction progress photographs.
 - l. Mobile device compatibility, including smartphones and tablets.
 - 2. Provide Project software user licenses for use of Owner, Construction Manager, Architect, and Architect's consultants. Provide eight hours of software training at Architect's office for web-based Project software users.
 - 3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
- D. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:
 - 1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
 - 2. Name file with submittal number or other unique identifier, including revision identifier.

3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

- A. General: Schedule and conduct Construction Manager will schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Construction Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: ~~Architect will schedule and conduct~~ Construction Manager will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
 1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors, suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Sustainable design requirements.
 - o. Preparation of Record Documents.
 - p. Use of the premises and existing building.
 - q. Work restrictions.
 - r. Working hours.
 - s. Owner's occupancy requirements.
 - t. Responsibility for temporary facilities and controls.
 - u. Procedures for moisture and mold control.
 - v. Procedures for disruptions and shutdowns.
 - w. Construction waste management and recycling.
 - x. Parking availability.
 - y. Office, work, and storage areas.
 - z. Equipment deliveries and priorities.
 - aa. First aid.
 - bb. Security.
 - cc. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Project Closeout Conference: Construction Manager will schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
 1. Conduct the conference to review requirements and responsibilities related to Project closeout.

CM and Contractor are the same entity. Sometimes the term CM is used where it appears the Owner is intended

2. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for completing sustainable design documentation.
 - f. Requirements for preparing operations and maintenance data.
 - g. Requirements for delivery of material samples, attic stock, and spare parts.
 - h. Requirements for demonstration and training.
 - i. Preparation of Contractor's punch list.
 - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - k. Submittal procedures.
 - l. Coordination of separate contracts.
 - m. Owner's partial occupancy requirements.
 - n. Installation of Owner's furniture, fixtures, and equipment.
 - o. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: Construction Manager will conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner, Construction Manager, 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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Status of sustainable design documentation.
 - 6) Deliveries.
 - 7) Off-site fabrication.
 - 8) Access.
 - 9) Site use.
 - 10) Temporary facilities and controls.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Status of correction of deficient items.
 - 14) Field observations.
 - 15) Status of RFIs.
 - 16) Status of Proposal Requests.

- 17) Pending changes.
 - 18) Status of Change Orders.
 - 19) Pending claims and disputes.
 - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Coordination Meetings: Construction Manager will 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 Owner, Construction Manager, 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 schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.
 - 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Work hours.
 - 11) Hazards and risks.
 - 12) Progress cleaning.
 - 13) Quality and work standards.
 - 14) Status of RFIs.
 - 15) Proposal Requests.
 - 16) Change Orders.
 - 17) Pending changes.
 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

SECTION 013110 - REQUEST FOR INFORMATION

(This form is to be transmitted from GC or CM to SmithGroup) RFI NO.: _____
DATE TRANSMITTED: _____; Bid Pack: _____; Trade Contract: _____
Response requested from: Civil; Struct; Arch; Mech; Elec; Other _____

Brief description of RFI: (give details below): _____

PROVIDE	Section No.	Section No.	Section No.	Section No.	example:	Section No.
SPECIFIC	_____	_____	_____	_____		019999
REFERENCES:	Reference No.	Reference No.	Reference No.	Reference No.		Reference No.
	→ _____	_____	_____	_____		2.2.A.1

PROVIDE DRAWING REFERENCES: _____

Contractor requests information for the following from SmithGroup:

(Note: Request information for only 1 item per RFI. This permits individual handling and expedites response.)

This box, if checked, indicates a potential change to the Contract Sum associated with this RFI.
The change is in the range of \$ _____ to \$ _____.

This box, if checked, indicates a potential change to the Contract Time associated with this RFI.
The change is in the range of _____ days to _____ days

Requested By: (name): _____
(After saving file, email or fax to SmithGroup Project Architect or Project Administrator.)

SmithGroup response: Date Received: _____

SG DOES NOT expect a change to the Contract Sum Contract Time related to this RFI.
 SG expect a change to the Contract Sum Contract Time related to this RFI.

Response By: _____ Date: _____

Date Transmitted: _____ (Indicate the recipients and the means of transmittal below)

Distributed to: Name, Email Address or Fax Number	<u>Email</u>	<u>Fax</u>	<u>Hand</u>	<u>Mail</u>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

SmithGroup: Master Office Files

NOTE: This form is formatted for completion on screen using MS Word. Only form revisions by SmithGroup are valid.

END OF DOCUMENT

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SECTION 013200 - 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. Unusual event reports.

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 completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 1. Float time is not for the exclusive use or benefit of either Owner 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.

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 file.
- B. Startup construction schedule.
 1. Submittal of cost-loaded, startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.

- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost 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 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 each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at monthly intervals.
- H. Material Location Reports: Submit at monthly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "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 phasing, work stages, area separations, interim milestones, and partial Owner occupancy.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner'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 Owner startup procedures.
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.6 COORDINATION

- A. 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.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- C. Time Frame: Extend schedule from date established for the Notice of Award to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each floor or 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 Architect.
 - 2. Procurement Activities: Include procurement process activities for the following 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 Section 013300 "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. Commissioning Time: Include no fewer than 15 days for commissioning.
 - 6. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 - 7. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- E. 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. Phasing: Arrange list of activities on schedule by phase.
 - 2. Work under More Than One Contract: Include a separate activity for each contract.
 - 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 - 4. 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.
 - 5. 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.

- n. Commissioning.
- 6. 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.
- F. 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.
 - 1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- G. 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 the Contract Time.
- H. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- I. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- J. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 STARTUP CONSTRUCTION SCHEDULE

- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within seven days of date established for the Notice to Proceed.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

1.9 GANTT-CHART SCHEDULE REQUIREMENTS

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for the Notice to Proceed.
 - 1. Base schedule on the startup construction schedule and additional information received since the start of Project.

- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

1.10 CPM SCHEDULE REQUIREMENTS

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost loaded, time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and final completion.
 - l. Activities occurring following final completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
 - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
 - 5. Cost-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
 - a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.

- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
 - 1. Contractor or subcontractor and the Work or activity.
 - 2. Description of activity.
 - 3. Main events of activity.
 - 4. Immediate preceding and succeeding activities.
 - 5. Early and late start dates.
 - 6. Early and late finish dates.
 - 7. Activity duration in workdays.
 - 8. Total float or slack time.
 - 9. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
 - 1. Identification of activities that have changed.
 - 2. Changes in early and late start dates.
 - 3. Changes in early and late finish dates.
 - 4. Changes in activity durations in workdays.
 - 5. Changes in the critical path.
 - 6. Changes in total float or slack time.
 - 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
 - 1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 - 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 - 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 - 4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
 - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
 - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

1.11 REPORTS

- A. 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. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Testing and inspection.
 - 8. Accidents.
 - 9. Meetings and significant decisions.
 - 10. Unusual events.
 - 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. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.

19. Substantial Completions authorized.
- B. Material Location Reports: At monthly 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.
- D. Unusual Event Reports: 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, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.
1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013233 - PHOTOGRAPHIC 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 the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
 - 4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
 - 1. Submit photos by uploading to web-based project software site. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description in web-based project software site:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

- A. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with record of providing satisfactory services similar to those required for Project.

1.5 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.
- B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- C. Metadata: Record accurate date and time and GPS location data from camera.

- D. File Names: Name media files with date and Project area and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of demolition, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Construction Manager.
1. Flag construction limits before taking construction photographs.
 2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
 3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Periodic Construction Photographs: Take 20 photographs weekly . Select vantage points to show status of construction and progress since last photographs were taken.
- E. Final Completion Construction Photographs: Take 20 photographs after date of Substantial Completion for submission as Project Record Documents. Construction Manager will inform photographer of desired vantage points.
- F. Additional Photographs: Architect or Construction Manager may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013300 - 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. Submittal schedule requirements.
 - 2. Administrative and procedural requirements for submittals.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontractor list and for requirements for web-based Project software.
 - 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
 - 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and final completion construction photographs.
 - 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
 - 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
 - 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
 - 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
 - 9. Section 018113.15 "Sustainable Design Requirements - LEED V4 BD+C" for submittals for sustainability design requirements.

1.3 DEFINITIONS

- A. Contractor: Refers to an entity in direct Contract with the Owner to furnish and/or perform any portion of the Work of the Contract, including but not limited to a Construction Manager. Contractor shall review and approve product submittals.
 - 1. Contractor shall review and approve Product Submittals prior to forwarding them to the Architect.
- 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 and Construction Manager'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 and Construction Manager'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. 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.
- F. Newforma Info Exchange Server (NIX): The Info Exchange Server is a Web-enabled server that enables internal project team members to easily and securely exchange project files with external project team members (and vice-versa) using a website. It provides email notifications, reminders, and a history log (audit trail) for all posted file transfers.
 - 1. Information Exchange server to be confirmed.
- G. Submittal Review Stamp: The review stamp used by the Contractor as evidence that submittal has been reviewed for compliance with Contract Documents.
- H. Submittal Review Sheet: The document provided by the Architect to the Contractor for inclusion with all submittals.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit, as an action submittal, at least on a monthly basis indicating the submittals to be included in the following month, a schedule of submittals with calendar dates, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and Construction Manager and additional time for handling and reviewing submittals required by those corrections. Note that submittal schedule is a separate document required in addition to the construction schedule.
 - 1. 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.
 - 2. Coordinate submittal schedule with list of subcontractors, the schedule of values, and Contractor's construction schedule.
 - a. Submittal shall be combined as required for each submittal and not subject to any delay cost on the should these requirements not be met.
 - 3. 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.
 - a. Additional time shall be included by the Architectural submittal review to allow for additional time for large and major system reviews.
 - b. All submittal shall be reviewed as received.
 - 4. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 - 5. 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.

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)

Inl	Installation Instructions
AT	Acceptance Test
Opl	Operating Instructions
Mal	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

6. "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.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Requirements specified for submittals are intended to provide efficient handling, while permitting review responsibilities to be carried out.
- B. Architect will accept submittals only from the Contractor. Only items specified to be submitted will be accepted.
- C. Bind submittals in a manner suitable for 8-1/2 by 11-inch file folder storage, except where doing so is not workable.
- D. Transmit submittals with all transportation charges prepaid.
- E. Avoidable Resubmittals: The first two reviews of each specified submittal will be processed without cost to the Contractor. After the second review, the Owner shall charge the Contractor for the cost of such additional processing, (minimum two thousand (\$2000) dollars) unless the processing results from approved Change Orders causing revisions to previously approved submittals. Automatic rejection will be applied if cost of second resubmittal is not paid in full in a specified time period.
- F. MSDS: Do not submit Material Safety Data Sheets. If MSDS are required by the Contract Documents, request clarification of instructions from the Architect.
- G. Architect's Digital Data Files:
1. With the Owner's concurrence, Architect's BIM model/CAD drawing digital data files used to create the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals, subject to the Architect's electronic file transfer agreement. The Contractor shall expect, and shall so agree, to execute and deliver the Architect's agreement before the transfer of such Instruments of Service.
 2. Request the Architect's electronic file transfer agreement form. Submit the request for file transfer directly to the Architect. Include the executed agreement and a list of documents requested, as identified in the Contract Documents.
 3. 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.
- H. 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.

- I. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's Construction Manager'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: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent 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 business days for review of each resubmittal.
 - 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.
- J. Maintain at the Project Site ready access to the latest reviewed Shop Drawings and Product Data, and one set of samples.

1.6 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections. Before preparing the initial submittal of each type, request the Architect's direction regarding the Contractor's Transmittal format. All submittals, except for samples, shall be submitted as PDF electronic files unless indicated otherwise.
 - 1. Post electronic submittals as PDF electronic files directly to web-based file server specifically established for Project.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 2. Submit electronic submittals via email as PDF electronic files.
 - a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 - 3. Action Submittals: Submit electronic PDF files of each submittal unless otherwise indicated. Architect, through Construction Manager, will return electronic PDF copies.
 - 4. Informational Submittals: Submit electronic PDF files of each submittal unless otherwise indicated. Architect and Construction Manager will return a received receipt without further review.
 - 5. 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.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

1.7 PREPARING 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 each submittal item matching the itemized descriptions on the Contractor's Submittal Transmittal.
 - 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. Product Data: Collect information into a single submittal per specification section for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

2. Mark each copy of each submittal to show which products and options are applicable.
 - a. Mark where selections are to be made.
 - b. Tailor large catalogs so that excessive unrelated products are not included.
 3. To highlight and mark-up Product Data information, use bold markings that will be easily seen on electronic file format. Do not use a highlighter, pencil, or color.
 4. Clearly convey the differences between similar products included in the submittal.
 - a. Highlight information that differs for different sizes or grades.
 5. Correlate Product Data with Contract Documents:
 - a. Where the Contract Documents include designations such as types or marks, mark Product Data with these itemized designations and include them on the Submittal Transmittal. For example: glass types; fixture item numbers.
 - b. Clearly highlight information on Product Data that shows compliance with specified requirements. For example: manufacturer only (not supplier, distributor, etc.); model number; rating; performance characteristics.
 6. If multiple manufacturers or products are being submitted for similar items, include manufacturer or product name in separate line item descriptions on the Contractor's Submittal Transmittal. Do not use distributor or other supplier names other than manufacturer.
 7. 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.
 8. Submit Product Data before or concurrent with Samples.
- C. Shop Drawings: As part of the Agreement prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, shop drawings based on this criteria shall be rejected.
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 PDFs formatted such that when printed will fit on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Each sheet of the same item or system shall be uniform in size and numbered consecutively.
 4. Each sheet shall contain the title block specified below plus an unobstructed space at the right side or bottom, of size not less than 6 by 8 inches for submittal review stamps and notations.
 5. Dimensions on Shop Drawings shall be the same system of measure (i.e., metric or inch-pound) as on the Contract Drawings.
 6. BIM Incorporation: Develop and incorporate Construction Manager will incorporate Contractor's Shop Drawings into BIM established for Project.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Submit submittal transmittal electronically as directed above. Electronic copy shall contain digital images of samples with identifying labels clearly visible.
 2. Submit samples with identifying labels firmly attached.
 - a. Labels shall be of a size to contain the Title Block plus unobstructed space for Submittal Review Stamp(s) and notations.
 - b. Each sample shall display, as a minimum, the Architect's project number, and the submittal and item numbers. Where Sample size does not permit the full title block without obstructing information, provide a separate sheet of paper, 8-1/2 by 11-inch, securely attached to each sample (or sample set), with the information above included.

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.
 5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect, through Construction Manager, will return submittal with options selected.
 7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Unless indicated otherwise in individual specification sections, provide three sets of Samples. One to the Architect who will retain it for their records; one to the Owner and one shall be retained at the jobsite.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- F. 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 owners, and other information specified.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit 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. Provide a notarized signature where indicated.
 2. 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 AWS forms. Include names of firms and personnel certified.
 3. 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.

4. 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.
 5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
 6. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- H. Test and Research Reports:
1. 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.
 2. Product Test Reports: Submit written reports indicating that 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.
 3. 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:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.
 4. 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.
 5. 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.
 6. Field Test Reports: Submit written 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.
- I. 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.
- J. Subcontractor 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.

1.8 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark up with review comments before submitting to Architect and Construction Manager.
- B. The Contractor shall be 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.
- C. The Contractor shall be responsible for the submittal to be in conformance with information given and the design concept expressed in the Contract Documents.

- D. The Contractor with each submission shall provide specific written notice of any variation from the requirements of the Contract Documents by causing a specific notation to be made on the Submittal attachments or the Submittal-Transmittal.
- E. The Contractor shall affix its own Submittal Review Stamp to all submittals. Architect will not review submittals that do not include a completed Contractor's Submittal Review stamp.

1.9 ARCHITECT'S, CONSTRUCTION MANAGER'S AND GENERAL CONTRACTOR'S ACTION

- A. General: Architect will not review submittals that do not include the Submittal Review Sheet.
- B. Action Submittals: Architect's staff and consultants will review the submittal, and mark the Submittal Review Sheet with an action code. The code meanings are described below.
- C. Additional codes may be provided within comments or as an electronic submittal review stamp and shall be used in help indicating return of partial submittals.
- D. The Final Review Code on the Submittal Review Sheet prevails and governs the action of the overall submittal.
- E. Review Code meanings are as follows:
 - 1. Action Codes Permitting Use:
 - a. 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.
 - b. Code AP - Approved: The Work covered by the submittal item may proceed, provided it complies with Contract Document requirements.
 - c. 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.
 - d. 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.
 - 2. Action Code Prohibiting Use:
 - a. 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.
 - 3. Action Code for Items Not Required:
 - a. 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.
- F. Informational Submittals: For Architect's information only. Architect and Construction Manager will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect and Construction Manager will forward each submittal to appropriate party.
 - 1. Action Code for Information Only:
 - a. Action Code INF - Information Only - Received: The submittal item is not called for a return with a reviewed action code by the Contract Documents and is being returned un-reviewed by the Architect except to the extent necessary to determine its status.
- G. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect and Construction Manager.
- H. Incomplete submittals are not acceptable, will be considered non-responsive, and will be returned without review.
- I. Architect and Construction Manager will return without review or discard submittals received from sources other than the Contractor.
- J. Submittals not required by the Contract Documents may be returned by the Architect without action.

1.10 SUBMITTAL TRANSMITTAL REQUIREMENTS

- A. General: The Contractor's Submittal Transmittal shall be a PDF file in electronic format. It is recommended, to expedite the submittal review, the electronic form be emailed for review to the Architect as early as possible.
1. Submittal Numbering: See below.
 2. Contact Information: Full Name, Phone Number and Email Address.
- B. 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 Form (including continuation sheet), it is a complete submittal.
 3. Partial Submittals: If it is necessary to divide the required items of a given Specifications section into two or more submittals to meet schedule or handling requirements, the separate submittals are partial submittals. All partial submittals have the same submittal number, and are differentiated by sequential P-numbers (see below).
 4. All items in each submittal, whether complete or partial, will be processed together: Individual items will not be 'broken out' for special handling. Arrange submittals accordingly.
- C. Submittal Numbering
1. Number submittals as described below to assist tracking.
 2. Number each submittal in the format nnnnnn-nn.
 - a. The 6-digit number is the number of the section that requires the submittal. For example, 044200.
 - b. The 2-digit number is based on the numerical sequence of submittals from that section. In other words, for each section, the first submittal is 01, the second is 02, and so on. The 2-digit number does not change for partial or re-submittals, so that the submittal can be tracked.
 - c. P-Number for Partial Submittals: Number each partial submittal in the P space, beginning with P1, and increasing by one for each partial submittal of that submittal. If the submittal is a complete submittal, leave the P space blank.
 - d. R-Number for Re-submittals: Number each re-submittal in the arr space, beginning with R1, and increasing by one for each re-submittal of that submittal. Do not include an R-Number for the initial submittal.
 - e. Examples:
 - 1) Initial Complete Submittal: 044200-01. First Re-Submittal: 044200-01-R1.
 - 2) Initial Partial Submittal: 044200-01-P1. Second Partial Submittal: 0044200-01-P2. First Re-submittal of Second Partial Submittal: 044200-R1-P2.
- D. Item Kind: Identify each submittal item using the code explanation specified for submittal schedule entries.
- E. Shop Drawings: Include a description of each drawing, matching the description on the drawing itself.
- F. 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.
- G. 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.

1.11 SUBMITTAL REVIEW SHEET REQUIREMENTS

- A. General: The Contractor shall obtain the Submittal Review Sheet from the SmithGroup Project Manager.
- B. The Submittal Review Sheet obtained shall be in PDF format, and shall be submitted as the page after the Submittal Transmittal.
- C. When attached, the Submittal Review Sheet shall not obscure information contained in the submittal.

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

- D. The Contractor shall not edit any of the information contained within the Submittal Review Sheet except as follows:
 - 1. Submittal Number: See Submittal Numbering in Submittal Transmittal Requirements paragraph.
- E. The Contractor shall submit the PDF file in a manner that will allow editing of the Submittal Review Sheet fields by SmithGroup and its consultants.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

ATTACHMENTS

Sample Submittal Review Sheet

END OF SECTION

SMITHGROUP

SUBMITTAL REVIEW SHEET www.smithgroup.com

PROJECT

PROJECT NO. SUBMITTAL NO.

DESCRIPTION

DATE RECEIVED DATE RETURNED

Review is only for the limited purpose of checking for general conformance with information given and the design concept expressed in the Contract Documents. Refer to attached for additional SmithGroup comments and/or review codes. The final review code prevails.

SMITHGROUP ACTION		
DISCIPLINE	REVIEWED BY	REVIEW CODE
<input type="text"/>	<input type="text"/>	<input type="text"/>
<input type="text"/>	<input type="text"/>	<input type="text"/>
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FINAL REVIEW CODE:		<input type="text"/>

GENERAL REVIEW COMMENTS:

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SECTION 014000 - 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 inspection 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 quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, Construction Manager, or authorities having jurisdiction are not limited by provisions of this Section.
 - 4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described 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.
- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. 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, assembly, 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).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and 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. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
 - 1. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as as part of permanent construction, consisting of multiple products, assemblies, and subassemblies.
- E. 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.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. 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.
- J. 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. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements 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 direction 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 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 submitted to authorities having jurisdiction before starting work on the following systems:
 - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
 - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- 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. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, 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.
- H. Mock-up Completion: Process submittal for documentation when mock-up is complete.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit concise quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference to be approved by the Architect and the Owner. Submit in format acceptable to Architect. 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.
- 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. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
 - 3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by 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.

1.7 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, telephone number, and email address 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 inspection.
 - 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, telephone number, and email address 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, telephone number, and email address 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.

1.8 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. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- 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, applying, 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 inspection 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.
- 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.
2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, through Construction Manager, 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 of size indicated using the same documented personnel and supervision that will be contracted to do the Work upon acceptance of the mockup.
 2. Build mockups in location indicated or, if not indicated, as directed by Architect or Construction Manager.
 3. Obtain Architect's and Construction Manager's approval of mockups before starting corresponding work, fabrication, or construction.
 - a. Allow ten business days for initial review and each re-review of each mockup.
 4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 5. 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. Comply with requirements in "Mockups" Paragraph.

1.9 QUALITY CONTROL

- A. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
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. Engage a qualified testing agency to perform quality-control services.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection 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 inspection 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.
- B. 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.
- C. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority, Construction Manager, and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect, Commissioning Authority, Construction Manager, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the locations 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 duties of Contractor.
- D. **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 Section 013300 "Submittal Procedures."
- E. **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.
- F. **Associated Contractor Services:** Cooperate with agencies and representatives 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 inspection. 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 inspection equipment at Project site.
- G. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- H. **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 Owner, Architect, Commissioning Authority, Construction Manager, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

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, and Construction Manager's reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspection, 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 Section 017300 "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 014200 - REFERENCES

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 Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "As Otherwise Direct": Used in relation to items to be determined after Contract by agreement between Owner, Architect, and Contractor, with input from other entities as appropriate.
- D. "Certified": Guaranteed in writing over the signature of an authorized representative of the certifying organization.
- E. "Directed": An instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- F. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- G. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- H. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- I. "Install": Operations including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations at Project site.
- J. "N.I.C" or "NIC": Not in Contract.
- K. "Necessary": That which is reasonably necessary to the proper completion of the Work.
- L. "Per": In accordance with the requirements of.
- M. "Products": Materials, equipment, or systems.
- N. "Provide": Furnish and install, complete and ready for the intended use.
- O. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- P. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- Q. "Replace": To put something new in place of.
- R. "Required": Referring to requirements of the Contract Documents, unless its use clearly implies a different interpretation.
- S. "Shown" or "Indicated": Appearing on the Drawings, unless their use clearly implies a different interpretation.
- T. "Supply": Same as Furnish.

1.3 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless 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 standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should 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, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
 - 1. AABC - Associated Air Balance Council; www.aabc.com.
 - 2. AAMA - American Architectural Manufacturers Association; www.aamanet.org.
 - 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 - 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 - 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 - 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 - 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 - 8. ACI - American Concrete Institute; (Formerly: ACI International); www.concrete.org
 - 9. ACPA - American Concrete Pipe Association; www.concrete-pipe.org.
 - 10. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 - 11. AF&PA - American Forest & Paper Association; www.afandpa.org.
 - 12. AGA - American Gas Association; www.aga.org.
 - 13. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 - 14. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 - 15. AI - Asphalt Institute; www.asphaltinstitute.org.
 - 16. AIA - American Institute of Architects (The); www.aia.org.
 - 17. AISC - American Institute of Steel Construction; www.aisc.org.
 - 18. AISI - American Iron and Steel Institute; www.steel.org.
 - 19. AITC - American Institute of Timber Construction; www.aitc-glulam.org.
 - 20. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 - 21. ANSI - American National Standards Institute; www.ansi.org.
 - 22. AOSA - Association of Official Seed Analysts, Inc.; www.aosaseed.com.
 - 23. APA - APA - The Engineered Wood Association; www.apawood.org.
 - 24. APA - Architectural Precast Association; www.archprecast.org.
 - 25. API - American Petroleum Institute; www.api.org.
 - 26. ARI - Air-Conditioning & Refrigeration Institute; (See AHRI).
 - 27. ARI - American Refrigeration Institute; (See AHRI).
 - 28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 - 29. ASCE - American Society of Civil Engineers; www.asce.org.
 - 30. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (See ASCE).
 - 31. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
 - 32. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.

33. ASSE - American Society of Safety Engineers (The); www.asse.org.
34. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
35. ASTM - ASTM International; www.astm.org.
36. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
37. AWEA - American Wind Energy Association; www.awea.org.
38. AWI - Architectural Woodwork Institute; www.awinet.org.
39. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
40. AWPA - American Wood Protection Association; www.awpa.com.
41. AWS - American Welding Society; www.aws.org.
42. AWWA - American Water Works Association; www.awwa.org.
43. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
44. BIA - Brick Industry Association (The); www.gobrick.com.
45. BICSI - BICSI, Inc.; www.bicsi.org.
46. BIFMA - BIFMA International; (Business and Institutional Furniture Manufacturer's Association); www.bifma.org.
47. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
48. BWF - Badminton World Federation; (Formerly: International Badminton Federation); www.bissc.org.
49. CDA - Copper Development Association; www.copper.org.
50. CE - Conformite Europeenne; <http://ec.europa.eu/growth/single-market/ce-marking/>
51. CEA - Canadian Electricity Association; www.electricity.ca.
52. CEA - Consumer Electronics Association; www.ce.org.
53. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
54. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
55. CGA - Compressed Gas Association; www.cganet.com.
56. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
57. Cisca - Ceilings & Interior Systems Construction Association; www.cisca.org.
58. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
59. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
60. CPA - Composite Panel Association; www.pbmdf.com.
61. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
62. CRRC - Cool Roof Rating Council; www.coolroofs.org.
63. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
64. CSA - Canadian Standards Association; www.csa.ca.
65. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
66. CSI - Construction Specifications Institute (The); www.csinet.org.
67. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
68. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
69. CWC - Composite Wood Council; (See CPA).
70. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
71. DHI - Door and Hardware Institute; www.dhi.org.
72. ECA - Electronic Components Association; (See ECIA).
73. ECAMA - Electronic Components Assemblies & Materials Association; (See ECIA).
74. ECIA - Electronic Components Industry Association; www.eciaonline.org.
75. EIA - Electronic Industries Alliance; (See TIA).
76. EIMA - EIFS Industry Members Association; www.eima.com.
77. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
78. ESD - ESD Association; (Electrostatic Discharge Association); www.esda.org.
79. ESTA - Entertainment Services and Technology Association; (See PLASA).
80. ETL - Intertek (See Intertek); www.intertek.com.
81. EVO - Efficiency Valuation Organization; www.evo-world.org.
82. FCI - Fluid Controls Institute; www.fluidcontrolsintstitute.org.
83. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
84. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
85. FM Approvals - FM Approvals LLC; www.fmglobal.com.
86. FM Global - FM Global; (Formerly: FMG - FM Global); www.fmglobal.com.

87. FRSA - Florida Roofing, Sheet Metal & Air Conditioning Contractors Association, Inc.;
www.floridarroof.com.
88. FSA - Fluid Sealing Association; www.fluidsealing.com.
89. FSC - Forest Stewardship Council U.S.; www.fscus.org.
90. GA - Gypsum Association; www.gypsum.org.
91. GANA - Glass Association of North America; www.glasswebsite.com.
92. GS - Green Seal; www.greenseal.org.
93. HI - Hydraulic Institute; www.pumps.org.
94. HI/GAMA - Hydronics Institute/Gas Appliance Manufacturers Association; (See AHRI).
95. HMMA - Hollow Metal Manufacturers Association; (See NAAMM).
96. HPVA - Hardwood Plywood & Veneer Association; www.hpva.org.
97. HPW - H. P. White Laboratory, Inc.; www.hpwhite.com.
98. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
99. IAS - International Accreditation Service; www.iasonline.org.
100. IAS - International Approval Services; (See CSA).
101. ICBO - International Conference of Building Officials; (See ICC).
102. ICC - International Code Council; www.iccsafe.org.
103. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
104. ICPA - International Cast Polymer Alliance; www.icpa-hq.org.
105. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
106. IEC - International Electrotechnical Commission; www.iec.ch.
107. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
108. IES - Illuminating Engineering Society; (Formerly: Illuminating Engineering Society of North America); www.ies.org.
109. IESNA - Illuminating Engineering Society of North America; (See IES).
110. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
111. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
112. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
113. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
114. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
115. ISA - International Society of Automation (The); (Formerly: Instrumentation, Systems, and Automation Society); www.isa.org.
116. ISAS - Instrumentation, Systems, and Automation Society (The); (See ISA).
117. ISFA - International Surface Fabricators Association; (Formerly: International Solid Surface Fabricators Association); www.isfanow.org.
118. ISO - International Organization for Standardization; www.iso.org.
119. ISSFA - International Solid Surface Fabricators Association; (See ISFA).
120. ITU - International Telecommunication Union; www.itu.int/home.
121. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
122. LMA - Laminating Materials Association; (See CPA).
123. LPI - Lightning Protection Institute; www.lightning.org.
124. MBMA - Metal Building Manufacturers Association; www.mbma.com.
125. MCA - Metal Construction Association; www.metalconstruction.org.
126. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
127. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
128. MHIA - Material Handling Industry of America; www.mhia.org.
129. MIA - Marble Institute of America; www.marble-institute.com.
130. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
131. MPI - Master Painters Institute; www.paintinfo.com.
132. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.;
www.mss-hq.org.
133. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
134. NACE - NACE International; (National Association of Corrosion Engineers International);
www.nace.org.
135. NADCA - National Air Duct Cleaners Association; www.nadca.com.
136. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
137. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
138. NBI - New Buildings Institute; www.newbuildings.org.
139. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.

140. NCMA - National Concrete Masonry Association; www.ncma.org.
141. NEBB - National Environmental Balancing Bureau; www.nebb.org.
142. NECA - National Electrical Contractors Association; www.necanet.org.
143. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
144. NEMA - National Electrical Manufacturers Association; www.nema.org.
145. NETA - InterNational Electrical Testing Association; www.netaworld.org.
146. NFHS - National Federation of State High School Associations; www.nfhs.org.
147. NFPA - National Fire Protection Association; www.nfpa.org.
148. NFPA - NFPA International; (See NFPA).
149. NFRC - National Fenestration Rating Council; www.nfrc.org.
150. NHLA - National Hardwood Lumber Association; www.nhla.com.
151. NLGA - National Lumber Grades Authority; www.nlga.org.
152. NOFMA - National Oak Flooring Manufacturers Association; (See NWFA).
153. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
154. NRCA - National Roofing Contractors Association; www.nrca.net.
155. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
156. NSF - NSF International; www.nsf.org.
157. NSPE - National Society of Professional Engineers; www.nspe.org.
158. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
159. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
160. NWFA - National Wood Flooring Association; www.nwfa.org.
161. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
162. PDI - Plumbing & Drainage Institute; www.pdionline.org.
163. PLASA - PLASA; (Formerly: ESTA - Entertainment Services and Technology Association); <http://www.plasa.org>.
164. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
165. RFCI - Resilient Floor Covering Institute; www.rfci.com.
166. RIS - Redwood Inspection Service; www.redwoodinspection.com.
167. SAE - SAE International; www.sae.org.
168. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
169. SDI - Steel Deck Institute; www.sdi.org.
170. SDI - Steel Door Institute; www.steeldoor.org.
171. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
172. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (See ASCE).
173. SIA - Security Industry Association; www.siaonline.org.
174. SJI - Steel Joist Institute; www.steeljoist.org.
175. SMA - Screen Manufacturers Association; www.smainfo.org.
176. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
177. SMPTE - Society of Motion Picture and Television Engineers; www.smpete.org.
178. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
179. SPIB - Southern Pine Inspection Bureau; www.spib.org.
180. SPRI - Single Ply Roofing Industry; www.spri.org.
181. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
182. SSINA - Specialty Steel Industry of North America; www.ssina.com.
183. SSPC - SSPC: The Society for Protective Coatings; www.sspc.org.
184. STI - Steel Tank Institute; www.steeltank.com.
185. SWI - Steel Window Institute; www.steelwindows.com.
186. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
187. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
188. TCNA - Tile Council of North America, Inc.; www.tileusa.com.
189. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
190. TIA - Telecommunications Industry Association (The); (Formerly: TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance); www.tiaonline.org.
191. TIA/EIA - Telecommunications Industry Association/Electronic Industries Alliance; (See TIA).
192. TMS - The Masonry Society; www.masonrysociety.org.
193. TPI - Truss Plate Institute; www.tpinst.org.
194. TPI - Turfgrass Producers International; www.turfgrassod.org.
195. TRI - Tile Roofing Institute; www.tilerroofing.org.
196. UL - Underwriters Laboratories Inc.; <http://www.ul.com>.

197. UNI - Uni-Bell PVC Pipe Association; www.uni-bell.org.
 198. USAV - USA Volleyball; www.usavolleyball.org.
 199. USGBC - U.S. Green Building Council; www.usgbc.org.
 200. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
 201. WASTEC - Waste Equipment Technology Association; www.wastec.org.
 202. WCLIB - West Coast Lumber Inspection Bureau; www.wclib.org.
 203. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 204. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 205. WI - Woodwork Institute; www.wicnet.org.
 206. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
 207. WWPA - Western Wood Products Association; www.wwpa.org.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.
1. COE - Army Corps of Engineers; www.usace.army.mil.
 2. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
 3. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
 4. DOD - Department of Defense; www.quicksearch.dla.mil.
 5. DOE - Department of Energy; www.energy.gov.
 6. EPA - Environmental Protection Agency; www.epa.gov.
 7. FAA - Federal Aviation Administration; www.faa.gov.
 8. FG - Federal Government Publications; www.gpo.gov/fdsys.
 9. GSA - General Services Administration; www.gsa.gov.
 10. HUD - Department of Housing and Urban Development; www.hud.gov.
 11. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
 12. OSHA - Occupational Safety & Health Administration; www.osha.gov.
 13. SD - Department of State; www.state.gov.
 14. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
 15. USDA - Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
 16. USDA - Department of Agriculture; Rural Utilities Service; www.usda.gov.
 17. USDOJ - Department of Justice; Office of Justice Programs; National Institute of Justice; www.ojp.usdoj.gov.
 18. USP - U.S. Pharmacopeial Convention; www.usp.org.
 19. USPS - United States Postal Service; www.usps.com.
- E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. CFR - Code of Federal Regulations; Available from Government Printing Office; www.gpo.gov/fdsys.
 2. DOD - Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.quicksearch.dla.mil.
 3. DSCC - Defense Supply Center Columbus; (See FS).
 4. FED-STD - Federal Standard; (See FS).
 5. FS - Federal Specification; Available from DLA Document Services; www.quicksearch.dla.mil.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from General Services Administration; www.gsa.gov.

- c. Available from National Institute of Building Sciences/Whole Building Design Guide;
www.wbdg.org/ccb.
 - 6. MILSPEC - Military Specification and Standards; (See DOD).
 - 7. USAB - United States Access Board; www.access-board.gov.
 - 8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (See USAB).
- F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.
- 1. CBHF; State of California; Department of Consumer Affairs; Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; www.bearhfti.ca.gov.
 - 2. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.calregs.com.
 - 3. CDHS; California Department of Health Services; (See CDPH).
 - 4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cal-iaq.org.
 - 5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
 - 6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
 - 7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; www.txforestservation.tamu.edu.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

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SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

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 requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Section 312319 "Dewatering" for disposal of ground water at Project site.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use. Provide connections and extensions of services as required for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 - 1. Locations of dust-control partitions at each phase of work.
 - 2. HVAC system isolation schematic drawing.
 - 3. Location of proposed air-filtration system discharge.
 - 4. Waste-handling procedures.
 - 5. Other dust-control measures.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines.

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails. Provide concrete or galvanized-steel bases for supporting posts.
- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum 36 by 60 inches.
- E. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, Construction Manager, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
 - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
 - 2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
 - 3. Drinking water and private toilet.
 - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

2.4 PROJECT IDENTIFICATION SIGNS

- A. General:
 - 1. Provide one project identification sign(s). Locate where indicated or as directed by Architect.

2. Refer to Document 015000.01 "Project Identification Sign", for sign dimensions, layout specifications, structure and typefaces.
 3. Submit shop drawings for approval showing structure, exact dimensions, copy, confirmation of specified colors and typefaces, and location(s) on site. Receive approval before erection.
 4. Maintain sign(s) until final acceptance of the Work, and repaint sign(s) at least once in each 12-month period.
- B. Sign Construction:
1. Fabricate sign of 3/4 inch minimum thickness, waterproof marine plywood, and 1/4 inch hardwood edge strips with mitered corners.
 2. Include the name of the Owner, the Architect and major Contractor(s) on the sign.
 3. Mount project sign on pressure-preservative-treated wood posts, 4 x 4 inch minimum, set in concrete, with 2 x 4 inch horizontal back bracing to 2 x 6 inch deadman anchors driven into soil.
 4. Anchor field office sign to field office or mount on 2 x 2 inch pressure-preservative-treated wood post set in ground, or otherwise anchored as approved.
 5. Paint fasteners through face of signs to match background.
 6. Provide Sherwin-Williams Co. colors as follows:
 - a. Owner's panel: white, SW 2123 (Exterior).
 - b. Architect's panel: gray, SW 2115 (Exterior).
 - c. Contractor's panel: gray, SW 2115 (Exterior).
 - d. Field office signs: white, SW 2123 (Exterior).
 - e. Type: black, SW 2126 (Exterior).

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities 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. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- G. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one land-based telephone line(s) for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
- I. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
 - 1. Processor: Intel Core i5 or i7.
 - 2. Memory: 4 gigabyte.
 - 3. Disk Storage: 500 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 - 4. Display: 24-inch LCD monitor with 256-Mb dedicated video RAM.
 - 5. Full-size keyboard and mouse.
 - 6. Network Connectivity: 10/100BaseT Ethernet.
 - 7. Operating System: Microsoft Windows 7 Professional.
 - 8. Productivity Software:
 - a. Microsoft Office Professional, 2010 or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader 11.0 or higher.
 - c. WinZip 7.0 or higher.
 - 9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
 - 10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 1.0 Mbps upload and 15 Mbps download speeds at each computer.
 - 11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
 - 12. Backup: External hard drive, minimum 2 terabyte, with automated backup software providing daily backups.

3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
 - 2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
 - 1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
 - 1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
 - 2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
 - 3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
 - 4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
 - 1. Identification Signs: Provide Project identification signs as indicated on Drawings.
 - 2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 - 3. Maintain and touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
 - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Section 311000 "Site Clearing."
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- I. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.
 - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
 - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction and requirements indicated on Drawings.

1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 2. Paint and maintain appearance of walkway for duration of the Work.
- M. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
 3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard and replace stored or installed material that begins to grow mold.
 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.

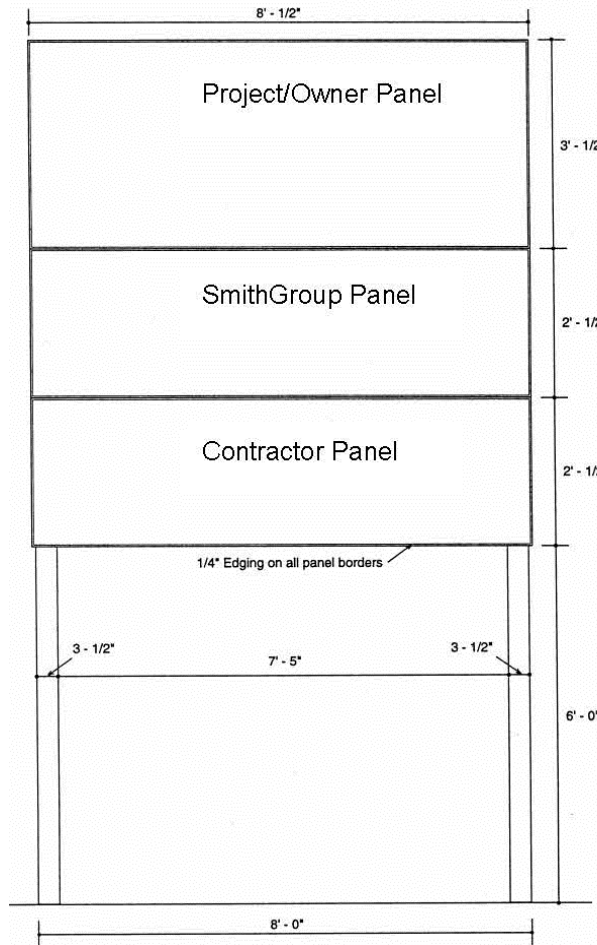
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

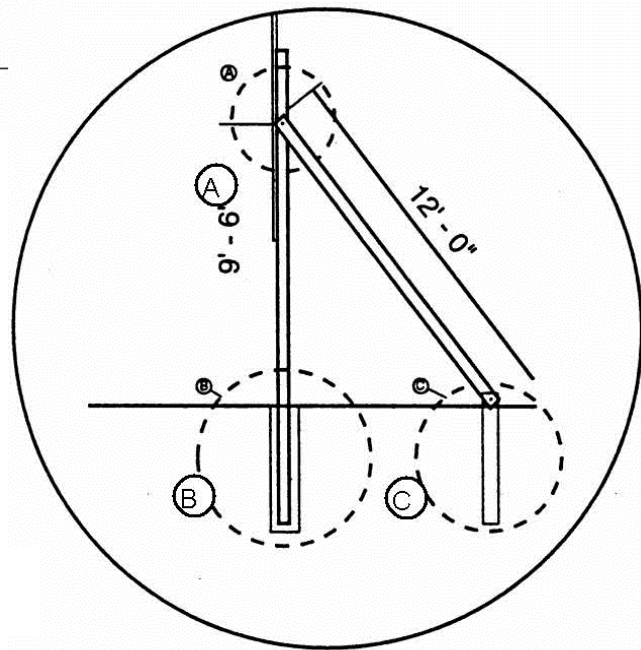
- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION

DOCUMENT 015000.01 – PROJECT IDENTIFICATION SIGN

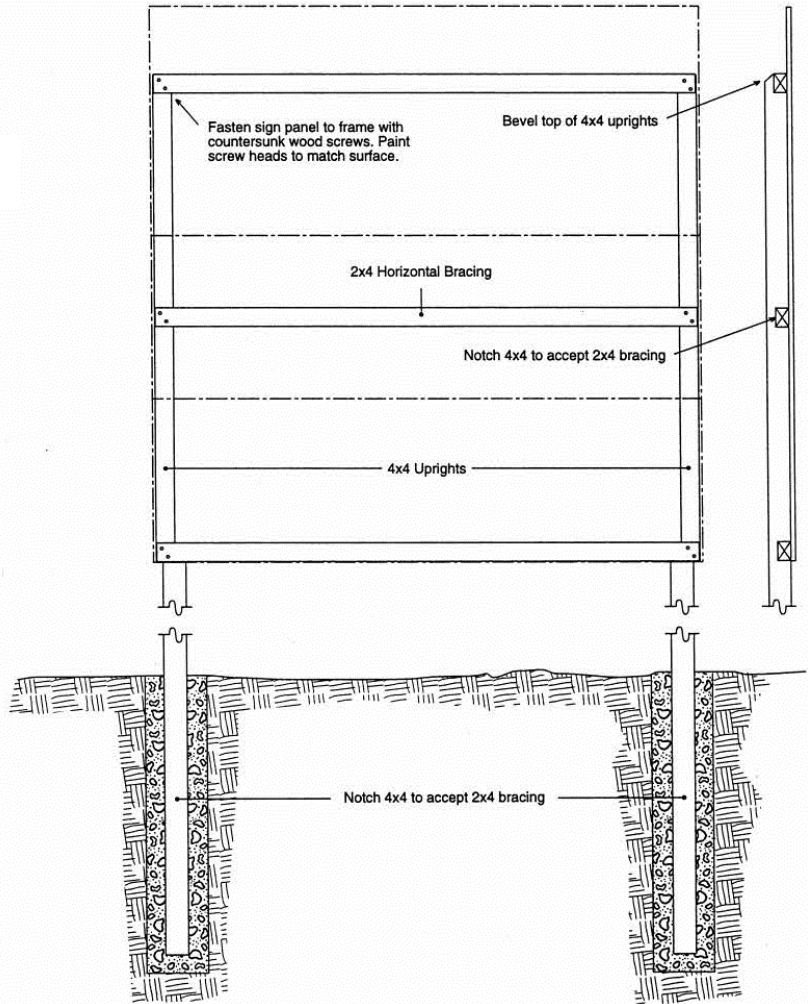
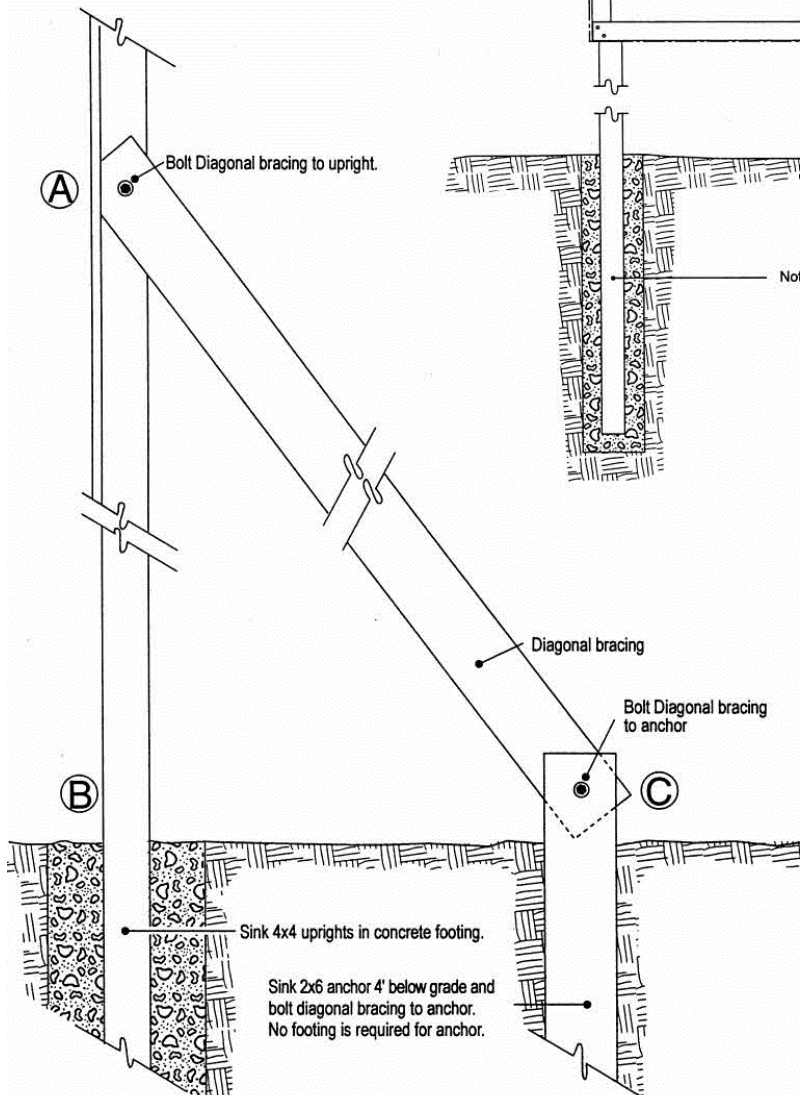


Front Elevation



Section
[Details on next page]

Rear and Side Elevations



Section Details

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

SMITHGROUP

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Architecture, Engineering, Interiors, Planning

Architect will provide color graphic design for SmithGroup panel, incorporating logo (similar to image above) and additional text. Design will be provided in the form of an electronic file in Adobe Illustrator format. Request the electronic file from the Architect.

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SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

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 general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.
- B. Related Requirements:
 - 1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches above the ground for trees up to and including 4-inch size at this height and as measured at a height of 12 inches above the ground for trees larger than 4-inch size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 54 inches above the ground line for trees with caliper of 8 inches or greater as measured at a height of 12 inches above the ground.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
 - b. Arborist's responsibilities.
 - c. Quality-control program.
 - d. Coordination of Work and equipment movement with the locations of protection zones.
 - e. Trenching by hand or with air spade within protection zones.
 - f. Field quality control.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
 - 2. Detail fabrication and assembly of protection-zone fencing and signage.
 - 3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:
 - 1. Organic Mulch: 1-pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.

3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
1. Species and size of tree.
 2. Location on site plan. Include unique identifier for each.
 3. Reason for pruning.
 4. Description of pruning to be performed.
 5. Description of maintenance following pruning.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
1. Use sufficiently detailed photographs or video recordings.
 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
- D. Quality-control program.

1.7 QUALITY ASSURANCE

- A. Arborist Qualifications: Licensed arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.8 FIELD CONDITIONS

- A. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
 2. Moving or parking vehicles or equipment.
 3. Foot traffic.
 4. Erection of sheds or structures.
 5. Impoundment of water.
 6. Excavation or other digging unless otherwise indicated.
 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- B. Do not direct vehicle or equipment exhaust toward protection zones.
- C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Backfill Soil: Stockpiled soil from location shown on Drawings Stockpiled soil mixed with planting soil Planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
1. Mixture: Well-blended mix of two parts stockpiled soil to one part planting soil.

2. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation"
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 1. Type: Wood and bark chips.
 2. Size Range: 3 inches maximum, 1/2 inch minimum.
 3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements: Previously used materials may be used when approved by Architect.
 1. Chain-Link Protection-Zone Fencing: Polymer-coated galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- OD line posts, and 2-7/8-inch- OD corner and pull posts and 0.177-inch- diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 48 inches.
 - b. Polymer-Coating Color: Dark green.
 2. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.
 - a. Height: 48 inches.
 - b. Color: High-visibility orange, nonfading.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
 1. Size and Text: As shown on Drawings.
 2. Lettering: 3-inch- high minimum, white or black characters on white or red background.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
 1. Apply 2-inch uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within 6 inches of tree trunks.

3.3 PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.
- B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as follows:
1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 2. Cut Ends: Coat cut ends of roots more than 1-1/2 inches in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist.
 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots flush with the edge of the protection zone by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as directed by City of Tokoma Park arborist.

1. Prune to remove only injured, broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
 2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
 3. Pruning Standards: Prune trees according to ANSI A300 (Part 1).
 - a. Type of Pruning: Cleaning, raising, reducing, and thinning where indicated.
- B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.
- C. Cut branches with sharp pruning instruments; do not break or chop.
- D. Do not paint or apply sealants to wounds.
- E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.
- F. Chip removed branches and stockpile in areas approved by Architect.

3.7 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.
 1. Submit details of proposed pruning and repairs.
 2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
- C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a 2-inch uniform thickness to remain.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off the College's property.

END OF SECTION

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SECTION 016000 - PRODUCT 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 selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved by Architect through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification.
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications. Submit a comparable product request, if applicable.

1.4 ACTION SUBMITTALS

- A. Comparable Product Request Submittal: Submit request for consideration of each comparable product. Identify basis-of-design product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
 - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a comparable product request. Architect will notify Contractor through Construction Manager of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Form of Architect's Approval of Submittal: As specified in Section 013300 "Submittal Procedures."

- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 2. Equipment Nameplates: Provide a permanent nameplate on each item of service-connected or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 3. See individual identification sections in Divisions 21, 22, 23, and 26 for additional identification requirements.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. 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.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
 1. Store products to allow for inspection and measurement of quantity or counting of units.
 2. Store materials in a manner that will not endanger Project structure.
 3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
 4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 6. Protect stored products from damage and liquids from freezing.
 7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 - 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - 1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - 3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - 4. Where products are accompanied by the term "as selected," Architect will make selection.
 - 5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - 6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - a. Submit additional documentation required by Architect through Construction Manager in order to establish equivalency of proposed products. Evaluation of "or equal" product status is by the Architect, whose determination is final.
- B. Product Selection Procedures:
 - 1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole product may be indicated by the phrase: "Subject to compliance with requirements, provide the following: ..."
 - 2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - a. Sole manufacturer/source may be indicated by the phrase: "Subject to compliance with requirements, provide products by the following: ..."
 - 3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated by the addition of "Or As Approved" or "Or Approved Comparable Product".

- a. Limited list of products may be indicated by the phrase: "Subject to compliance with requirements, provide one of the following: ..."
4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, which complies with requirements.
 - a. Non-limited list of products is indicated by the phrase: "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following: ..."
5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated by the addition of "Or As Approved" or "Or Approved Comparable Product".
 - a. Limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, provide products by one of the following: ..."
6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, which complies with requirements.
 - a. Non-limited list of manufacturers is indicated by the phrase: "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following: ..."
7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
 - a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.
8. Reference Standards: Where Specifications describe a product by referring to a reference standard without listing product/manufacturer, propose a product that meets the standard. Where additional product description modifies the reference standard, proposed product shall meet the standard as modified.
 - a. A product specified by reference standard shall comply with the requirements of the standard in effect on the date of the Bidding Documents, except:
 - 1) Where a date is specified with the standard; then the edition of the standard so dated shall govern.
 - 2) Where the governing code requires compliance to another edition of the standard.
- C. Product Uniformity: It is the intent of the Documents that the completed construction be uniform throughout the Project. For each type of product, the manufacturer and model shall not vary. After a particular product has been identified and approved for an application, that product shall be used for that application across all the subcontracts and other Work-related contracts held by the Contractor or Construction Manager. This provision applies equally to accepted substitutions.
- D. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.
- E. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
1. The product option and selection procedure, as described in this Section, governing the specified product:
 - a. Allows the Contractor to make comparable product requests.
 - b. Does not require the use of the product substitution procedure.
 2. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant product qualities include attributes such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
 5. Samples, if requested.
 6. By proposing a product that is not listed, for consideration as a comparable product, the Contractor affirms that it meets requirements, except where clearly indicated otherwise. Approval, if granted, will be contingent upon the product meeting requirements as comparable product. In the absence of clear indication of non-compliance in product submittal, approval of the comparable product by Architect, will be based on Contractor's affirmation, whether explicit or implicit.
- B. Submittal Requirements: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 017300 - EXECUTION

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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner-installed products.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024116 "Structure Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at Project site.
 - 1. Prior to commencing work requiring cutting and patching, review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affecting by cutting and patching operations.
 - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
 - 1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 - 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 - 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 - 4. Dates: Indicate when cutting and patching will be performed.
 - 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- E. Certified Surveys: Submit two copies signed by land surveyor.
- F. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Electrical wiring systems.
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Sprayed fire-resistive material.
 - d. Equipment supports.
 - e. Piping, ductwork, vessels, and equipment.
 - f. Noise- and vibration-control elements and systems.
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
 - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
 - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
 - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
 - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
 - 1. Description of the Work.
 - 2. List of detrimental conditions, including substrates.
 - 3. List of unacceptable installation tolerances.
 - 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
 - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
 - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. 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.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
 - 1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 5. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 - 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction personnel.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

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 the following:
 - 1. Salvaging nonhazardous demolition waste.
 - 2. Recycling nonhazardous demolition waste.
 - 3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

- A. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- B. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- C. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- D. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent may serve as Waste Management Coordinator.
- B. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

1.6 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to 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 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 in compliance with Section 024119 "Selective Demolition."

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. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
4. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
5. 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total nonhazardous 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, including the following:
 1. Demolition Waste:
 - a. Concrete.
 - b. Concrete reinforcing steel.
 - c. Brick.
 - d. Concrete masonry units.
 - e. Plywood and oriented strand board.
 - f. Wood trim.
 - g. Structural and miscellaneous steel.
 - h. Rough hardware.
 - i. Roofing.
 - j. Insulation.
 - k. Doors and frames.
 - l. Door hardware.
 - m. Windows.
 - n. Glazing.
 - o. Metal studs.
 - p. Gypsum board.
 - q. Acoustical tile and panels.
 - r. Carpet.
 - s. Equipment.
 - t. Cabinets.
 - u. Plumbing fixtures.
 - v. Piping.
 - w. Supports and hangers.
 - x. Valves.
 - y. Sprinklers.
 - z. Mechanical equipment.
 - aa. Refrigerants.
 - bb. Electrical conduit.
 - cc. Copper wiring.
 - dd. Lighting fixtures.
 - ee. Lamps.
 - ff. Ballasts.
 - gg. Electrical devices.
 - hh. Switchgear and panelboards.
 - ii. Transformers.
 2. Construction Waste:
 - a. Masonry and CMU.
 - b. Metals.
 - c. Insulation.
 - d. Gypsum board.

- e. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
 - 1) Paper.
 - 2) Cardboard.
 - 3) Boxes.
 - 4) Plastic sheet and film.
 - 5) Polystyrene packaging.
 - 6) Wood crates.
 - 7) Wood pallets.
 - 8) Plastic pails.
- f. Construction Office Waste: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following construction office waste materials:
 - 1) Paper.
 - 2) Aluminum cans.
 - 3) Glass containers.

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 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan.
- C. 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 three 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.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.
- B. 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.
- C. Salvaged Items for : Permitted on Project site.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.

- H. 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 be shared equally by Owner and 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 Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
 - 2. Crush concrete and screen to comply with requirements in Section 312000 "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 1-inch size.
 - a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.
 - b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.
 - 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. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- F. 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.
- G. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- H. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- I. Carpet: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
 - 1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

- J. 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.
- K. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- L. Conduit: Reduce conduit to straight lengths and store by material and size.
- M. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

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.
- 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.
- D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, 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. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.

3.7 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-7 for construction waste reduction progress report.
- F. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION 017419

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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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MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
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LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT
27 SEPTEMBER 2019

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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:						

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-7: CONSTRUCTION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
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:								

FORM CWM-8: DEMOLITION WASTE REDUCTION PROGRESS REPORT								
MATERIAL CATEGORY	GENERATION POINT	TOTAL QUANTITY OF WASTE TONS (TONNES) (A)	QUANTITY OF WASTE SALVAGED		QUANTITY OF WASTE RECYCLED		TOTAL QUANTITY OF WASTE RECOVERED TONS (TONNES) (D = B + C)	TOTAL QUANTITY OF WASTE RECOVERED % (D / A x 100)
			ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (B)	ESTIMATED TONS (TONNES)	ACTUAL TONS (TONNES) (C)		
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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SECTION 017700 - 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. Section 013233 "Photographic Documentation" for submitting final completion construction photographic documentation.
 - 2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- 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 Owner 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, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.
 - 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 testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner'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 Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner'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 Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner 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.
 10. Touch up paint 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, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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 Architect, that must be completed or corrected before certificate will be issued.
1. 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 Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. 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.
 5. Submit final completion photographic documentation.
- 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, Architect and Construction Manager will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect 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. 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 and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel electronic file. Architect, through Construction Manager, will return annotated file.
 - b. PDF electronic file. Architect, through Construction Manager, will return annotated file.
 - c. Web-based project software upload. Utilize software feature for creating and updating list of incomplete items (punch list).

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner'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 Owner 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.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Architect.
- E. Warranties in Paper Form:
 - 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.
- F. 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. 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 not planted, mulched, or 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 and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - m. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - n. 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 ACR. Provide written report on completion of cleaning.
 - o. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - p. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 017419 "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 017823 - 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 manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

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. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved 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 operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
- 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.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. 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: Bookmark 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.
- B. 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 "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. Enclose title pages and directories in clear plastic sleeves.
 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.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: 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 Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Construction Manager.
 7. Name and contact information for Architect.
 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. 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."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 EMERGENCY MANUALS

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
 - 1. Type of emergency.
 - 2. Emergency instructions.
 - 3. Emergency procedures.
- C. 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.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. 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.

1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 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 Owner's operating personnel.

- B. 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.
- C. 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.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
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 Owner's operating personnel.
- B. 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 warranties and bonds as described below.
- C. 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.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins; 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.
 - a. 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.

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.
- E. 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.
- F. 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.
- G. 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.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. 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.
- J. 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 maintenance manuals.

1.11 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. 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.
- C. 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.
- D. 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.
- E. 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.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. 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 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 017839 - 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 017300 "Execution" for final property survey.
 - 2. Section 017700 "Closeout Procedures" for general closeout procedures.
 - 3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit 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 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.

1.4 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 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.
 - d. Locations and depths of underground utilities.

will field set be paper or digital?

- 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 and Construction Manager. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
 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 through Construction Manager for resolution.
 4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 013100 "Project Management and Coordination" 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. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints 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 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 and Construction Manager.
 - e. Name of Contractor.

1.5 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.

1.6 RECORD PRODUCT DATA

- 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. 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.
- C. 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.

1.7 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.

1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents 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 and Construction Manager's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 018113.15 - SUSTAINABLE DESIGN REQUIREMENTS - LEED v4 BD+C

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 general requirements and procedures for compliance with certain prerequisites and credits needed for Project to obtain "LEED Version 4 for Building Design and Construction" (LEED v4 BD+C) Silver certification based on USGBC's LEED v4 BD+C.
 - 1. Specific requirements for LEED are also included in other Sections.
 - 2. Some LEED prerequisites and credits needed to obtain LEED certification depend on product 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.
 - 3. A copy of the LEED Project checklist is attached at the end of this Section for information only.
 - a. Some LEED prerequisites and credits needed to obtain the indicated LEED certification depend on aspects of Project that are not part of the Work of the Contract.
 - 4. Definitions included in the "LEED Version 4 for Building Design and Construction" (LEED v4 BD+C) Reference Guide and online amendments apply to this Section.
 - 5. The LEED v4.1 MR beta credits are acceptable.
- B. Related Requirements:
 - 1. Section 013233, "Photographic Documentation."
 - 2. Section 013300, "Submittal Procedures."
 - 3. Section 015000, "Temporary Facilities and Controls" for temporary heating and cooling requirements.
 - 4. Section 017419, "Construction Waste Management and Disposal."
 - 5. Section 017823, "Operation and Maintenance Data."
 - 6. Section 019113, "General Commissioning Requirements."
 - 7. Divisions 02 through 49 Sections for LEED requirements specific to the work of each of these Sections. Requirements may or may not include reference to LEED.

1.3 DEFINITIONS

- A. Bio-Based Materials: Materials that meet the Sustainable Agriculture Network's Sustainable Agriculture Standard. Bio-based raw materials shall be tested using ASTM D 6866 and be legally harvested, as defined by the exporting and receiving country.
- B. CDPH Standard Method v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010, for the emissions testing and requirements of products and materials.
- C. Chain-of-Custody (COC): A procedure that tracks a product from the point of harvest or extraction to its end use, including all successive stage of processing, transformation, manufacturing, a distribution.
- D. Chain-of-Custody Certificates: Certificates signed by manufacturers and fabricators certifying that wood used to make products was obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001.
- E. Composite Wood and Agrifiber: Products made of wood particles and/or plant material pressed and bonded with adhesive or resin such as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, and door cores.
- F. Corporate Sustainability Report: A third-party verified report that outlines the environmental impacts of extraction operations and activities associated with the manufacturer's product and the product's supply chain.

- G. Environmental Product Declaration (EPD): An independently verified report based on life-cycle assessment studies that have been conducted according to a set of common rules for each product category and peer-reviewed.
 - 1. Product-Specific Declaration: A product with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
 - 2. Industry-Wide (Generic) EPD: Provide products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
 - 3. Product-Specific Type III EPD: A product with a third-party certification, including external verification, in which the manufacturer is explicitly recognized by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
- H. Extended Producer Responsibility (EPR): Measures undertaken by the maker of a product to accept its own and sometimes other manufacturers' products as postconsumer waste at the end of the products' useful life.
- I. Health Product Declaration Open Standard (HPD): A standard format for reporting product content and associated health information for building products and materials.
- J. Indoor Air Quality (IAQ) Management Plan: Plan developed by the Contractor to provide a healthy indoor environment for workers and building occupants during construction. Plan must meet or exceed the recommendations of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) "IAQ Guidelines for Occupied Buildings Under Construction."
- K. Leadership Extraction Practices: Products that meet at least one of the responsible extraction criteria, which include: extended producer responsibility; bio-based materials; FSC wood products; materials reuse; recycled content; and other USGBC approved programs.
- L. Material Cost: The dollar value of materials being provided to the site, after Contractor mark-ups, including transportation costs, taxes, fees, and shop labor, but excluding field equipment and field labor costs.
- M. Materials Reuse: Reuse includes salvaged, refurbished, or reused products.
- N. Multi-Attribute Optimization: Third party certified products that demonstrate impact reduction below industry average in at least three of the following six categories: global warming potential; stratospheric ozone depletion; acidification; eutrophication; tropospheric ozone creation; nonrenewable resource depletion.
- O. Recycled Content: Recycled content is the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on cost.
 - 1. "Postconsumer" 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. "Preconsumer" 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.
- P. Regional Materials: Materials that are extracted, harvested, recovered, and manufactured within a radius of 100 miles from the Project site.
- Q. Volatile Organic Compounds (VOC) Emissions Test: Refer to CDPH Standard Method v1.1 definition.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Work of this project includes completed building and application for LEED certification. Work is not complete until Owner has accepted USGBC's final review of LEED certification.
 - 1. Provide documentation required by LEED and LEED review.

- B. Provide materials and procedures necessary to obtain LEED prerequisites and credits required in this Section. Other Sections may specify requirements that contribute to LEED prerequisites and credits. Refer to other sections for additional materials and procedures necessary to obtain LEED prerequisites and credits.
- C. Respond to questions and requests for additional information from Architect and the USGBC regarding LEED credits until the USGBC has made its determination on the project's LEED certification application.
- D. LEED Online Submittals: Upload LEED documentation submittal data directly to USGBC project "LEED Online" website. Complete online forms at least monthly and as necessary to document LEED credits for submittals required in this Section.
- E. LEED Conference: Schedule and conduct a conference at a time convenient to Owner and Architect within 21 days prior to commencement of the work. Advise Architect, Owner's Commissioning Authority, and Owner's Project Manager of scheduled meeting dates.
 - 1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Owner's Project Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 - 2. Agenda: LEED goals for the project, Contractor's action plans, and discussion of targeted LEED Prerequisites and Credits.
 - 3. Minutes: Record and distribute minutes to attendees and other entities with responsibilities for obtaining LEED Credits.

1.5 ACTION SUBMITTALS

- A. General: Submit additional LEED submittals required by other Specification Sections.
 - 1. Submit each LEED submittal simultaneously with applicable product submittal.
- B. LEED Credit Action Plan: For each material, product, or assembly, the Contractor shall complete a "LEED Credit Action Plan" to provide the documentation in accordance with requirements below under article 1.6D and within the technical sections of the specifications.
 - 1. The pilot LEED v4.1 beta pilot credits are acceptable.
 - 2. MRc2 Building product disclosure and optimization - EPD; Option 2 Form: List minimum of 10 products from 3 manufacturers or indicated 10% by cost can provide an EPD (Environmental Product Declaration).
 - 3. MRc3 Building product disclosure and optimization - sourcing of raw materials Option 2 Form: 40% by cost for Forest Stewardship Council (FSC) certification, materials reuse, and recycled content. Indicate extended producer responsibility (EPR), Non-wood bio-based materials that meet Sustainable Agriculture Network (SAN) certification requirements, and "Legal Wood" standards.
 - 4. MRc4 Building product disclosure and optimization - material ingredients Option 2 Form: indicating a minimum of 10 products from 3 manufacturers with 10% of the products by cost meeting the listing requirements. indicate whether any of the listed products will include third-party HPD or Declare labels.
 - 5. These electronic forms shall be provided by the Architect at the beginning of the Construction Phase and reviewed in the Preconstruction Conference.
- C. LEED Documentation Submittals:
 - 1. General, Sustainable Materials Attributes Form: Project submittals must be accompanied by a completed Sustainable Materials Attributes Form. Submittal packages must also include highlighted documentation supporting the sustainability claims made on the Sustainable Materials Attributes Form.
 - a. Provide location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material.
 - 2. EA p3, Building-Level Energy Metering: Product data for meters, sensors, and data collection system used to provide continuous metering of building energy-consumption performance.
 - 3. MRp2/MRc5, Construction and Demolition Waste Management: Comply with submittal requirements of Section 017419 "Construction Waste Management and Disposal."
 - 4. MRc2, Building Product Disclosure and Optimization: Environmental Product Declarations complying with LEED requirements.

5. MRc3, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 1, Raw Material Source and Extraction Reporting.
 - a. Corporate sustainability reports for products that comply with LEED requirements for raw material and source extraction reporting.
6. MRc3, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 2, Leadership Extraction Practices.
 - a. Extended Producer Responsibility: Product data and certification letter from product manufacturers, indicating participation in an extended producer responsibility program and statement of costs.
 - b. Bio-Based Materials: Product data and certification for bio-based materials, indicating that they comply with requirements. Include statement of costs.
 - c. Certified Wood: Product data and chain-of-custody certificates for products containing certified wood. Include statement indicating cost for each certified wood product.
 - d. Materials Reuse: Receipts for salvaged and refurbished materials used for Project, indicating sources and costs.
 - e. Recycled Content: Product data and certification letter from product manufacturers, indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement of costs.
7. MRc4, Building Product Disclosure and Optimization, Material Ingredients: Option 1, Material Ingredient Reporting.
 - a. Material ingredient reports for products that comply with LEED requirements for material ingredient reporting, including but not limited to the following:
 - 1) Manufacturer Inventory.
 - 2) Health Product Declaration.
 - 3) Cradle to Cradle certifications.
 - 4) Declare product labels.
 - 5) ANSI/BIFMA e3 Furniture Sustainability Standard.
8. MRc4, Building Product Disclosure and Optimization, Material Ingredients: Option 2, Material Ingredient Optimization.
 - a. Documentation for products that comply with LEED requirements for material ingredient optimization, including but not limited to the following:
 - 1) GreenScreen Benchmarks.
 - 2) Cradle to Cradle certifications.
 - 3) REACH optimizations.
9. EQp2/EQc3/EQc4, Indoor Air Quality:
10. EQc2, Low-Emitting Materials: Product data, indicating VOC content and emissions testing documents showing compliance with requirements for low-emitting materials, for the following materials:
 - a. Paints and coatings.
 - b. Adhesives and sealants.
 - c. Flooring.
 - d. Products containing composite wood or agrifiber products or wood glues.
 - e. Ceilings, walls, thermal, and acoustic insulation.
 - f. Exterior applied materials.
 - g. Furniture.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For LEED coordinator.
- B. Project Materials Cost Data: Provide statement indicating total cost and shop labor for materials used for Project. Costs exclude site labor, overhead, and profit. Include breakout of costs for the following categories of items:
 1. Wood construction materials.
 2. Furniture.
 3. Passive plumbing materials.
 4. Passive mechanical (HVAC) materials.
 5. Passive electrical materials.
 6. Earthwork and exterior improvements, hard costs.

- C. LEED Action Plan Components: Provide preliminary submittals within seven days of date established for the Notice to Proceed indicating how the following requirements will be met:
 - 1. MRp2/MRc5, Waste management plan, complying with Section 017419 "Construction Waste Management and Disposal."
 - 2. EQp2/EQ3/EQ4, Indoor air quality plan. Comply with article 3.3
- D. The USGBC BPDO tracking form that are provided will include the following:
 - 1. MRc2 - Provide an action plan that identifies specific products that contribute to the following goal: 10% of all materials by cost or 10 products sourced from at least three different manufacturers have an optimized EPD. Products that qualify as having an optimized EPD shall be as defined in LEED v4.1 Credit MRc2 - Option 2 (Multi-attribute optimization). This credit also provides guidance on the % of overall cost that can be counted for a project based on the type of optimized EPD that is achieved.
 - 2. MRc3 - Provide an action plan that identifies specific products that contribute to the following goal: 40% of all materials by cost from at least 5 different manufacturers to have be responsibly sourced and extracted. Products that qualify as responsibly sourced and extracted shall be as defined in LEED v4.1 Credit MRc3 - which includes extended producer responsibility, bio-based, FSC-certified wood, salvaged, or recycled. This credit also provides guidance on the % of overall cost that can be counted for a project based on the type of optimized sourcing and extraction methods.
 - 3. MRc4 - Provide an action plan that identifies specific products that contribute to the following goal: 10% of all materials by cost or 10 products sourced from at least three different manufacturers have optimized material ingredients. Products that qualify as having optimized material ingredients shall be as defined in LEED v4.1 Credit MRc4 - Option 2. This credit also provides guidance on the % of overall cost that can be counted for a project based on the type of optimized material ingredient inventory that is achieved.
- E. 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. MRp2/MRc5, Waste reduction progress reports complying with Section 017419 "Construction Waste Management and Disposal."
 - 2. MRc2, Building product disclosure and optimization – environmental product declarations.
 - 3. MRc3, Building product disclosure and optimization – sourcing of raw materials.
 - a. General: Manufacturing locations.
 - b. Option 1: Corporate sustainability reports.
 - c. Option 2:
 - 1) Extended producer responsibility.
 - 2) Bio-based materials.
 - 3) Certified wood products.
 - 4) Materials reuse.
 - 5) Recycled content.
 - 4. MRc4, Building product disclosure and optimization – material ingredients.
 - 5. EQc2, Low emitting materials.
 - a. Low Emitting Materials Tracking Sheet monitoring the project's progress towards targeted LEED Indoor Environmental Quality Credits. Tracking Sheet to be presented at construction meetings.
 - 6. EQc3, Indoor air quality, during construction, complying with Section 017300, "Execution."
 - 7. EQc4, Indoor air quality assessment, comply with article 3.3

1.7 QUALITY ASSURANCE

- A. LEED Coordinator: Engage an experienced LEED-Accredited Professional to coordinate LEED requirements. LEED coordinator may also serve as waste management coordinator.
- B. LEED Preconstruction Meeting: Architect to conduct meeting at project site as part of the Pre-Construction Conference to comply with requirements of this section.
 - 1. The General Contractor shall require all major subcontractors to attend meeting.
 - 2. Review methods and procedures related to managing the LEED construction process and to include, but are not limited to the following:
 - a. Understanding LEED process and terminology.
 - b. Understanding contractor responsibilities and LEED submittal process.

- c. Maintaining proper meeting minutes, records, and tracking mechanisms related to LEED credit responsibilities.
- d. Understanding LEED certification process and filling out LEED Online submittal forms.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Provide products and procedures necessary to obtain LEED credits required in this Section. Although other Sections may specify some requirements that contribute to LEED credits, the Contractor shall determine additional materials and procedures necessary to obtain LEED credits indicated. Contractor to determine a combination of credit options best suited for achieving credits required.
 1. Exclusions: Special equipment, such as elevators, escalators, process equipment, and fire suppression systems, is excluded from the credit calculations. Also excluded are products purchased for temporary use on the project, like formwork for concrete.

2.2 BUILDING PRODUCT DISCLOSURE AND OPTIMIZATION

- A. MRc2, Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Option 1. Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the disclosure criteria:
 1. Product-Specific Declaration: Valued as one quarter (1/4) of a product.
 2. Industry-Wide (Generic) EPD: Valued as one half (1/2) of a product.
 3. Product-Specific Type III EPD: Valued as one whole product.
- B. MRc3, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 1, Raw Material Source and Extraction Reporting. Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the disclosure criteria:
 1. Corporate sustainability reports.
- C. MRc3, Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 2, Leadership Extraction Practices. Provide products that meet at least one of the responsible extraction criteria below for at least 25%, by cost, of the total value of permanently installed building products in the project:
 1. Extended producer responsibility program.
 2. Bio-based materials.
 3. Certified Wood: 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. Heavy timber construction.
 - d. Wood decking.
 - e. Metal-plate-connected wood trusses.
 - f. Structural glued-laminated timber.
 - g. Finish carpentry.
 - h. Architectural woodwork.
 - i. Wood paneling.
 - j. Wood veneer wall covering.
 - k. Wood flooring.
 - l. Wood lockers.
 - m. Wood cabinets.
 - n. Furniture.
 4. Materials Reuse: The following materials may be salvaged, refurbished, or reused materials:
 - a. BUILDING STONE.
 5. Recycled content.
 - a. Exceptions: Do not include fire protection, operational plumbing, operational mechanical, and operational electrical components, and specialty items, such as elevators and equipment, in the calculation.
- D. MRc4, Building Product Disclosure and Optimization, Material Ingredients: Option 1, Material Ingredient Reporting.

1. Use at least 20 different permanently installed products from at least five different manufacturers that use any of the following programs to demonstrate the chemical inventory of the product to at least 0.1% (1000 ppm), which meet one of the following disclosure criteria:
 - a. Manufacturer Inventory.
 - b. Health Product Declarations (HPDs).
 - c. Cradle to Cradle (C2C) certifications.
 - d. Declare product labels.
 - e. ANSI/BIFMA e3 Furniture Sustainability Standard.
- E. MRc4, Building Product Disclosure and Optimization, Material Ingredients: Option 2, Material Ingredient Optimization.
1. Use products that document their material ingredient optimization using the paths below for at least 25%, by cost, of the total value of permanently installed products in the project, which meet one of the following disclosure criteria:
 - a. GreenScreen benchmarks.
 - b. Cradle to Cradle certifications.
 - c. REACH optimizations.

2.3 LOW-EMITTING MATERIALS

- A. EQc2, Low-Emitting Materials, General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDHP), Standard Method v1.1-2010, using the applicable exposure scenario. Manufacturer’s documentation demonstrating compliance must state the range of total VOCs (tVOC) after 14 days measured as specified in the CDPH Standard Method v1.1 as follows:
1. 0.5mg/m3 or less,
 2. between 0.5 and 5.0 mg/m3 or,
 3. 0.50 mg/m3 or more.
- B. EQc2, Low-Emitting Materials, Paints and Coatings: For field applications that are inside the weatherproofing system, use paints and coatings that comply with the limits for VOC content when calculated according to the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011.

Product Type:	Allowable VOC Content (g/L):
Bond Breaker	350
Clear wood finishes - Varnish	275
Clear wood finishes – Sanding Sealer	275
Clear wood finishes - Lacquer	275
Colorant – Architectural Coatings, excluding IM coatings	50
Colorant – Solvent Based IM	600
Colorant - Waterborne IM	50
Concrete – Curing compounds	100
Concrete – Curing compounds for roadways & bridges	350
Concrete surface retarder	50
Driveway Sealer	50
Dry-fog coatings	50
Faux finishing coatings - Clear topcoat	100
Faux finishing coatings – Decorative Coatings	350
Faux finishing coatings - Glazes	350
Faux finishing coatings - Japan	350
Faux finishing coatings – Trowel applied coatings	50
Fire-proof coatings	150
Flats	50
Floor coatings	50

Form release compounds	100
Graphic arts (sign) coatings	150
Industrial maintenance coatings	100
Industrial maintenance coatings – High temperature IM coatings	420
Industrial maintenance coatings – Non-sacrificial anti-graffiti coatings	100
Industrial maintenance coatings – Zinc rich IM primers	100
Magnesite cement coatings	450
Mastic coatings	100
Metallic pigmented coatings	150
Multi-color coatings	250
Non-flat coatings	50
Pre-treatment wash primers	420
Primers, sealers and undercoaters	100
Reactive penetrating sealers	350
Recycled coatings	250
Roof coatings	50
Roof coatings, aluminum	100
Roof primers, bituminous	350
Rust preventative coatings	100
Stone consolidant	450
Sacrificial anti-graffiti coatings	50
Shellac- Clear	730
Shellac – Pigmented	550
Specialty primers	100
Stains	100
Stains, interior	250
Swimming pool coatings – repair	340
Swimming pool coatings – other	340
Traffic Coatings	100
Waterproofing sealers	100
Waterproofing concrete/masonry sealers	100
Wood preservatives	350
Low solids coatings	120

- C. EQc2, Low-Emitting Materials, Paints and Coatings: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. EQc2, Low-Emitting Materials, Adhesives and Sealants: For field applications that are inside the weatherproofing system, use adhesives and sealants that comply with the limits for VOC content when calculated according to South Coast Air Quality Management District (SCAQMD) Rule #1168, requirements in effect on July 1, 2005, and rule amendment date January 7, 2005:

Architectural Applications:	Allowable VOC Content (g/L):
Indoor carpet adhesives	50
Carpet pad adhesives	50
Outdoor carpet adhesives	150
Wood flooring adhesives	100
Rubber floor adhesives	60
Subfloor adhesives	50
Ceramic tile adhesives	65

VCT and asphalt tile adhesives	50
Dry wall and panel adhesives	50
Cove base adhesives	50
Multipurpose construction adhesives	70
Structural glazing adhesives	100
Single ply roof membrane adhesives	250
Specialty Applications:	
PVC welding	510
CPVC welding	490
ABS welding	325
Plastic cement welding	250
Adhesive primer for plastic	550
Computer diskette manufacturing	350
Contact adhesive	80
Special purpose contact adhesive	250
Tire retread	100
Adhesive primer for traffic marking tape	150
Structural wood member adhesive	140
Sheet applied rubber lining operations specialty	850
Top and Trim adhesive	250
Substrate Specific Applications:	
Metal to metal substrate specific adhesives	30
Plastic foam substrate specific adhesives	50
Porous material (except wood) substrate specific adhesives	50
Wood substrate specific adhesives	30
Fiberglass substrate specific adhesives	80
Sealants:	
Architectural sealant	250
Marine deck sealant	760
Nonmember roof sealant	300
Roadway sealant	250
Single-ply roof membrane sealant	450
Other sealant	420
Sealant Primers:	
Architectural non-porous sealant primer	250
Architectural porous sealant primer	775
Modified bituminous sealant primer	500
Marine deck sealant primer	760
Other sealant primer	750
Other	
Other adhesives, adhesive bonding primers, adhesive primers or any other primers	250

1. Exception: The provisions of SCAQMD Rule 1168 do not apply to adhesives and sealants subject to state or federal consumer product VOC regulations.

- E. EQc2, Low-Emitting Materials, Adhesives and Sealants: For field applications that are inside the weatherproofing system, 90 percent of adhesives and sealants shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- F. EQc2, Low-Emitting Materials, Flooring: Flooring shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- G. EQc2, Low-Emitting Materials, Composite Wood: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.
- H. EQc2, Low-Emitting Materials, Ceilings, Walls, Thermal, and Acoustic Insulation: Ceilings, walls, and thermal insulation shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- I. EQc2, Low-Emitting Materials, Exterior Applied Materials: At least 90 percent of exterior applied materials, measured by volume, shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 1. The following materials are prohibited and do not count toward total percentage compliance:
 - a. Hot-mopped asphalt for roofing.
 - b. Coal tar sealants for parking lots and other paved surfaces.
- J. EQc2, Low-Emitting Materials, Furniture: At least 90 percent of furniture, measured by cost, shall be tested in accordance with ANSI/BIFMA Standard Method M7.1-2011; comply with ANSI/BIFMA e3-2011 Furniture Sustainability Standard, Sections 7.6.1 and 7.6.2, using either the concentration modeling approach or the emissions factor approach; and model the test results using the open plan, private office, or seating scenario in ANSI/BIFMA M7.1, as appropriate.
- K. Additional Low-Emitting Requirements:
 - 1. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
 - 2. If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
 - 3. Methylene chloride and perchloroethylene may not be intentionally added in paints, coatings, adhesives, or sealants.

2.4 INDOOR WATER USE REDUCTION

- A. WEp2, Indoor Water Use Reduction, Appliances: Provide ENERGY STAR or performance equivalent appliances.
- B. WEp2/WEc2, Indoor Water Use Reduction, Plumbing Fixtures: Do not exceed water flow requirements indicated in Division 22 - PLUMBING.

PART 3 - EXECUTION

3.1 NONSMOKING BUILDING

- A. EQp2, Environmental Tobacco Smoke Control: Smoking is not permitted within the building or within 25 feet of entrances, operable windows, or outdoor-air intakes.

3.2 CONSTRUCTION WASTE MANAGEMENT

- A. MRp2 MRc5, Construction and Demolition Waste Management: Comply with Section 017419 "Construction Waste Management and Disposal."

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

- A. EQc3/EQc4, Construction Indoor Air Quality Management Plan:
- B. Flush-Out:

1. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total volume of 14,000 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. If occupancy is desired prior to flush-out completion, the space may be occupied following delivery of a minimum of 3500 cu. ft. of outdoor air per sq. ft. of floor area to the space. Once a space is occupied, it shall be ventilated at a minimum rate of 0.30 cfm per sq. ft. of outside air or the design minimum outside-air rate, whichever is greater. During each day of the flush-out period, ventilation shall begin a minimum of three hours prior to occupancy and continue during occupancy. These conditions shall be maintained until a total of 14,000 cu. ft./sq. ft. of outside air has been delivered to the space.
- C. Air-Quality Testing: Engage testing agency to perform the following:
1. Conduct baseline IAQ 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 Reference Guide for Building Design and Construction."
 2. Demonstrate that the contaminant maximum concentrations listed below are not exceeded:
 - a. Formaldehyde: 27 ppb.
 - b. Particulates (PM10): 50 micrograms/cu. m.
 - c. Ozone: 0.075 ppm, according to ASTM D 5149.
 - d. Total Volatile Organic Compounds: 500 micrograms/cu. m.
 - e. 4-Phenylcyclohexene (4-PH): 6.5 micrograms/cu. m.
 - f. Carbon Monoxide: 9 ppm and no greater than 2 ppm above outdoor levels.
 - g. Target Chemicals in California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Table 4-1 (except formaldehyde): Allowable concentrations in California Department of Public Health "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers," Table 4-1.
 3. For each sampling point where the maximum concentration limits are exceeded, take corrective action until requirements have been met.
 4. Air-sample testing shall be conducted as follows:
 - a. 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.
 - b. 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.
 - c. Number of sampling locations varies 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 5000 sq. ft.. For large open spaces, one sampling point per 50,000 sq. ft. may be used.
 - d. 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 018113.15

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PRODUCT DATA REPORTING FORM for LEED v4 Projects

THIS FORM IS REQUIRED TO BE SUBMITTED WITH Product Data Submittals

You must include backup documentation such as SPECIFIC Product Data Sheets, Cut Sheets, Product Specific Letter from Manufacturer, etc. DO NOT INCLUDE GENERIC MARKETING MATERIAL

LEED PROJECT NAME: _____
 SUBCONTRACTOR: _____
 Specification Section: _____ Submittal Number: _____

Project Product Data			Materials and Resources LEED Credits											Low-Emitting Materials LEED Credits					
Product	Manufacturer	Product Costs ¹ (only exclude install labor) (\$)	Product Specific (PS) or Industry Wide (IW) Env. Product Declaration (EPD) ^{3?} (Option 1)	Multi-Attribute Product Declaration (EPD) ^{3?} (Option 2)	FSC Certified ⁷ Wood Products? (%)	Post-Consumer Recycled Content ⁸ (%)	Pre-Consumer Recycled Content ⁹ (%)	Extended Producer Responsibility ⁵ Program Name?	Declare. ⁶ Declare Label with ingredient disclosure greater than 1000 ppm?	Fully Declared HPD to 1000 ppm Declaration ⁴ included? (Option 1)	Fully Declared HPD Material Optimization? (Option 2)	Product Manufacturers Supply Chain HPD Material Optimization? (Option 3)	C2C version (2.1.1 or 3.0) Level of Certification	ONLY if product has FSC or recycled content, then fill Regional Data	Extracted, Manufactured, & Purchased within ² 100 miles?	CDPH Emissions ¹⁰ testing compliant?	VOC Content ¹¹ (g/L)	Wet-Applied Products Volume Used (L)	Wood Products are ULEF or NAUF ^{12?}
Ex. ABC Product	ABC. Inc.	\$ XX,XXX	PS/IW	PS / IW	%	%	%	Yes / No	Yes / No	Yes/No	Yes/No	Yes / No	Yes / No		Yes / No	Yes / No	##	##	Yes / No
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			

- NOTES / DEFINITIONS:**
- Furnish Costs include all expenses to deliver the material to the project site, including taxes, transport, fabrication and profit. Do not include site labor or installation.
 - Within 100 miles distance is defined as travel by air to the project site, not travel distance by road. <http://www.distancefromto.net/>
 - Environmental Product Declarations which conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope. <http://productguide.ulenvironment.com/QuickSearch.aspx>
 - The end use product has a published, complete Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration open Standard. [HPD Collaborative Repository](#)
 - Extended producer responsibility. Products purchased from a manufacturer (producer) that participates in an extended producer responsibility program or is directly responsible for extended producer responsibility. (e.g. Closed Loop or Take Back Program)
 - Wood products must be certified by the Forest Stewardship Council (FSC) and must provide proof of vendor FSC Chain-of-Custody with this Product Data Submittal. <http://info.fsc.org/certificate.php>
 - Post-Consumer Recycled Content: Sourced from recovered Consumer Waste and used as a raw material (e.g. plastic bottles, newspaper, etc).
 - Pre-Consumer Recycled Content: Recovered Industrial Materials diverted from municipal solid waste for use in a different mfg. process, prior to use by a consumer. Note: "home scrap" from the original mfg. process that are reused / reprocessed do not qualify.
 - TVOC Emissions for Building products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1-2010 <http://www.usgbc.org/resources/low-emitting-materials-third-party-certification-table>
 - All paints and coatings wet-applied on site must meet applicable VOC limits of the California Air Resources Board (CARB) 2007, Suggested Control Measure (SCM) for Architectural Coatings, or the South Coast Air Quality Management District (SCAQMD) Rule 1113, effective June 3, 2011. All adhesives and sealants wet-applied on site must meet the applicable chemical content requirements of SCAQMD Rule 1168, July 1, 2005, Adhesive and Sealant Applications, as analyzed by the methods specified in Rule 1168.
 - Composite Wood Evaluation as defined by the California Air Resources Board (CARB), Airborne Toxic Measure to Reduce Formaldehyde Emissions from Composite Wood Products Regulation, must be documented to have low formaldehyde emissions that meet the CARB ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde (NAUF) resins.

I, _____ a duly authorized representative of _____ hereby certify that the material information submitted here is an accurate representation of the material to be provided under our contract.

EMAIL CONTACT FOR AUTHORIZED REPRESENTATIVE: _____ Direct Phone: _____
 SIGNATURE OF AUTHORIZED REPRESENTATIVE: _____ DATE: _____



LEED v4 for BD+C: New Construction and Major Renovation

Project Checklist

Project Name:

Date:

Y ? N

1 Credit Integrative Process 1

8 6 18 Location and Transportation 16				5 6 0 Materials and Resources 13						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	LEED for Neighborhood Development Location	16	<input type="checkbox"/>	Prereq	Storage and Collection of Recyclables	Required	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Sensitive Land Protection	1	<input type="checkbox"/>	Prereq	Construction and Demolition Waste Management Planning	Required	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	High Priority Site	2	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Building Life-Cycle Impact Reduction	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Surrounding Density and Diverse Uses	5	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Access to Quality Transit	5	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Bicycle Facilities	1	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Building Product Disclosure and Optimization - Material Ingredients	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Reduced Parking Footprint	1	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Construction and Demolition Waste Management	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Green Vehicles	1	<input type="checkbox"/>	<input type="checkbox"/>			

5 5 0 Sustainable Sites 10				9 7 0 Indoor Environmental Quality 16						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Construction Activity Pollution Prevention	Required	<input type="checkbox"/>	Prereq	Minimum Indoor Air Quality Performance	Required	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Site Assessment	1	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Enhanced Indoor Air Quality Strategies	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Site Development - Protect or Restore Habitat	2	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Low-Emitting Materials	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Open Space	1	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Construction Indoor Air Quality Management Plan	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Rainwater Management	3	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Indoor Air Quality Assessment	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Heat Island Reduction	2	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Thermal Comfort	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Light Pollution Reduction	1	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Interior Lighting	2
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	Credit	Daylight	3
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	Credit	Quality Views	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				<input type="checkbox"/>	<input type="checkbox"/>	Credit	Acoustic Performance	1

7 4 0 Water Efficiency 11				3 3 0 Innovation 6						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Outdoor Water Use Reduction	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Innovation	5
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Indoor Water Use Reduction	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	LEED Accredited Professional	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Building-Level Water Metering	Required	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Outdoor Water Use Reduction	2	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Indoor Water Use Reduction	6	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Cooling Tower Water Use	2	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Water Metering	1	<input type="checkbox"/>	<input type="checkbox"/>			

10 23 0 Energy and Atmosphere 33				4 0 0 Regional Priority 4						
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Fundamental Commissioning and Verification	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Regional Priority: Specific Credit	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Minimum Energy Performance	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Regional Priority: Specific Credit	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Building-Level Energy Metering	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Regional Priority: Specific Credit	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Prereq	Fundamental Refrigerant Management	Required	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Regional Priority: Specific Credit	1
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Enhanced Commissioning	6	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Optimize Energy Performance	18	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Advanced Energy Metering	1	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Demand Response	2	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Renewable Energy Production	3	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Enhanced Refrigerant Management	1	<input type="checkbox"/>	<input type="checkbox"/>			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Credit	Green Power and Carbon Offsets	2	<input type="checkbox"/>	<input type="checkbox"/>			

52 54 18 TOTALS Possible Points: **110**

Certified: 40 to 49 points, Silver: 50 to 59 points, Gold: 60 to 79 points, Platinum: 80 to 110

SECTION 035300 - CONCRETE TOPPING

1.1 QUALITY ASSURANCE

- A. Mockups for concrete floor toppings.

1.2 MATERIALS

- A. Emery-Aggregate Concrete Topping:
 - 1. Compressive Strength (28 Days): 10,000 psi.
- B. Semirigid joint filler.

1.3 INSTALLATION

- A. Concrete Floor Topping Application: Monolithic topping to new OR Deferred topping with bonding slurry to new concrete; hard trowel finish.

1.4 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 035300

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SECTION 042000 - UNIT MASONRY

1.1 QUALITY ASSURANCE

- A. Mockups of typical wall areas.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Regional materials.

1.3 PERFORMANCE REQUIREMENTS

- A. Net-Area Compressive Strengths of Structural Unit Masonry: As indicated.
- B. Determine net-area compressive strength of masonry by testing masonry prisms.

1.4 MATERIALS

- A. Concrete Masonry Units (CMUs):
 - 1. CMUs: Normal weight.
- B. Reinforcement: Uncoated-steel reinforcing bars.
- C. Masonry-Joint Reinforcement:
 - 1. Interior Walls: Mill- galvanized, carbon steel.
 - 2. Exterior Walls: Stainless steel.
 - a. Basis of Design: Fercorp Slotted Block Tie Type II at CMU backup wall
 - b. Basis of Design: Fercorp Heavy Duty Slopped Rap Tie at cast in place concrete backup wall
 - c. Basis of Design: Fercorp Slotted Stud Tie Type II at metal stud backup wall
- D. Ties and Anchors: Stainless steel. Mill galvanized in interior walls.
 - 1. Individual wire ties.
 - 2. Adjustable anchors for connecting to structural steel framing.
 - a. Basis of Design: FeroCorp Tie; model to be determined
 - 3. Adjustable anchors for connecting to concrete.
 - 4. Partition top anchors.
 - 5. Rigid anchors.
 - 6. Adjustable Masonry-Veneer Anchors: Screw attached.
- E. Embedded Flashing:
 - 1. All Flashing: Stainless steel exposed edge hemmed.
 - 2. Partially Exposed Flashing: Stainless steel.
- F. Weep/Vent Holes: cellular plastic or open-head joints.
- G. Cavity drainage material.
- H. Reinforcing bar positioners.
- I. Mortar:
 - 1. Portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
 - 2. Pigmented mortar for exposed mortar joints.

Sloped?



1.5 INSTALLATION

- A. Bond Pattern: Running bond.
- B. Clean masonry waste recycled as fill material.
- C. For CMU walls, that receive 072726 fluid applied air barriers, CMU face and mortar joint finish shall be finished per the recommendation of the selected fluid applied air barrier manufacturer.
- D. For CMU walls that receive 071326 water proofing, CMU face and mortar joint finish shall be finished per the recommendation of the selected manufacturer.
- E. Joints for exposed CMU walls on finished interior to be concave joints.

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

1.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
- B. Testing: One set of tests for each 5000 sq. ft. of wall area.

END OF SECTION 042000

SECTION 042613 - MASONRY VENEER (AD-ALT)

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Mockups of typical wall areas.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4:
 - 1. Regional materials.

1.3 MATERIALS

- A. Clay Face Brick:
 - 1. Color and Texture: As selected by Architect.
- B. Ties and Anchors: Galvanized steel.
 - 1. Adjustable anchors for connecting to concrete.
- C. Embedded Flashing:
 - 1. Concealed (Flexible) Flashing: elastomeric thermoplastic.
 - a. Used with sealant stop.
- D. Cavity drainage material.
- E. Mortar:
 - 1. Masonry cement or mortar cement unless otherwise indicated.
 - 2. Mortar for exposed mortar joints: match architecture.

1.4 INSTALLATION

- A. Match architecture masonry coursing, bonding, color, and texture.
- B. Bond Pattern: Random bond to match architecture.
- C. Clean masonry waste recycled as fill material.

1.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
- B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

MONTGOMERY COLLEGE PROJECT # FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT
27 SEPTEMBER 2019

END OF SECTION

SECTION 047200 - CAST STONE MASONRY

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-stone bricks, including the following:
 - a. Cast stone bricks
 - b. Window sills.

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A plant certified by the Cast Stone Institute the Architectural Precast Association or the Precast/Prestressed Concrete Institute for Group A, Category AT.
- B. Mockups.

1.3 MATERIALS

- A. Basis of Design: Arriscraft; linear brick series.
 - 1. Brick module: 3 5/8"W X 2 1/4"H X 23 5/8"L
 - 2. Color: Midnight Gray.
 - 3. Bricks are laid in random bond / random length pattern.
 - 4. Joints to be concave joints.
- B. Cast-Stone Units: ASTM C 73 and resistant to freezing and thawing.
- C. Embedded Anchors: Stainless steel.
- D. Mortar: Portland cement and lime type N as recommended by the masonry fabricator.
 - 1. Coloring: Pigmented mortar.
 - 2. Aggregates extracted and manufactured within 500 miles of Project site.

1.4 SOURCE QUALITY CONTROL

- A. Contractor-engaged testing agency to test according to ASTM C 73.
 - 1. One test for resistance to freezing and thawing.

1.5 INSTALLATION

- A. Cast stone set in mortar.
- B. Mechanically anchored cast stone with sealant-filled joints.

END OF SECTION 047200

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SECTION 055000 - METAL FABRICATIONS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Environmental product declaration.
 - 3. Product certificates.

1.2 PRODUCTS

- A. Materials: Steel plates, shapes, and bars Steel tubing Steel pipe .
- B. Miscellaneous Framing and Supports: Galvanized where indicated.
 - 1. Steel framing and supports for ceiling-hung toilet compartments, overhead doors, countertops, mechanical and electrical equipment,.
 - 2. Elevator machine beams, hoist beams, and divider beams.
 - 3. Steel shapes for supporting elevator door sills.
- C. Metal Ladders Including Elevator Pit Ladders: Steel.
- D. Galvanized exterior ladders; custom color to be determined..
- E. Loose bearing and leveling plates, galvanized.
- F. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts cast into concrete or built into unit masonry.
- G. Steel weld plates and angles not specified in other Sections, for casting into concrete.

END OF SECTION 055000

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SECTION 055113 - METAL PAN STAIRS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.

1.2 SUMMARY

- A. Preassembled steel stairs with concrete-filled treads.
- B. Stainless Steel railings and steel guards attached to metal stairs.
- C. Stainless Steel handrails attached to walls adjacent to metal stairs.

1.3 PERFORMANCE REQUIREMENTS

- A. Engineering delegated design of steel stairs, railings, and guards by Contractor.

1.4 STEEL-FRAMED STAIRS

- A. Stair Standard: NAAMM AMP 510, "Metal Stairs Manual," Architectural Commercial Class.
- B. Stringers: Steel plates or channels .
- C. Metal Pan Stairs:
 - 1. Exterior: Galvanized sheet steel
 - a. Exterior Stair at Science North to include metal diamond plate pan.
 - 2. Interior: Uncoated hot or cold rolled steel.
 - a. Color: Selected by Architect.
- D. Steel Tube Railings and Guards:
 - 1. Rails and Posts: 1-5/8-inch- diameter top and bottom rails and 1-1/2-inch- square posts.
 - 2. Intermediate Rails Infill: 1-5/8-inch- diameter intermediate rails spaced less than 12 inches clear.
 - 3. Refer to Drawings for locations and dimensions.

END OF SECTION 055113

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SECTION 055213 - PIPE AND TUBE RAILINGS

1.1 SUMMARY

- A. Interior: Steel pipe vertical railings and pickets with stainless steel railings.
- B. Exterior:
 - 1. Stainless-steel pipe tube railings; Type 316L.
 - 2. Galvanized grating for catwalk and catwalk access stair with galvanized post.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.3 PERFORMANCE REQUIREMENTS

- A. Engineering design of railings by Contractor.

1.4 FABRICATION

- A. Changes in Direction of Members: By bending or by inserting prefabricated fittings.
- B. Connections: Welded or Nonwelded.

1.5 FINISHES

- A. Steel and Iron: Galvanized after fabrication, shop painted with high-performance coating.
- B. Stainless Steel Tubing: Polished and buffed finish: 320-grit finish followed by buffing.
- C. Stainless Steel Sheet and Plate: No. 4 .

END OF SECTION 055213

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SECTION 055213- PIPE AND TUBE RAILINGS

1.1 SUMMARY

- A. Stainless-steel custom railings; Type 304.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4:
 - 1. Recycled content.

1.3 PERFORMANCE REQUIREMENTS

- A. Engineering design of railings by Contractor.

1.4 FABRICATION

- A. Changes in Direction of Members: by welding or by inserting prefabricated fittings.
- B. Connections: Welded
- C. Stainless Steel Tubing: Polished and buffed finish: 320-grit finish followed by buffing.

END OF SECTION

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SECTION 055313 - BAR GRATINGS

1.1 PERFORMANCE REQUIREMENTS

- A. Engineering design of gratings by Contractor.
- B. Floors Loads: 250 lbf/sq. ft. or concentrated load of 3000 lbf.

1.2 GRATINGS

- A. Steel Bar Gratings: Welded .
 - 1. Traffic Surface: Plain Applied abrasive.
 - 2. Finish: Zinc-rich primer .
- B. Recycled Content of Steel: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Low-Emitting Primer: Primer complies with LEED v4.

1.3 GRATING FRAMES AND SUPPORTS

- A. Metal: Same metal as grating.
- B. Exterior and indicated interior steel frames galvanized.

END OF SECTION 055313

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SECTION 057000 - DECORATIVE METAL

1.1 SUMMARY

- A. Decorative Metal Products:
 - 1. Decorative metal gates for Dumpster enclosure indicated on the Drawings.
 - a. Custom color to be determined

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.3 FINISHES

- A. Steel and Iron: Galvanized, high-performance coating .

END OF SECTION 057000

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SECTION 057300 - DECORATIVE METAL RAILINGS

1.1 SUMMARY

- A. Steel and iron decorative railings.
 - 1. painted rails with painted rod in-fills
- B. Illuminated decorative railings.

1.2 QUALITY ASSURANCE

- A. Contractor to engineer railings to withstand structural loads.
- B. Preconstruction Testing: Paid by Owner .
- C. Mockups for each form and finish of railing.

1.3 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.4 MATERIALS

- A. Steel and iron.

1.5 FABRICATION

- A. Connections: Welded or Brazed .
- B. Changes in Direction of Members: By bending or by inserting prefabricated fittings.

1.6 FINISHES

- A. Steel and Iron: Ungalvanized, painted .

1.7 FIELD QUALITY CONTROL

- A. Field Quality-Control Testing: Paid by Owner.

END OF SECTION 057300

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SECTION 057500 - DECORATIVE FORMED METAL

1.1 PERFORMANCE REQUIREMENTS

- A. Engineering design of exterior items by Contractor.
- B. Including exterior canopy fascia elements and other locations indicated on the Drawings.

1.2 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Low-VOC Materials: Adhesives and sealants.
- C. Low-Emitting Materials: Adhesives sealants and paints and coatings comply with LEED v4.
- D. Beam Wraps: Steel .
- E. Closures and Trim: Galvanized steel .
- F. Filler Panels: Galvanized steel .

1.3 FINISHES

- A. Galvanized Steel: High performance, organic coating
 - 1. Custom color to be selected by the Architect

END OF SECTION 057500

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SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Regional materials.
 - 2. Certified wood.
 - 3. Low-emitting adhesives.

1.2 MATERIALS

- A. Wood Products, General:
 - 1. Maximum Moisture Content of Lumber: 15 percent.
- B. Wood-Preservative-Treated Materials:
 - 1. Preservative Treatment: AWPAC U1; Use Category UC2 except Use Category UC3b for exterior construction and Use Category UC4a for items in contact with ground.
 - a. Preservative Chemicals: Containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. Application: Items indicated and the following:
 - a. Items in contact with roofing or waterproofing.
 - b. Items in contact with concrete or masonry.
 - c. Framing less than 18 inches aboveground in crawlspaces.
 - d. Floor plates installed over concrete slabs-on-grade.
- C. Fire-Retardant-Treated Materials:
 - 1. Exterior type for exterior locations and where indicated.
 - 2. Interior Type A, High Temperature (HT) for enclosed roof framing and where indicated.
 - 3. Interior Type A unless otherwise indicated.
 - 4. Application: Items indicated and the following:
 - a. Concealed blocking.
 - b. Roof framing and blocking.
 - c. Items in contact with roofing.
 - d. Plywood backing panels.
- D. Miscellaneous Lumber:
 - 1. Utility Shelving: 15 percent maximum moisture content.
 - a. Mixed southern pine, No. 1 .
 - 2. Concealed Boards: 15 percent maximum moisture content.
 - a. Mixed southern pine, No. 2 .
 - b. Eastern softwoods, No. 2 Common.
- E. Plywood Backing Panels: Exterior, AC .
 - 1. Complies with low-emitting materials requirements of LEED v4.
- F. Fasteners: Hot-dip galvanized Stainless steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.
- G. Metal Framing Anchors:
 - 1. Metal: Galvanized steel; hot-dip heavy galvanized steel for wood-preservative-treated lumber and where indicated; stainless steel for exterior and where indicated.

1.3 INSTALLATION

- A. Furring to Receive Plywood: 1-by-3-inch nominal- size furring at 24 inches o.c.

END OF SECTION 061053

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SECTION 061600 - SHEATHING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Certified wood.
 - 2. Low-emitting adhesives.

1.2 MATERIALS

- A. Wall Sheathing:
 - 1. Glass-Mat Gypsum: Type X, 5/8 inch thick.
 - 2. Cementitious backer units.
- B. Fasteners: Hot-dip galvanized Stainless steel where exposed to weather, in ground contact, in contact with treated wood, or in area of high relative humidity.
- C. Miscellaneous Materials:
 - 1. Sealant for gypsum sheathing.
 - 2. Sheathing tape.

1.3 INSTALLATION

- A. Gypsum Sheathing:
 - 1. Screw to cold-formed metal framing.

END OF SECTION 061600

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SECTION 062023 - INTERIOR FINISH CARPENTRY

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Certified wood.
 - 2. Low-emitting adhesives.

1.2 MATERIALS

- A. Preservative Treatment by Pressure Process: All interior lumber and plywood.

END OF SECTION 062023

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SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.
 - 3. Certified wood.
 - 4. Low-emitting composite wood products.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: .
- B. Mockups for typical plastic-laminate cabinets.

1.3 PLASTIC-LAMINATE-CLAD CABINETS

- A. Architectural Woodwork Standards Grade: Custom .
- B. Type of Construction: Frameless .
- C. Door and Drawer-Front Style: Flush overlay.
- D. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS .
 - 2. Postformed Surfaces: Grade HGP.
 - 3. Vertical Surfaces: Grade HGS .
- E. Materials for Semiexposed Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade VGS .

1.4 MATERIALS

- A. Fire-Retardant-Treated Materials: Where indicated on Drawings.
- B. Cabinet Hardware:
 - 1. Hinges: Frameless, concealed.
 - 2. Pulls: Wire.
 - 3. Adjustable shelf supports.
 - 4. Exposed Hardware Finishes: Satin chromium plated .

metal, not plastic

END OF SECTION 064116

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SECTION 066116 - SOLID SURFACING FABRICATIONS

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid surface material fabrications.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of fabrications.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical fabrication as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.3 SOLID SURFACE FABRICATION MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Type: Provide Standard type unless Special Purpose type is indicated.
 - 2. Colors and Patterns: Match Architect's samples.
- B. Particleboard: ANSI A208.1, Grade M-2 Grade M-2-Exterior Glue.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

1.4 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by solid surface material manufacturer.
 - 1. Adhesives shall have a VOC content of 70 g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

END OF SECTION 066116

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SECTION 071113 - BITUMINOUS DAMPPROOFING

1.1 MATERIALS

- A. Cold-applied, emulsified asphalt.
- B. Primer: Emulsified asphalt.
- C. Protection Course: Fiberglass or asphaltic-core sheets .

1.2 INSTALLATION

- A. Cold-Applied, Emulsified-Asphalt Dampproofing:
 - 1. Unexposed Faces of Masonry Retaining Walls: Primer and one brush or spray coat.
 - 2. Masonry Backup for Brick Veneer Assemblies : Primer and one brush or spray coat.
 - 3. Exterior Face of Inner Wythe of Cavity Walls: Primer and one brush or spray coat.

END OF SECTION 071113

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SECTION 071326 - SELF-ADHERING SHEET WATERPROOFING

1.1 WARRANTY

- A. Manufacturer's Warranty: Five years for materials only.
- B. Installer's Warranty: Two years on specified form.

1.2 MATERIALS

- A. Sheet Waterproofing: modified bituminous sheet waterproofing, fabric reinforced blindside sheet waterproofing for vertical applications, and blindside sheet waterproofing for horizontal applications.
- B. Auxiliary Materials:
 - 1. Primer: Waterborne .
 - 2. Metal Termination Bars: Aluminum.
 - 3. Protection Course: Fiberglass or asphaltic core sheets
 - 4. Drainage board
 - 5. 072100 rigid insulation .

1.3 INSTALLATION

- A. Modified Bituminous Sheet: One -ply application.

1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
- B. Inspections by manufacturer's site representative.
- C. Testing: Flood testing of each deck area.

END OF SECTION 071326

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SECTION 071619 - METAL OXIDE WATERPROOFING

1.1 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, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Metallic Waterproofing.
 - b. Metalcrete Industries; Metalcrete Waterproofing.
 - c. Specco Industries, Inc.; Speccrete Metallic Waterproofer.

1.2 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. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.
- C. Portland Cement: ASTM C 150, Type I.
- D. Sand: ASTM C 144.
- E. Water: Potable.

1.3 MIXES

- A. Metal-Oxide Waterproofing Compound: Add metal oxide waterproofing components, pre mixed or field mixed, per manufacturer's written instructions. Blend together with mechanical mixer or by hand to required consistency for each coat.
- B. Protection Coating: Field mix protection coat consisting of portland cement and sand as recommended by same manufacturer as metal-oxide waterproofing according to manufacturer's written instructions for application over waterproofing. Measure, batch, and mix materials with potable water. Blend together with mechanical mixer to required consistency.

END OF SECTION

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SECTION 071800 - TRAFFIC COATINGS

1.1 QUALITY ASSURANCE

- A. Mockups for each traffic coating and substrate.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting paints and coatings.

1.3 WARRANTY

- A. Materials and Workmanship: Five years.

1.4 PRODUCTS

- A. Traffic Coating: For pedestrian and equipment-room-floor application.
 - 1. Primer: Polyurethane or epoxy.
 - 2. Preparatory and Base Coats: Polyurethane or epoxy.
 - 3. Intermediate Coat: Polyurethane or epoxy.
 - 4. Topcoat: Polyurethane or epoxy.
 - 5. Fire-Test-Response Characteristics:
 - a. Class A roof covering per ASTM E108.

1.5 INSTALLATION

- A. Concrete Substrate Preparation: Remove incompatible materials that might affect coating adhesion and mechanically abrade .

1.6 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 071800

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SECTION 072100 - THERMAL INSULATION

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Low-emitting adhesives.
 - 3. Low-emitting walls and ceilings.
 - 4. Low-emitting insulation.

1.2 MATERIALS

- A. Insulation:
 - 1. Extruded Polystyrene Board: Type VII, 60 psi.
 - 2. Mineral-Wool Blanket: Unfaced.
 - 3. Mineral-Wool Board, Unfaced: 6 lb/cu. ft..
 - 4. Mineral Wool curtainwall cavity insulation: foil faced, seal and tape all joints to adjacent mullions. Clean adjacent surface to ensure tape adheres. Protect tape and foil from damage during construction.
- B. Auxiliary Insulating Materials:
 - 1. Insulation fasteners.
 - 2. Adhesive.
 - 3. Seaming tape

END OF SECTION 072100

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MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

SECTION 072119 - FOAMED-IN-PLACE INSULATION

1.1 MATERIALS

- A. Closed-Cell Spray Polyurethane Foam: Type II, minimum density of 1.5 lb/cu. ft..

END OF SECTION 072119

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27 SEPTEMBER 2019

SECTION 072500 - WEATHER BARRIERS

1.1 MATERIALS

- A. Flexible Flashing: Butyl rubber or rubberized asphalt.

END OF SECTION 072500

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SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

1.1 QUALITY ASSURANCE

- A. Installer Qualifications: Trained and approved by manufacturer and ABAA certified.
- B. Mockups of wall assembly for preconstruction testing.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting coatings.

1.3 PRECONSTRUCTION TESTING

- A. Mockup testing for air leakage locations, air leakage volume, and adhesion.

1.4 PERFORMANCE REQUIREMENTS

- A. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft..

1.5 AIR-BARRIER MEMBRANES

- A. High-Build Air Barrier: Vapor-retarding , type.
- B. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft..
- C. Vapor Permeance:
 - 1. Vapor-Retarding Type: Maximum 0.1 perm.
- D. Fire Propagation Characteristics: Passes NFPA 285.
- E. UV Resistance: Can be exposed to sunlight for 180 days.

1.6 FIELD QUALITY CONTROL

- A. ABAA Quality Assurance Program.
- B. Testing and Inspecting: By Owner-engaged agency for air-leakage locations, air-leakage volume, and adhesion.

END OF SECTION 072726

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SECTION 074113.13 - FORMED METAL ROOF PANELS

1.1 SUMMARY

- A. Provide formed metal roof panels for exterior entrance canopy.

1.2 QUALITY ASSURANCE

- A. Portable roll-forming equipment allowed.

1.3 WARRANTY

- A. Special Warranty: Two years.
- B. Finishes: 20 years.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: ASTM E1592.
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings .
 - 3. Deflection Limits: 1/180 .
- B. Wind-Uplift Resistance: UL 580.
 - 1. Uplift Rating: UL 90.
- C. FM Global listed.
 - 1. Hail Resistance: MH .

1.5 PRODUCTS

- A. Exposed-Fastener, Lap-Seam Metal Roof Panels:
 - 1. Material: Metallic-coated steel sheet.
 - 2. Exterior Finish: Two-coat fluoropolymer .
 - a. Custom color to be selected by the Architect
- B. Accessories:
 - 1. Flashing and trim.
 - 2. Gutters.
 - 3. Downspouts.
 - 4. Roof curbs.

1.6 INSTALLATION

- A. Watertight Installation: Sealant or tape at side laps.

1.7 FIELD QUALITY CONTROL

- A. Testing: By factory-authorized service representative.

END OF SECTION 074113.13

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SECTION 074213.13 - FORMED METAL WALL PANELS

1.1 QUALITY ASSURANCE

- A. Portable roll-forming equipment not allowed.
- B. Mockups.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.3 WARRANTY

- A. Special Warranty: Two years.
- B. Finishes: 20 years.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: ASTM E1592.
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: As indicated on Drawings .
 - 3. Deflection Limits: 1/180.
- B. Air Infiltration: ASTM E283.
- C. Water Penetration: ASTM E331.
- D. Fire-Resistance Rating: ASTM E119 and UL listed.

1.5 PRODUCTS

- A. Exposed-Fastener, Lap-Seam Metal Wall Panels:
 - 1. Profile: Corrugated basis of design is Centria BR5-36 profile
 - 2. Material: Metallic-coated steel sheet.
 - 3. Exterior Finish: Two-coat fluoropolymer .
 - a. Color: Custom color to be selected by the Architect.
 - b. Exposed fasteners to be color matched.
- B. 20 gage panel and manufacturers rail support system.
- C. Concealed-Fastener, Lap-Seam Metal Wall Panels:
 - 1. Basis of Design Manufacturer: Centria
 - 2. Exterior Soffits:
 - a. Basis of Design: Formawall series
 - b. Profile: Flush .
 - c. Material: Metallic-coated steel sheet.
 - d. Exterior Finish: Two-coat fluoropolymer .
 - 3. Backup wall system
 - a. Metalwrap series
 - b. Profile: Manufacturers standard
 - c. Material: Metalic-coated steel sheet
 - d. Exterior Finish: Manufacturers standard epoxy primer
- D. Exterior Louvers
 - 1. Basis of Design Manufacturer: Centria
 - 2. Louver Profile: Match Centria BR5-36
 - 3. Exterior Finish: Two-coat fluoropolymer.
 - a. Color: Custom color to be selected by the Architect
 - 4. Installation: frame-less exterior appearance, and aligned with exposed fastener panels.
- E. Accessories: Flashing and trim.
- F. Insulation: 3" XPS and fluid applied moisture and vapor barrier

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1. Basis of Design: Centria 2 inch insulated metal panel liner assemblies in locations shown on the Drawings.

1.6 INSTALLATION

- A. Watertight Installation: Sealant or tape at joints.

1.7 FIELD QUALITY CONTROL

- A. Testing: By factory-authorized service representative.

END OF SECTION 074213.13

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SECTION 075216 - STYRENE-BUTADIENE-STYRENE (SBS) MODIFIED BITUMINOUS MEMBRANE ROOFING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Solar reflectance index.
 - 2. Recycled content.
 - 3. Low-emitting adhesives.
 - 4. Low-emitting sealants.

1.2 PREINSTALLATION MEETINGS

- A. Preliminary roofing and preinstallation roofing conference.

1.3 WARRANTY

- A. Manufacturer's Materials and Workmanship Warranty: 20 years.
- B. Installer's Warranty: Two years.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind Uplift Resistance:
 - 1. Zone 1 (Roof Area Field) Uplift Pressure: 25 psf.
 - 2. Zone 2 (Roof Area Perimeter) Uplift Pressure: 42 psf.
 - 3. Zone 3 (Roof Area Corner) Uplift Pressure: 64 psf.
- B. SPRI's Directory of Roof Assemblies Wind Uplift Load Capacity Listing: 120 psf.
- C. Cool-Roof Performance: LEED v4.
- D. Exterior Fire-Test Exposure: Class A.

1.5 MATERIALS

- A. Low-emitting adhesives and sealants.
- B. Sheathing paper.
- C. Base Sheet: ASTM D6164/D6164M, Type II, Grade S.
- D. Base Sheet: ASTM D6163/D6163M, Type II, Grade S.
- E. Base Sheet: ASTM D6162/D6162M, Type III, Grade S.
- F. Base Sheet: ASTM D4601/D4601M, Type II.
- G. Cap Sheet: ASTM D6164/D6164M, Type II, Grade G.
- H. Cap Sheet: ASTM D6163/D6163M, Type III, Grade G.
- I. Cap Sheet: ASTM D6162/D6162M, Type III, Grade G.
- J. Base Flashing Sheet:
 - 1. Backer Sheet: SBS-modified asphalt sheet, reinforced with polyester fabric; smooth surfaced
SBS-modified asphalt sheet, reinforced with glass fibers; smooth surface or SBS-modified asphalt
sheet, reinforced with a combination of polyester fabric and glass fibers; smooth surfaced.
- K. Substrate Board: Glass-mat, water-resistant gypsum substrate.
- L. Vapor Retarder: Self-adhering, rubberized asphalt sheet.
- M. Roof Insulation: Polyisocyanurate board.
 - 1. Tapered Insulation: 1/4 inch per 12 inches.
- N. Insulation cant strips.
- O. Tapered edge strips.
- P. Cover Board: Glass-mat, water-resistant gypsum substrate .

- Q. Walkways:
1. Pads: Reinforced asphaltic composition pads with mineral-granule surface.

1.6 INSTALLATION

- A. Roof Insulation: Adhered and mechanically fastened.
- B. Roofing System:
1. Base Sheet: One, installed over sheathing paper.
2. Base Sheet Adhering Method: Cold-applied adhesive.
3. Number of Interply Sheets: Two.
4. Cap Sheet Adhering Method: Cold-applied adhesive.

1.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.
1. Flood testing.
2. Infrared thermography testing.
3. Electrical capacitance/impedance testing.
4. Low-voltage electrical conductance testing.
5. High-voltage spark testing.

END OF SECTION 075216

SECTION 076200 - SHEET METAL FLASHING AND TRIM

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 QUALITY ASSURANCE

- A. Mockups of typical roof edge fascia .

1.3 PERFORMANCE REQUIREMENTS

- A. Sheet Metal Standard for Flashing and Trim: NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" SMACNA's "Architectural Sheet Metal Manual" .
- B. FM Approvals Listing: For copings roof edge flashings for windstorm classification, Class 1-90 .
- C. SPRI Wind Design Standard: For roof edge flashings according to ANSI/SPRI/FM 4435/ES-1 for design pressure of :

1.4 MATERIALS

- A. Sheet Metals:
 - 1. Stainless Steel Sheet, Type 304: ASTM A480/A480M, No. 2D (dull, cold-rolled) finish with smooth, flat surface.
- B. Underlayment: Synthetic underlayment Self-adhering, high-temperature sheet.

1.5 PRODUCTS

- A. For exterior dimensioned fascia and trim refer to sections 057000 and 057500.
- B. Manufactured reglets with counterflashing.
- C. Formed Low-Slope Roof Fabrications: Including roof expansion-joint covers, base flashing, counterflashing, flashing receivers, roof-penetration flashing, and roof-drain flashing.

END OF SECTION 076200

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SECTION 077100 - ROOF SPECIALTIES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 WARRANTY

- A. Roofing-System Warranty: Roof specialties included in warranty provisions of roofing Section.

1.3 PRODUCTS

- A. Copings: Zinc-coated (galvanized) steel .
 - 1. Preformed to match profile indicated on drawings.
 - 2. All exposed edges hemmed
- B. Roof-Edge Drainage Systems:
 - 1. Concealed Gutters: Stainless steel .
 - a. Fabricated and installed by the roofing contractor.
 - 2. Rain chains as rain leaders.
 - a. Cast aluminum with black powdercoat
 - b. Architectural link style
- C. Finishes:
 - 1. Zinc-Coated (Galvanized) Steel: Three-coat fluoropolymer.
 - a. Color: Custom color to be selected by the Architect.
 - 2. Stainless Steel: ASTM A489/A480M No. 4.

END OF SECTION 077100

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SECTION 078100 - APPLIED FIREPROOFING

1.1 QUALITY ASSURANCE

- A. Mockups for each type of fireproofing, substrate, and finish.

1.2 PRECONSTRUCTION TESTING

- A. Testing service engaged by Owner.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Design: Tested according to ASTM E 119 or UL 263. Steel members are considered unrestrained.
- B. VOC content of sealer and topcoat:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
- C. Sealer and topcoat low emitting for LEED v4.

1.4 SPRAYED FIRE-RESISTIVE MATERIALS

- A. Sprayed Fire-Resistive Material: Wet, cementitious type for interior use:
 - 1. Bond Strength: Minimum 430 lbf/sq. ft. .
 - 2. Compressive Strength: Minimum 100 lbf/sq. in. according to ASTM E 761.
 - 3. Fungus resistant.
 - 4. Finish: As selected by Architect from manufacturer's standard finishes .
 - a. Exposed Ceiling areas: Apply separate, colored topcoat after finishing.

END OF SECTION 078100

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SECTION 078413 - PENETRATION FIRESTOPPING

1.1 QUALITY ASSURANCE

- A. Installer Qualifications: FM Approval approved or UL qualified.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting sealants.

1.3 PENETRATION FIRESTOPPING

- A. Penetrations in Fire-Resistance-Rated Walls: F-ratings per ASTM E814 or UL 1479.
- B. Penetrations in Horizontal Assemblies: F-, T-, and W-ratings per ASTM E814 or UL 1479.
- C. Penetrations in Smoke Barriers: L-ratings per UL 1479.
- D. All penetrations to be included per UL requirements.

1.4 INSTALLATION

- A. Identification: All rated walls and penetrations.

1.5 FIELD QUALITY CONTROL

- A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E2174.

END OF SECTION 078413

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SECTION 078443 - JOINT FIRESTOPPING

1.1 QUALITY ASSURANCE

- A. Installer Qualifications: FM Approvals approved or UL qualified.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting sealants.

1.3 FIRE-RESISTIVE JOINT SYSTEMS

- A. Joints in or between Fire-Resistance-Rated Construction: ASTM E1966 or UL 2079.
- B. Joints at Exterior Curtain-Wall/Floor Intersections: ASTM E119 or ASTM E 2307.
- C. All fire resistive joints as required by UL.

1.4 FIELD QUALITY CONTROL

- A. Inspection of Installed Firestopping: By Owner-engaged agency according to ASTM E2393.

END OF SECTION 078443

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SECTION 079200 - JOINT SEALANTS

1.1 PRECONSTRUCTION TESTING

- A. Preconstruction laboratory testing.
- B. Preconstruction field-adhesion testing.

1.2 WARRANTY

- A. Installer Warranty: Two years.
- B. Special Manufacturer's Warranty: Five years.

1.3 JOINT SEALANTS

- A. VOC Content of Interior Sealants:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- B. Low-Emitting Interior Sealants: Sealants comply with LEED V 4.
- C. Silicone joint sealants.
- D. Nonstaining silicone joint sealants.
- E. Urethane joint sealants.
- F. Mildew-resistant joint sealants.
- G. Latex joint sealants.
- H. Joint-sealant backing.

1.4 FIELD QUALITY CONTROL

- A. Field-adhesion testing.

END OF SECTION 079200

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SECTION 079219 - ACOUSTICAL JOINT SEALANTS

1.1 WARRANTY

- A. Installer Warranty: Two years.
- B. Special Manufacturer's Warranty: Two years.

1.2 JOINT SEALANTS

- A. VOC Content of Interior Sealants:
 - 1. Architectural Sealants: 250 g/L.
 - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
 - 3. Sealant Primers for Porous Substrates: 775 g/L.
- B. Low-Emitting Interior Sealants: Sealants comply with LEED v4.
- C. Acoustical Sealants for Exposed and Concealed Joints: Latex.
 - 1. All non-rated partition assemblies to include acoustical joint sealants for all penetrations, top and bottom, and all unfinished ends.
- D. Acoustical Sealant for Concealed Joints: Nonskinning, synthetic rubber.

END OF SECTION 079219

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SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 PERFORMANCE REQUIREMENTS

- A. Fire-rated assemblies.
- B. Windborne-debris-impact-resistant doors and frames.

1.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2.
 - 1. Face: Uncoated steel sheet, minimum thickness of 0.042 inch.
 - 2. Edge Construction: Model 1, Full Flush .
 - 3. Core: Manufacturer's standard .
 - 4. Frames: Face welded ; steel sheet, minimum thickness of 0.053 inch.
 - 5. Exposed Finish: Prime .
 - a. Refer to section 099123 "Interior Painting" for interior metal coating system requirements.

1.4 EXTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3.
 - 1. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
 - 2. Edge Construction: Model 1, Full Flush .
 - 3. Core: Manufacturer's standard .
 - 4. Frames: Face welded ; metallic-coated steel sheet, minimum thickness of 0.053 inch.
 - 5. Exposed Finish: Prime .
 - a. Refer to section 099113 "Exterior Painting" for Exterior metal coating system requirements.

1.5 ACCESSORIES

- A. Louvers: Sightproof Lightproof , steel.
- B. Mullions and transom bars.

1.6 INSTALLATION

- A. Metal-Stud Partitions and Concrete Walls: Frames filled with insulation.

END OF SECTION 081113

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SECTION 081213 - HOLLOW METAL FRAMES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 STANDARD STEEL FRAMES

- A. Interior: SDI A250.8.
 - 1. Materials: Uncoated steel sheet, 0.053-inch thickness.
 - 2. Construction: Face welded .
 - 3. Exposed Finish: Prime .
 - a. Refer to section 099123 "Interior Painting" for interior metal coating system requirements.

1.3 INSTALLATION

- A. Metal-Stud Partitions and Concrete Walls: Frames filled with insulation.

END OF SECTION 081213

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SECTION 081416 - FLUSH WOOD DOORS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Regional materials.
 - 2. FSC Certified wood.
 - 3. Low-emitting adhesives.
 - 4. Low-emitting paints and coatings.
 - 5. Low-emitting composite wood products.

1.2 QUALITY ASSURANCE

- A. Manufacturer and Vendor: FSC certified for chain of custody.
- B. Manufacturer: Licensed participant in AWI's Quality Certification Program.

1.3 DOOR CONSTRUCTION, GENERAL

- A. Quality Standard: Architectural Woodwork Standards.
 - 1. AWI Quality Certification Labels.

1.4 FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors :
 - 1. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
 - 2. Architectural Woodwork Standards Grade: Custom.
 - 3. Species: White oak.
 - 4. Cut: Plain sliced (flat and quarter sliced).
 - 5. Match between Veneer Leaves: Random match.
 - 6. Assembly of Veneer Leaves on Door Faces: Random match.
 - 7. Special Matching:
 - a. Pair and set match.
 - b. Room Match: Door faces of compatible color and grain within each room.
 - c. Blueprint matching.
 - 8. Core: Either glued or nonglued wood stave or structural composite lumber.
 - 9. Construction: Five plies, bonded.

1.5 LIGHT FRAMES AND LOUVERS

- A. Light-Opening Frames:
 - 1. Wood beads.
 - 2. Metal for fire doors.
- B. Louvers: Extruded aluminum with clear anodic finish.
 - 1. Fire-Door Louvers: Galvanized steel with fusible links.

1.6 PRIMING/FINISHING

- A. Factory Finishing: All doors.

END OF SECTION 081416

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SECTION 083113 - ACCESS DOORS AND FRAMES

1.1 PRODUCTS

- A. Flush access doors and frames with concealed flanges.
 - 1. Material:
 - a. Steel frame with gypsum board insert color to match adjacent wall or ceiling surfaces.
 - b. Stainless steel at wall tile locations and as indicated on the Drawings.
- B. Finishes:
 - 1. Steel: Factory primed .
 - 2. Stainless Steel: ASTM A480/A480M No. 4 finish.

END OF SECTION 083113

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SECTION 083323 - OVERHEAD COILING DOORS

1.1 PERFORMANCE REQUIREMENTS

- A. Operability under specified wind load is required.
- B. Air-infiltration limit for exterior doors.
- C. Windborne-debris impact-resistance performance.

1.2 DOOR ASSEMBLY

- A. Finishes: Panels and Glazing to match adjacent metal wall panels.
- B. Insulated Service Door: Door curtain of galvanized steel with fenestrated openings and glazed vision panels.
- C. Operation Cycles: 50,000 .
- D. Design Wind Load: as indicated on the Drawings.
- E. Hood: Match curtain material and finish .
- F. Electric Door Operator: Heavy duty, with emergency manual chain operation.

1.3 MAINTENANCE SERVICE

- A. Initial Maintenance Service: 12 months.

1.4 DEMONSTRATION

- A. Factory-authorized representative to train Owner's personnel.

END OF SECTION 083323

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SECTION 083473.16 - WOOD SOUND CONTROL DOOR ASSEMBLIES

1.1 PERFORMANCE REQUIREMENTS

- A. Sound Rating: STC to be determined.

1.2 WARRANTY

- A. Materials and Workmanship: Two years.

1.3 SOUND CONTROL ASSEMBLIES

- A. Wood Doors: Flush design, thickness as required to provide STC rating .
 - 1. Grade, faces, veneer matching, fabrication, and finishing to match Section 081416 "Flush Wood Doors."
 - 2. Forest Certification: FSC-certified wood doors.
 - 3. Low-Emitting Materials: Adhesives and composite wood products urea formaldehyde free.
 - 4. Low-Emitting Materials: Made with adhesives and composite wood products that comply with requirements of LEED v4.
- B. Steel Frames: Welded unit construction.
- C. Door Hardware: Sound control system, including head and jamb seals, door bottoms, cam-lift hinges, and thresholds, as required by testing to achieve STC rating.
 - 1. Seals: Compression .
 - 2. Door Bottoms: Automatic .
 - 3. Thresholds: Stainless steel .
- D. Steel Finishes: Prime .
 - 1. Color and Gloss: Match Architect's sample .
- E. Wood Finishes: Factory finished to match doors specified in Section 081416 "Flush Wood Doors."
 - 1. Finishing Materials: Low-emitting materials for LEED v4.

1.4 FIELD QUALITY CONTROL

- A. Acoustical Testing Agency: Owner engaged.

END OF SECTION 083473.16

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

1.1 PRECONSTRUCTION LABORATORY MOCKUPS

- A. Preconstruction Testing Service: Owner engaged.

1.2 WARRANTY

- A. Materials and Workmanship: Two years.
- B. Finish: 20 years.

1.3 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.
 - 3. Low-emitting sealant.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Contractor to design aluminum-framed systems.
- B. Windborne-Debris-Impact Resistance: Wind Zone 2.

1.5 SYSTEM COMPONENTS

- A. Basis of Design: Kawneer; TriFab 451 series
- B. Storefront:
 - 1. Interior Vestibule Construction: Nonthermal.
 - 2. Glazing System: Gaskets on two sides (butt-glazed) and structural sealant on two sides.
 - 3. Glazing Plane: Front.
- C. Glazing: Section 088000 "Glazing."
- D. Entrance Doors:
 - 1. Door Construction: 2- to 2-1/4-inch overall thickness.
 - 2. Door Design: Medium stile .
 - 3. Glazing stops and gaskets.
 - 4. Integrate with Curtain Wall systems indicated in section 084413
- E. Entrance Door Hardware: Section 087100 "Door Hardware." As scheduled. Custom color to match Curtain Wall systems in section 084413.

1.6 ALUMINUM FINISHES

- A. Aluminum Finishes:
 - 1. Interior: Baked enamel or powder coat] [High-performance organic (two coats)
 - 2. Exterior Entrances: High-performance organic (three coats) .

1.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.9 MAINTENANCE SERVICE

- A. Entrance Door Hardware: Six months.

END OF SECTION 084113

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SECTION 084413 - GLAZED ALUMINUM CURTAIN WALLS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.
 - 3. Low-emitting sealants.

1.2 WARRANTY

- A. Materials and Workmanship: Two years.
- B. Finish: 20 years.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Contractor to design glazed aluminum curtain walls.
- B. Windborne-Debris-Impact Resistance: Wind Zone 2 , basic protection.

1.4 SYSTEM COMPONENTS

- A. Basis of Design:
 - 1. Kawneer 1600 UT System 1
- B. Framing Members:
 - 1. Construction: Thermally broken .
 - 2. Glazing System: Gaskets on four sides.
 - 3. Glazing Plane: Front .
- C. Glazing: Section 088000 "Glazing."

1.5 ALUMINUM FINISHES

- A. Aluminum Finishes: Superior-performance organic (three coats) PVDF; custom color .

1.6 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 084413

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SECTION 086200 - UNIT SKYLIGHTS

1.1 WARRANTY

- A. Materials and Workmanship: Five years.

1.2 PERFORMANCE REQUIREMENTS

- A. AAMA/WDMA/CSA 101/I.S.2/A440.
 - 1. Performance Class and Grade: Class CW-PG 50 .
 - 2. AAMA-, WDMA-, or CSA-certified unit skylights with label attached to each.
- B. Thermal Transmittance: Center of glass U-factor of 0.29.
- C. Solar Heat-Gain Coefficient (SHGC): SHGC of 0.22.
- D. Windborne-Debris-Impact Resistance: Wind Zone 2 .

1.3 UNIT SKYLIGHTS

- A. Unit Shape and Size: As indicated .
- B. Insulating Glass (SKY GU-1):
 - 1. Exterior Lite: 6-mm (1/4 inch) clear fully tempered glass.
 - 2. Interior Lite: Laminated glass.
 - a. 6 mm (1/4 inch) clear heat treated glass
 - b. 0.060 PVB
 - c. 6 mm (1/4 inch) clear heat treated glass
 - 3. Interspace Content: Air .
 - 4. Low-Emissivity Coating: Manufacturer's standard .
 - a. Basis of Design: Viracon VNE-63 Coating with screen 5006 W/V175 White on side #2.
- C. Integral Curb: Extruded-aluminum , self-flashing type.
- D. Security grilles.
- E. Protective screens.
- F. Finishes: High-performance organic PVFD 3 coat.

1.4 FIELD QUALITY CONTROL

- A. Testing: By Owner -engaged agency.

END OF SECTION 086200

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SECTION 087100 - DOOR HARDWARE

Linnel certification required for access control installer/programmer

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: Everything necessary for and incidental to the execution and completion of all door hardware work, as indicated on the drawings and specified herein
1. Extent of door hardware is shown on the drawings and in the schedules. Door hardware includes all items known commercially as "Builders Hardware" required for swinging, sliding and bi-folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.
- B. Related Requirements:
1. Division 03 for concrete work.
 2. Section 081113 - Hollow Metal Doors and Frames.
 3. Section 081213 - Hollow Metal Frames.
 4. Section 081416 - Flush Wood Doors.
 5. Section 083313 - Coiling Counter Doors.
 6. Section 083323 - Overhead Coiling Doors.
 7. Section 083473.16 - Wood Sound Control Door Assemblies.
 8. Section 084113 - Aluminum-Framed Entrances and Storefronts.
 9. Section 084126 - All-Glass Entrances and Storefronts.
 10. Division 09 for painting.
 11. Division 26 for line voltage wiring and power requirements.
 12. Division 28 Sections for low-voltage wiring including provisions for electronic security system and for connections to building fire alarm system.

1.3 REFERENCES

- A. The publications listed below, including the amendments, addenda and designated changes, form a part of this specification to the extent referenced.
1. Federal Specifications (FS): FF-H-111C-74 Hardware, Builders Shelf and Miscellaneous.
 2. National Fire Protection Association (NFPA):
 - a. Standard 70, National Electric Code.
 - b. Standard 80, Fire Doors and Windows.
 - c. Standard 101, Life Safety Code.
 - d. Standard 252, Standard Methods of Fire Tests of Door Assemblies.
 3. American National Standards Institute (ANSI):
 - a. A156.6, Architectural Door Trim.
 - b. A156.18, Materials and Finishes.
 4. International Building Code (IBC): Basic Building Code.
 5. Americans with Disabilities Act (ADA): Standards for Accessible Design.
 6. Door and Hardware Institute (DHI):
 - a. Keying Systems and Terminology.
 - b. Abbreviations and Symbols.
 - c. Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames.
 7. Underwriters Laboratories, Inc. (UL):
 - a. UL-BMD, Building Materials Directory.
 - b. UL 294, Standard for Safety Access Control System Units.

1.4 ACTION SUBMITTALS

- A. Sustainable Design Submittals (LEED BD+C):
1. Product Data for LEED Credit MR 4: For products have recycled content, documentation indicating percentages by weight of pre-consumer and post-consumer recycled content. Include statement indicating cost of each product containing recycled content.

- B. Supplier's Hardware Schedule: Submit a door hardware schedule in accordance with Division 01 in the manner and format prescribed and used herein, complying with the actual construction progress. Hardware schedules are intended for coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.
1. Hardware Schedule Content: Based on hardware indicated, organize hardware schedule into headings or sets showing complete designations of every item required for each door opening. Schedule shall be vertical layout similar to the format used herein. Lines shall be double spaced with pages numbered and dated.
 - a. For doors of different sizes or where hinges, locks or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings. Horizontal hardware schedules are not acceptable. Include the following:
 - 1) Number, location, hand, fire rating, size and material of each door opening (hands and swings to be determined in relation to key side of opening).
 - 2) Type, style, function, size, finish and quantity of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastening requirements.
 - 5) Explanation of abbreviations used (use nomenclature consistent with DHI's "Abbreviations and Symbols" wherever possible).
 - 6) Special mounting locations and instructions.
 - b. Combined submittals are not acceptable. Do not combine hardware schedules with door and frame shop drawings.
 - c. Schedules not adhering to these parameters will not be reviewed.
 2. Hardware Schedule Index: Furnish an index cross referencing Contract Document door number and Hardware Set, and supplier's hardware set.
- C. Product Data:
1. Submit copies of manufacturers' specifications, maintenance and keying manuals, and installation instructions for each item of door hardware.
 2. Include photographs, catalog cuts, marked templates and other data as may be required to show compliance with these Specifications.
- E. Samples:
1. Submit full size hardware samples as requested by Architect.
 2. Items shall remain on file in the Architect's office until all other similar items have been installed in the project. At that time, items on file will become Owner Maintenance Stock.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Submit Hardware Supplier and Installer qualifications verifying years of experience and hardware manufacturers' certifications; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.
1. Furnish the Owner with written proof of certification of all qualified installers and/or hardware installation firms/subcontractors responsible for installation of hardware specified.
 2. Certifications of installers must be submitted for approval prior to the start of installation.
- B. Templates: Provide necessary templates and/or physical hardware to all trades or factories requiring them so they may cut, reinforce or otherwise prepare their material or product to receive the hardware item. If any manufacturer requires physical hardware, ship to them such hardware via prepaid freight in sufficient time to prevent any delay in the execution of their work.
- C. Other Informational Submittals: After Hardware Schedule has received approval; submit the following:
1. Keying Schedule: Meet with Architect and Owner to finalize keying requirements and obtain keying instructions in writing. Keying schedule shall be established in compliance with specific requirements determined in consultation with Owner. Furnish a detailed keying system schedule, in Microsoft Excel format, indicating Owner's approved keying schedule, for Owner review and approval. Include the following:
 - a. Schematic keying diagram
 - b. Index identifying each key set to unique door designations.
 - c. Key codes.
 - d. Building numbers.
 - e. Room numbers.

- c. Bitting list.
- 2. Wiring Diagrams: Details of electrified door hardware. Include fire alarm and/or access control system interface where applicable.
 - a. Diagrams shall be complete by opening and shall indicate connections between all components affected. Manufacturers' standard line diagrams are not acceptable. Include the following:
 - 1) System schematic.
 - 2) Point-to-point wiring diagram.
 - 3) Riser diagram.
 - 4) Elevation of each door.
 - b. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

1.6 CLOSEOUT SUBMITTALS

- A. Operations and Maintenance Data: Furnish two copies of the Operation and Maintenance manual. Coordinate delivery with the post-installation job site meeting. The manual shall consist of a hard cover and three-ring binder with the project name on the front. Include the following:
 - 1. Maintenance instructions for each item of hardware supplied.
 - 2. Copy of the final Door Hardware Schedules for all doors.
 - 3. Catalog cuts for all items scheduled.
 - 4. Names and phone numbers of the factory representatives for each item supplied.
 - 5. Copy of the final Keying Schedule.
 - 6. Copy of the final Wiring Diagrams.
 - 7. Include any specialized tools needed to maintain the hardware.
- B. Warranty: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

- A. Contractor: Assign all door hardware installation activities to a qualified and experienced hardware Installer; who meets the following criteria:
 - 1. An experienced Installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
 - 2. Factory-certified training in the installation of locksets, exit devices, and door closers.
 - 3. At least one certified Installer must be on site during installation for the purpose of guidance and inspection of all hardware installation, to ensure compliance to manufacturers' recommended installation procedures and Arlington Public Schools bid specifications.
 - 4. Installer shall arrange through Contractor to set up and attend pre-installation conference prior to installing door hardware. This conference shall cover mechanical and electrical hardware components including all locksets, door closers, and exit hardware.
 - 5. All hardware shall be installed with factory provided fasteners using factory provided installation instructions & templates.
- B. Supplier Qualifications: Recognized architectural door hardware supplier, with warehousing facilities in Project's vicinity, who has been furnishing hardware in the Project's vicinity for a period of not less than five years.
 - 1. Supplier must employ an Architectural Hardware Consultant who shall be available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware.
 - 2. Electrified Door Hardware Supplier Qualifications: An experienced door hardware supplier who has completed projects with electrified door hardware 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, and who is acceptable to manufacturer of primary materials.
 - a. Engineering Responsibility: Prepare 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.
 - 3. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- C. Architectural Hardware Consultant Qualifications: A person who is currently certified by the Door and Hardware Institute as an Architectural Hardware Consultant and 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.

1. Electrified Door Hardware Consultant Qualifications: Experienced in providing consulting services for electrified door hardware installations.
 - D. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
 1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that are listed to perform electrical modifications, by a testing and inspecting agency acceptable to authorities having jurisdiction, are acceptable.
 - E. Accessibility for Disabled Persons: Special hardware requirements for knurling, slow acting closers or other barrier free opening requirements shall be provided as indicated in the Door Hardware Sets and as required to comply with the U.S. Department of Justice's "ADA Standards for Accessible Design".
 - F. Hardware for Fire Doors and Exit Doors: Hardware for fire doors shall conform to NFPA 80; hardware for exit doors shall conform to NFPA 101. Other requirements specified shall also apply. Such hardware shall comply with the applicable UL standards for the intended use specified and be listed in UL BMD, or be labeled and listed by another testing laboratory deemed acceptable by the Owner and Architect.
 1. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
 - a. Test Pressure: After five minutes into the test, neutral pressure level in furnace shall be established at 40" or less above the sill.
 - G. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - H. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01. In addition to the Contractor's Project Manager and Superintendent and the Owner, conference participants shall also include Hardware Subcontractor as well as any others requested by the Owner.
 1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control cabinet.
 - d. Address for delivery of permanent keys and cores.
 - I. Pre-Installation Conference: Conduct conference at Project site. Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 2. Review sequence of operation for each type of electrified door hardware.
 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. Review required testing, inspecting, and certifying procedures.
 - J. Installation Inspections: Periodic inspections of door hardware installations will be conducted by the Owner on a continuing on-site basis throughout the time periods of installation.
 1. The Owner will provide feedback information relative to the acceptance or rejection of particular installations to all responsible parties.
 - K. Reference Standards: Except as otherwise required by governing authorities or Contract Documents, comply with applicable provisions of Door and Hardware Institute.
- 1.8 DELINEATION OF DOOR CONTROL INTERFACE RESPONSIBILITIES**
- A. Furnish and install electrified locking hardware, power transfers, magnetic door contacts, etc., as required for the system to perform the functions as defined herein.
 1. Electrically Operated Hardware: Where "fail safe" electric locking hardware is specified hardware devices shall be connected to building fire and smoke/heat alarm systems. Activation of alarm system shall disengage electric locking mechanism allowing free, unrestricted use of the opening.
 - a. Coordinate installation of electrically operated hardware to ensure proper size wire is used to power load(s).

- 1) Voltage drop shall not exceed 5% of load's stated voltage.
 - 2) Voltage drop shall be calculated by first determining resistance of load ($R=E/I$ voltage divided by AMP draw). Next, determine resistance of wire (per below chart). Divide this number by resistance of load. If result exceeds 5%, wire thickness shall be increased.
 - 3) Wire length shall equal distance to load and back to supply (Lock 50 ft. from power supply; wire length = 100 ft.). Two loads powered by one pair of wires draw double current and have half (50%) of resistance.
- | Wire Size | Resistance per 1000 feet |
|-----------|--------------------------|
| 12 Gauge | 1.6 OHM |
| 14 Gauge | 2.5 OHM |
| 16 Gauge | 4.1 OHM |
| 18 Gauge | 6.4 OHM |
| 20 Gauge | 10.1 OHM |
| 22 Gauge | 16.0 OHM |

- B. Provide a single point of interconnection at the hinge or power transfer.
- C. Provide a wiring interface for the project's Security System Integrator to make connections to the control systems. The wiring interface shall be a Molex-Type connector. The mating connector to which the Security system conductors are connected shall be furnished as part of the connector assembly and shall be furnished with conductor "pigtail" having a minimum length of six inches.
- D. Where required, furnish door hardware power supplies as required to power the specific equipment.
- E. Provide solenoids for direct current (DC) application with diodes for transient protection.
- F. Provide boxes or pockets in the door frame as required to accommodate magnetic door contacts, locks, power transfers, etc.; coordinate with door and frame manufacturers.
- G. Provide interconnecting conduit in the door frame between all switches, monitoring devices, and electrified hardware.

1.9 PRODUCT DELIVERY

- A. Deliver door hardware to the Contractor. Direct factory shipments (drop shipments) to the job site are not acceptable.
 1. Deliver items of hardware at the proper times to the proper locations (shop or project site) in their original individual containers, complete with necessary appurtenances including screws, keys, manufacturers' printed instructions, and where necessary, installation templates for manufacturer's suggested installation. Mark each individual container with the manufacturer's name and catalog number as they appear in the hardware schedule.
- B. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.
- C. Keys and Cores:
 1. Supply construction master keys and cores to Contractor when cylinders are delivered, for use during construction.
 2. Prior to the scheduled completion of the project, manufacturer shall ship all permanent keys and cores, including permanent control keys, directly to the UMD Maintenance Locksmith Supervisor via Registered Mail, Return Receipt Requested or other pre-approved means. A copy of the transmittal, clearly identifying all keys shall also be provided.
 3. Under no circumstance shall any permanent keys or cores be furnished direct to the Contractor.
 4. Failure to properly comply with these requirements shall be cause for replacement of cylinders and keys involved at no additional cost to Owner.
- D. Key Cabinet: Deliver key cabinet prior to building occupancy.

1.10 WARRANTIES

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails 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 operators and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Periods:
- a. Hinges: Life of the Building.
 - b. Manual Closers: Ten years from date of Substantial Completion.
 - c. Continuous Hinges: Ten years from date of Substantial Completion.
 - d. Exit Devices and Locksets:
 - 1) Mechanical: Five years from date of Substantial Completion
 - 2) Electrified: Three years from date of Substantial Completion.
 - e. All other hardware items: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Template Hardware: Hardware to be applied to metal or pre-finished doors and frames shall be made to template. Coordinate hardware locations to prevent interference with other hardware items.
- B. Identification: All hardware items shall be clearly and permanently marked by the manufacturer where it will be visible after installation.

2.2 HARDWARE ITEMS

- A. Butt Hinges: Bommer Industries, Hager Companies or McKinney Manufacturing.
 1. Butt hinges shall be Bommer BB5000, Hager BB1279 Series or McKinney TB2714 Series or Stanley FBB179 Series.
 2. Furnish two butt hinges for doors 60-inches or less in height and one additional butt hinge for each additional 30-inches of height or fraction thereof. Unless otherwise specified, butt hinges for doors through 36-inches wide shall be 4.5 x 4.5; butt hinges for doors over 40-inches wide shall be heavy-weight 5 x 4.5.
 3. All butt hinges shall have five knuckles. Furnish non-removable pins (NRP) for all reverse bevel doors receiving keyed locks, rigid outside trim or exit only hardware. Provide butt hinges with holes in the bottom plug to facilitate pin removal.
 4. Butt hinges for labeled doors shall comply with the requirements of NFPA 80.
- B. Pivots: Architectural Builders Hardware, Ives or Rixson.
 1. Where intermediate pivots are specified, they shall be spaced not to exceed 45-inches from centerline of pivot to centerline of pivot.
 2. Pocket Pivots: Furnish two pocket pivots for doors 60-inches or less in height and one additional pocket pivot for each additional 30-inches of height or fraction thereof. Pocket pivots for labeled doors shall comply with the requirements of NFPA 80.
- C. Continuous Hinges: PBB, Inc., Select Products Limited or Zero International.
 1. Geared-Type: Extruded aluminum leaves with interlocking cover and nylon bearings.
 - a. Continuous geared hinges shall consist of two full height bearing levers, geared together for the full length of the hinge and joined with a cover channel.
 - b. Continuous geared hinges are to be heavy duty type with a minimum of 32 bearings up to 84-inches in height. Bearings are to be completely concealed in a full cover channel.
- D. Cylinders: Schlage Lock Company.
 1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Provide cylinders for locksets, deadlocks, exit devices, and all other locking devices indicated in Hardware Sets.
 3. Description:
 - a. Primus® interchangeable core type with cores removable by special control key.
 - 1) Confirm format size with Owner prior to ordering.
 - b. Cylinder parts manufactured from brass, bronze, stainless steel, or nickel silver.
 - c. Equip all cylinders with brass color-coded, temporary cores for use during construction; plastic cores are prohibited.

- d. Include all necessary extensions, cams, tail pieces and hardened collars required for a complete installation.
- E. Locks and Latches: Schlage Lock Company.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Locks and latches shall be Schlage L9000 Series with #17A trim and large-bowed thumbturns.
 - a. For each lock and latchset, provide wrought strike box and square corner ASA strikes with curved lips of sufficient length to protect frames; at pairs of doors furnish flat lip strikes.
 - b. Furnish knurling to lever on corridor side of door to all doors leading to hazardous areas (e.g. Mechanical Rooms, Electrical Rooms, Elevator Machine Rooms, etc.).
 3. All internal working parts shall be brass, bronze, steel or stainless steel.
 4. Furnish keyed devices with cylinders keyed to building system.
 5. Electrical Modifications:
 - a. Locks specified to be electrified shall be modified to electrically lock (FS) or electrically unlock (FSE), as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Locks indicated to have "Request-To-Exit" switches (RX) shall incorporate internal SPDT contacts for remote signaling of operation of the inside lever handle. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
 - c. Field-connect electrified locks to associated power transfer devices; coordinate electrical connection and installation with Divisions 26 and 28.
- F. Exit Devices and Exit Device Accessories: Von Duprin, Inc.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Refer to the Hardware Set Schedule for grade and function.
 - a. Where lever handle functions are required on exit devices, they shall match the design and construction of lever handles specified for mortise locks.
 - b. At mortise exit devices, provide strike box and square corner, stainless steel ASA strike with curved lips of sufficient length to protect frames; at pairs of doors furnish flat lip strikes.
 3. Furnish with provision for concealed mounting, through bolts will not be acceptable.
 4. Furnish keyed devices with cylinders keyed to building system.
 5. Fire Exit Devices: Provide UL-labeled fire-exit hardware at all fire- and smoke-rated openings. Complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire protection, based on testing according to NFPA 252.
 6. Electrical Modifications:
 - a. Exit devices specified to be electrified shall be factory modified to electrically lock (FS) or electrically unlock (FSE), as indicated, upon receipt of a 24V signal and will remain in this mode until signal is interrupted.
 - b. Exit devices indicated to have electric latch retraction (QEL) shall be modified to electrically unlatch (dog down) upon receipt of a 1.0amp, 24V signal and will remain unlatched until signal is interrupted.
 - c. Exit Devices indicated to have "Request-To-Exit" switches (RX) shall incorporate internal SPDT contacts for remote signaling of operation of the push pad. Switches shall be used in conjunction with the Electronic Security Control System to accommodate "authorized egress".
 - d. Field-connect electrified exit devices to associated power transfer devices. Coordinate electrical connection and installation with Divisions 26 and 28.
- G. Automatic Flush Bolts and Coordinators: Hager Companies, Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc. (Trimco).
1. Coordinators: Continuous across door header, complete with filler plates and closer brackets as required. Furnish coordinators primed for field painting.
 2. Provide standard strikes with wrought boxes for top bolts. Dust proof strikes installed on fire-rated openings shall be UL listed for use with associated automatic flush bolts.
- H. Surface Closers: LCN Closers.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.

2. Surface closers shall be LCN 4011 Series with full plastic covers.
 3. Closer arms shall be forged and fluid shall accommodate all applicable weather conditions. Provide manufacturer's heaviest-duty arm assembly.
 4. Where factory sized closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable handicap requirements.
 - a. Door opening forces shall comply with ADA Standards 309.4 and 404.2.9.
 5. Install surface closers on the least conspicuous side of the door (side opposite public view).
 - a. All surface closers to be installed with sex nut and shoulder bolt fasteners.
 - b. Where required to avoid interference with acoustical seals, provide closer mounting brackets for proper frame attachment. Field-paint brackets to match frame finish.
 6. Provide surface closers complete with accessory items and attachments, including full metal closer covers, special arms, soffit shoes, and drop plates. Corner bracket installations are not acceptable.
 - a. Closers, covers, brackets and other components shall not extend below bottom of top horizontal rail of door.
- I. Concealed Closers: LCN Closers.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Concealed closers shall be LCN 2030 Series.
 3. Concealed closers shall be of heavy-duty cast iron construction. All arms shall be heavy-duty solid forged steel. Concealed closers shall have full rack and pinion, independent closing speed and latch speed regulating valves, and adjustable back check.
 4. Where factory sized concealed closers are specified, sizes are to be determined by manufacturer's recommendations for door size, location and applicable accessibility requirements.
 - a. Door opening forces shall comply with ADA Standards 309.4 and 404.2.9.
 5. Furnish for 180-degree door opening where partition construction will permit.
- J. Low Energy Operators: LCN Closers.
1. Provide scheduled products. The products scheduled shall be used to the exclusion of all others and no other products will be considered to be equal.
 2. Operators shall be of heavy-duty construction. Sizes are to be determined by manufacturer's recommendations for door size and location.
 - a. Units shall operate as manual door closers unless operator is activated and when power is lost.
 3. Operation: Activating actuator automatically opens door leaf to 90-degrees, operator then manually closes door after variable time delay expires.
 4. Actuators: Provide 4 1/2-inch square wall-mounted, and 1 3/4-inch wide jamb-mounted stainless-steel actuator plates as indicated.
 - a. Actuators shall operate on 24V current provided by operator.
 - b. Engrave the International Symbol for Accessibility and the text "PUSH TO OPEN" on all actuators; fill with blue enamel paint.
 5. Control Unit:
 - a. Micro-processor controlled.
 - b. Provide adjustable opening speed, adjustable backcheck speed, adjustable closing speed, and adjustable hold-open period.
 - c. Provide built-in 3-position switch for "OFF", "ON" and "HOLD-OPEN" operation and to deactivate actuator switches.
 - d. Provide safety-stop feature: If object or obstruction is encountered during opening and/or closing cycles, door operator stops and slowly returns to closed or open position respectively.
 - e. Provide with safety circuit so that if actuator switch is activated when door is latched or locked, power operator resets without operator and/or door damage.
 6. Accessories: Furnish complete with fastenings, fittings, and other accessories as required for a complete installation.
 7. Manufacturer shall provide detailed wiring diagrams showing point-to-point hook-up of all components affected (e.g. electrified locks, operators, actuators, power, etc.).
 8. Coordinate electrical connection and installation with Divisions 26 and 28.
- K. Architectural Door Trim: Hager Companies, Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc. (Trimco).
1. Protection Plates: Beveled on all sides, fabricated from 0.50-inch thick stainless steel.

- a. Unless narrow bottom rails dictate a smaller size, armor plates shall be 34-inches high and kick plates shall be 10-inches high.
 - b. Armor plates and kick plates shall be 1 1/2-inches less than the door width on single doors and 1-inch less than the door width on double doors.
 - c. Armor plates on labeled doors shall comply with the requirements of NFPA 80.
 2. Push and Pull Plates:
 - a. Plates shall be beveled on all sides, fabricated from 1/8-inch thick stainless steel.
 - 1) Plates shall be 4-inches wide and 16-inches high.
 - b. Pulls: Provide a minimum 2-1/4-inches clearance. Pulls shall be 10-inches center-to-center, mounted back-to-back with concealed fasteners.
 - 1) Fabricate pulls from 1-inch round solid bar stock.
 3. Push-Pull Bars: Push-pull bars shall be back-to-back mounted. Provide units complete with spacers threaded to accept concealed through bolt attachment including provision for spanner tightening of bolts and assembly. Do not furnish grommets at stile/pull interface.
 - a. Refer to the Hardware Set Schedule for style and profile.
 4. Signage: Satin stainless steel, engraved with block capital letters 1-inch in height. Fabricator shall fill lettering with red enamel paint. Signs shall be mounted on door face above and within 12-inches of the exit/actuation device.
 - a. Alarmed Exit Sign: Two centered lines reading:

EMERGENCY EXIT ONLY
ALARM WILL SOUND
 - b. Where glass-mounting is required, include stainless steel plate of matching size for back-to-back mounting; adhere plates to glass using two-part epoxy adhesive compatible with installed glass.
 - c. Refer to the Hardware Set Schedule for locations.
 5. Fasteners: Furnish all flat goods with Phillips undercut, countersunk screws per ANSI A156.6. Trusshead screws are not acceptable.
- L. Custom Push-Pulls and Exit Devices: ASSA Abloy Glass Solutions, C.R. Laurence Company or dormakaba.
1. Fabricate units from stainless steel bar stock. Provide units complete with spacers threaded to accept all-glass through bolt attachment.
 - a. At full height units, provide a minimum of three attachment posts.
 2. Refer to the Hardware Set Schedule for style and design.
- M. Auxiliary Hardware: Hager Companies, Ives, Rockwood Manufacturing Company or Triangle Brass Manufacturing Company, Inc. (Trimco).
1. Manual Flush Bolts: Top manual flush bolts shall not exceed 74-inches from floor to centerline.
 2. Stops: Provide wall stops equal to Rockwood #400 wherever door strikes wall. Where wall stops are not suitable, furnish floor stops equal to Rockwood #441CU (with removable riser).
 3. Silencers: Furnish rubber silencers equal to Rockwood #608 for hollow metal frames; three per single door and four per pair.
 - a. Silencers are not required at aluminum frames or at doors specified to receive continuous weather-stripping or seals.
- N. Overhead Holders and Stops: Glynn-Johnson, Rixson or Rockwood Manufacturing Company.
1. Where wall stops will not work, furnish surface overhead stops equal to Rockwood #OH900S.
 2. Holder arms and channels shall be made of extruded bronze or stainless steel.
 3. Overhead stops shall be installed with sex nut and shoulder bolt fasteners.
- O. Thresholds, Weather-stripping and Seals: National Guard Products, Inc., Pemko Manufacturing Company, Reese Enterprises, Inc. or Zero International.
1. Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Seals shall be polyurethane, neoprene or silicone, vinyl inserts are not acceptable. Provide noncorrosive fasteners for exterior applications and wet areas.
 2. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated.
 - a. Smoke Seals: At all fire-rated wood doors, all 20-minute rated doors, and any other doors required to be 'smoke resistant', provide the following:

- 1) Head and Jambs: Smoke seals equal to Pemko #S88BL.
 - 2) Meeting Stile at Pairs: Overlapping astragal seals equal to one Pemko #772BL or two Pemko #303AS as appropriate for intended hardware operation.
 - 3) Refer to the Drawings for locations.
3. Fire-Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
4. Where required, field-modify thresholds to receive strikes for exit devices and flush bolts.
- P. Key Control System: Lund Key Cabinets, MMF Industries or TELKEE, Inc.
1. Wall-mounted metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150% of the number of keys required herein.
 - a. Equip cabinet with hinged-panel door, key-holding panels, and pin-tumbler cylinder door lock.
 - b. Cross-Index System: Multiple-index system for recording key information. Include three receipt forms for each key-holding hook. Set up by Key Control Cabinet Manufacturer.
 - c. Contractor, in conjunction with the Owner's Representative, shall properly tag, index and file all keys in the key cabinet.
- Q. Fire Department Key Keeper:
1. Type: Recessed mounted.
 2. Finish: Satin aluminum unless otherwise dictated by local fire department.
 3. Provide key keepers for use by fire department.
 - a. Keying shall be as required by local fire department.
 4. Install key keepers in compliance with Authority Having Jurisdiction at locations indicated on Drawings or as directed by Owner.
 5. Acceptable Products:
 - a. American Postal - KK Series; Model #N1004652.
 - b. Bommer – 5622.
 - c. Knox Company - 4400 Series.
 - d. Salsbury – 1095.
- R. Electromagnetic Door Holders: Architectural Builders Hardware, LCN Closers, or Rixson.
1. Connect devices to fire or smoke/heat alarm system via dry contacts, so that when alarm devices are activated, or there is power loss in building, electromagnetic holders will automatically release allowing doors to close.
 2. Electromagnets shall be protected against transients and voltage surges up to 600 volts.
 3. Power Requirements: 24 V AC/DC nominal +10% -15% @ .110-amp maximum.
 4. Coordinate electrical connection and installation with Divisions 26 and 28.
- S. Electric Strikes: C.R. Laurence or Folger Adam Company.
1. Units shall operate at 24V current; refer to the Hardware Set Schedule for grade and function.
 2. Field-connect electric strikes to associated power transfer units.
 3. Coordinate electrical connection and installation with the Divisions 26 and 28.
- T. Egress Devices: Locknetics, Schlage Electronics or Securitron Magnalock Corporation.
1. Devices shall have adjustable, programmable relay latch time.
 2. Refer to the Hardware Set Schedule types and locations.
 3. Products must be UL 294 Listed.
 4. Coordinate electrical connection and installation with Divisions 26 and 28.
- U. Magnetic Door Contacts: Interlogix, Schlage Electronics or Securitron Magnalock Corporation.
1. Unless otherwise indicated, magnetic door contacts shall be equal to Interlogix #1078C. Provide built-in, end of line resistors as required by the Electronic Security Control System.
 2. Coordinate electrical connection and installation with Division 28.
- V. Power Transfer Pivots: Hager Companies, Securitron Magnalock or Von Duprin, Inc.
1. Concealed PTFE-jacketed wires, secured at each leaf and continuous through sleeve.
 2. Field-connect power transfer units to associated electrified locking hardware. Coordinate electrical connection and installation with Divisions 26 and 28.

- W. Special Tools: Provide any necessary special tools (e.g. spanner and socket wrenches, dogging keys, etc.) required to service and adjust hardware items.

2.3 HARDWARE FINISHES

- A. Base metals: Produce hardware units of basic metal and forming method indicated, using manufacturers standard metal alloy composition, temper and hardness, but in no case of lesser quality than specified or inferred by use of a particular manufacturer's number, style or grade or as established by appropriate referenced specification listed herein.
- B. Finishes: Finishes shall conform to the quality of finish including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than the standards established by ANSI/BHMA A156.18 or Federal Specifications FF-H-111C as applicable.
1. All exposed hardware except door closers, ferrous butt hinges and continuous hinges shall be satin stainless steel, ANSI/BHMA 630/US32D.
 - a. Factory-finish door closers to match satin stainless steel.
 - b. Butt hinges at exterior doors and doors in wet areas shall be satin stainless steel; butt hinges at all other doors shall be satin chrome plated, ANSI/BHMA 652/US26D.
 - c. Continuous hinges at aluminum storefront doors shall be factory-finished to match storefront, coordinate with Section 084113 "Aluminum-Framed Entrances and Storefronts".
 - d. Items of hardware not available in stainless steel shall be furnished satin chrome plated, ANSI/BHMA 626/US26D.
 2. Where painting of primed surfaces is required, refer to Division 09 specifications.

2.4 KEYING

- A. General: Key system shall be as directed by the Owner.
1. Keying is the responsibility of the Contractor; and shall be performed by the cylinder manufacturer.
 2. Provide the type of system required (e.g. master, grand master, great grand master). Nomenclature and layout shall be consistent with DHI "Keying Systems and Terminology".
 - a. All cylinder cores shall be grand master keyed into the existing Montgomery College, Schlage Lock Company master key system, utilizing the D125 keyway.
 - b. Construction keys and cores shall not be part of, or furnished on the same keyway as, the permanent keying system.
 3. Key System Summary, Cover Sheet, and Letter of Authorization shall accompany Keying Schedule and Purchase Order sent to Factory.
- B. Keys: Provide keys of nickel silver only in the following quantities:
1. Grand Master Key: One.
 2. Master Keys: Four per system.
 3. Change Keys: Provide three keys for each keyed core.
 4. Construction Master Keys: Ten.
 5. Control Keys (for removal of cores): Five permanent and three temporary/construction.
 6. Blank Keys: 100.
- C. Identification:
1. Permanent keys and all cores shall be marked with applicable blind code for identification. These concealed key control marks or codes shall not include actual key cuts.
 - a. Key and core identification stamping shall be approved by the Owner. Failure to properly comply with this requirement shall be cause for replacement of cylinder cores and keys involved at no additional cost to Owner.
 - b. All key blanks shall be stamped with Owner's exclusive Facility Code and "DO NOT DUPLICATE".

2.5 FASTENERS

- A. Manufacture hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping or sheet metal screws except as specifically indicated.
1. Furnish screws for installation with each hardware item. Provide Phillips flat head or oval head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to

match the hardware finish or, if exposed in surfaces of other work, to match the finish of such work as closely as possible, except as otherwise indicated.

- a. Where wood screws are required, they shall be full thread (to the head) type. Combination wood/machine screws, in lieu of wood screws, are not acceptable.
2. Provide concealed fasteners for hardware units which are exposed when the door is closed, except to the extent no standard manufactured units of the type specified are available with concealed fasteners. Do not use through bolts for installation except where it is not possible to adequately reinforce the work, to accept machine screws or concealed fasteners or another standard type, to avoid the use of through bolts.
3. Furnish fasteners which are compatible with both the unit fastened and the substrate, and which will not cause corrosion or deterioration of hardware, base material reinforcement or fastener. Furnish wall stops with "Toggler" anchors and wood screws. Furnish thresholds and floor stops with lead anchors and 1/4-20 stainless steel machine screws.

PART 3 - EXECUTION

3.1 STORAGE AND HANDLING

- A. Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.
 1. A dry, locked storage space complete with adequate shelving shall be set aside for the purpose of unpacking, sorting out, checking and storage. Control the handling and installation of hardware items, whether immediately replaceable or not, so completion of the work will not be delayed by losses before or after installation.
 2. Tag each item or package separately, with identification related to the final approved hardware schedule, and include basic installation instructions in the package. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

3.2 COORDINATION

- A. Coordinate Door Hardware Schedule submission and hardware ordering to ensure delivery of all items as directed by the Contractor.
 1. Prior to ordering any hardware, examine the shop drawings and details of doors and frames and other substrate suppliers to determine that the proper type and size pieces of hardware are being furnished. No extra for material or labor will be allowed for any corrections that should have been eliminated by proper prior coordination.
- B. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. 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. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, and access control system.
 1. Coordinate installation of the electronic security hardware with the Architect and Electrical Engineers and provide installation and technical data to the Installer and other related sub-contractors.
- D. Concrete, reinforcement, and formwork requirements are specified in Division 03.

3.3 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire 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.

3.4 INSTALLATION

- A. Install each hardware item in accordance with final approved Hardware Schedule and manufacturer's instructions.
 - 1. Set hardware level, plumb and true to line and location.
 - 2. Adjust and reinforce attachment substrate as required for proper installation and operation of hardware.
 - 3. Drill and countersink units which are not factory-prepared for anchorage fasteners; space fasteners and anchors uniformly, in accordance with industry standards.
- B. Hardware Mounting Heights:
 - 1. Provide heights as indicated on Drawings, except as otherwise required for compliance with governing regulations.
 - 2. Where heights are not indicated, comply with mounting requirements of DHI "Recommended Locations for Builder's Hardware" on custom steel doors and frames.
- C. Fire Doors and Exit Doors:
 - 1. Hardware for labeled fire doors shall be installed in accordance with the requirements of NFPA 80.
 - a. Where panic exit devices are required on fire rated doors, (with supplementary marking on door U.L. label indicating "Fire Door to be Equipped with Fire Exit Hardware") provide U.L. label on exit device indicating "Fire Exit Hardware."
 - 2. Hardware for listed exit doors shall be installed in accordance with the requirements of NFPA 101.
- D. Hinges: Install steel doors and wood doors to comply with reference standards, as specified in door sections.
 - 1. Where shimming is required to comply with tolerances, provide metal shims only.
- E. Electrified Hardware:
 - 1. Pre-wire and make field connections between all electrically operated and monitored hardware items including, but not limited to, locks, exit devices, power transfers and magnetic door contacts.
 - 2. All wiring must be 18 gauge or thicker.
- F. Closers:
 - 1. Do not install parallel arm closers until after weather-stripping or seals have been installed on head frame (where weather-stripping or seals are scheduled).
 - 2. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 - 3. Adjust closers to control door swing and to provide positive latching of doors.
 - a. Adjust closers not to exceed following manual opening forces:
 - 1) Exterior doors: As required to close and latch each leaf.
 - 2) Interior doors (non-fire-rated): Maximum 5-pound opening force.
 - 3) Fire-rated doors: As required to close and latch each leaf.
 - b. After air-handling system has been balanced, make final adjustment of all closers.
- G. Door Stops:
 - 1. Install stops for maximum degree of door opening swing allowed by conditions of installation.
 - 2. Locate floor stops so as not to create a tripping hazard.
 - 3. Locate wall stops centered on spindle of lever handles; coordinate with partition installer to ensure proper blocking is provided wherever wall stops are to be installed.
- H. Weather-stripping and Seals:
 - 1. Install continuous around door heads and jambs, and meeting stiles of pairs of doors.
 - 2. Install bottom weather-stripping and automatic door bottoms for full width of door.
 - 3. Do not cut weather-stripping or seals for attachment of closer brackets or shoes.
 - 4. Installation of adhesive gasketing and seals: The following installation instructions must be strictly adhered to. Failure to comply can result in premature product failure. Contractor will be required to remove failed product entirely and properly install new materials.
 - a. Before installation, thoroughly clean the frame with the manufacturer-enclosed cleansing towelette to remove grease, dust or cleanser build-up. Before installation, wait for frame surface to completely dry (evaporate). As an alternative or substitute cleanser, use isopropyl (rubbing) alcohol. Mineral spirits or other petroleum-based cleaning products should NOT be used.
 - b. Application Temperature: Do not install if frames are below 50°F or above 100°F.
 - c. When to Install:

- 1) Installation should take place after construction is completed, flooring is installed and final cleaning is completed.
 - 2) Paint on frame must be cured for at least 5-7 days. Paint cannot be wet under dry surface when gaskets are pressed on. Avoid quick-dry primers, which leave a powdery surface preventing sufficient adhesion.
 - 3) When applying to a wood frame, the surface must be non-porous and sealed. Follow standard industry guidelines on sealed wood frames and/or rough surface before applying.
5. Weather-stripping, gasketing and seals must form an airtight barrier around the full perimeter of the door. There can be no gaps that allow air, light, sound, or smoke to pass through.
- a. Contractor is responsible for adjusting the alignment of doors and seals until the above conditions are met. If gaps cannot be avoided because the door or frame is not properly sized, plumb, and level, the offending components must be replaced at contractor expense.
6. Align rain drips with the bottom edge of the door frame rabbet.
7. Set all rain drips and exterior thresholds in full bed of mastic sealant and attach with stainless steel fasteners.
- I. Cylinder Cores:
1. When notified by the Owner, Contractor shall employ a Schlage Lock Company Factory Representative to remove construction cores and install permanent cores in the presence of the Contractor and the Owner's designated representative.
 2. After removal, verify that all locking components (e.g. collars, tailpieces, etc.) are still intact.
 3. It is the contractor's responsibility to return the construction cores and keys to the manufacturer. Construction cores and keys remain the property of the Cylinder Manufacturer.
- J. Key Cabinet:
1. Install in accordance with manufacturer's instructions in location as directed. Instruct the Owner in the use of the key control system.
 2. Keys shall be tagged, neatly installed within the key cabinet. Submit documentation of keying compliance including copies of signed transmittals for all building keys and cabinet provided by the Hardware Supplier.
- K. Coordination with Adjacent Finishes:
1. If cutting and fitting are required to install hardware onto or into surfaces that are later painted or finished in another way, install each item completely and then remove and store in secure place during finish application.
 2. After completion of finishes, reinstall each item.
 3. Do not install surface mounted items until finishes are complete on substrate.

3.5 ADJUST AND CLEAN

- A. General: To ensure proper operation and function of every unit, adjust and check each operating item of hardware and each door. Lubricate moving parts with type lubrication recommended by the manufacturer (graphite-type if no other recommended). Replace unit that cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Verify that the Owner has been supplied with manufacturers' installation and maintenance manuals, product data, and any special adjusting tools normally supplied by the manufacturer.
- B. Continuity Testing: Inspect all connections between electrically operated and monitored hardware items including, but not limited to, electrified locks and exit devices, power transfers and power supplies. Upon completion of inspection, furnish the Architect with itemized report indicating any problems found and steps taken to repair anomalies.
- C. Final Adjustment: Wherever hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and perform a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate as necessary to restore proper function and finish of hardware and doors.
1. Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are functioning as intended by the specifications. Wiring shall be tested for

- correct voltage, current-carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.
2. Factory representatives shall inspect all exit devices and door closers prior to final acceptance to ensure proper installation and adjustment. A written report shall be filed with the Architect and Owner after inspection.
- D. Final Inspection and Acceptance: Prior to completion of Project, the Owner will perform a comprehensive punch-out inspection of all hardware installations and provide appropriate feedback/notification to all responsible parties.
1. All inspections conducted by the Owner shall be in accordance with all manufacturer's recommended procedures and specifications.
 2. The contractor is obligated to provide remedial repair and correction in a timely manner, not to exceed two calendar weeks or ten working days.
 3. In lieu of timely correction, UMD reserves the right to employ certified representatives to correct all deficiencies not properly addressed or executed by the contractor in the time frame outlined. Payment to correct these deficiencies shall be back charged to the contractor.

3.6 HARDWARE SET SCHEDULE

- A. Description of Work:
1. The following set schedules are to be used with Drawings as guide for furnishing door hardware.
 2. Set numbers specified correspond to set numbers indicated on Drawings.
 3. Schedules do not reflect hand, backset (except as noted) or method of fastening of hardware items.

Set 110 GROUP STUDY

	Hinges BB1279	Hager
1	Passage function latchset L9010	Schlage
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Automatic door bottom 369AA / 3551A	Zero
1	Stop	Rockwood

Set 116 UNIVERSAL TOILET, SERENITY

	Hinges BB1279	Hager
1	Privacy function latchset L9044 x L283-722 x L583-363	Schlage
1	Surface closer 4011	LCN
1	Kick plate 190S	Hager
1	Coat hook RM804	Rockwood
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Threshold	Flooring Contractor
1	Automatic door bottom 369AA / 3551A	Zero
1	Stop	Rockwood

Set 310 STAIR DOOR W/ELECTRIC HOLD OPEN

	Hinges BB1279	Hager
1	Passage function exit device 98L x 996L-BE	Von Duprin
1	Surface closer 4011	LCN
1	Electromagnetic holder SEM 7850	LCN

Function: Magnetic holder releases upon activation of Fire Alarm allowing door to close and latch.

Set 311 MAIN ELECTRICAL - SINGLE

	Hinges BB1279	Hager
1	Storeroom function exit device 98L x 996L-NL	Von Duprin
1	Cylinder & core	Schlage
1	Surface closer 4111-EDA	LCN
1	Stop	Rockwood

Set 320 CROSS CORRIDOR W/ELECTRIC HOLD-OPEN

2 sets	Pocket pivots 91105F	Ives
1	Passage function exit device 9447L x 940L-BE	Von Duprin
1	Exit only exit device 9447EO-LBR	Von Duprin
2	Pocket closers 4001T	LCN
2	Kick plates 190S	Hager
2	Electromagnetic holders SEM 7850	LCN

Function: Magnetic holders release upon activation of Fire Alarm allowing doors to close and latch.

Set 321 MAIN ELECTRICAL PAIR

	Hinges BB1279	Hager
1	Storeroom function exit device 9849L-LBL x 996L-NL	Von Duprin
1	Exit only exit device 9849EO-LBL	Von Duprin
1	Cylinder & core	Schlage
2	Surface closers 4111-EDA	LCN
2	Stops	Rockwood

Set 411 MAIN VESTIBULE ENTRY – SINGLE

1	Continuous hinge SL11 HD (factory-finish to match storefront)	Select
1	Dummy push pad 330	Von Duprin
1	Pull RM3411 (24" CTC) x 12HD (with finished end caps)	Rockwood
1	Surface closer 4111-CUSH x 30 x 61	LCN

Set 422 MAIN VESTIBULE ENTRY – PAIR W/POWER OPERATOR

2	Continuous hinges SL11 HD (factory-finish to match storefront)	Select
2	Dummy push pads 330	Von Duprin
2	Pulls RM3411 (24" CTC) x 12HD (with finished end caps)	Rockwood
1	Low energy operator 9542 (requires 120VAC)	LCN
1	Wall-mounted actuator 8310-853T – pull side	LCN
1	Jamb-mounted actuator 8310-818T – push side	LCN
1	Surface closer 4111-CUSH x 30 x 61	LCN
1	Stop 446 (power operator leaf)	Rockwood

Function: Pressing either actuator activates power operator.

Set 430 EXTERIOR STAIR DISCHARGE

1	Continuous hinge SL11 HD (factory-finish to match storefront)	Select
1	Exit only exit device 35A-EO x ALK x concealed fastening	Von Duprin
1	Cylinder & core (for alarm kit)	Schlage
1	Surface closer 4111-CUSH x 30 x 61	LCN
1	Alarmed exit sign 670 x B4E (with back plate)	Rockwood
1 set	Weather-stripping – Head & Jambs	Door Manufacturer
1	Threshold 273x224AFGT	Pemko
1	Sill sweep 315CN (grey insert) - pull-side	Pemko
1	Magnetic door contact 1078C	Interlogix

Function: Depressing crash bar sounds local alarm. Door position status monitored through Access Control System.

Set 431 MAIN EXTERIOR ENTRY – SINGLE

1	Continuous hinge SL11 HD x EPT (factory-finish to match storefront)	Select
1	Electrified exit device RX-QEL-35A-EO x concealed fastening	Von Duprin
1	Pull RM3411 (24" CTC) x 12HD (with finished end caps)	Rockwood
1	Surface closer 4111-CUSH x 30 x 61	LCN
1 set	Weather-stripping – Head & Jambs	Door Manufacturer
1	Threshold 273x224AFGT	Pemko
1	Sill sweep 315CN (grey insert) - pull-side	Pemko
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic door contact 1078C	Interlogix
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator

Function: Door is interfaced with Access Control System for automatic locking and unlocking. Door position status monitored through Access Control System.

When door is secured: No access. Depressing crash bar shunts door contact.

When door is unsecured: Door contact is shunted and electric latch is retracted.

Set 442 MAIN EXTERIOR ENTRY – PAIR W/POWER OPERATOR

2	Continuous hinges SL11 HD x EPT (factory-finish to match storefront)	Select
1	Electrified exit device RX-QEL-35A-NL-OP x concealed fastening	Von Duprin
1	Electrified exit device RX-QEL-35A-EO x concealed fastening	Von Duprin
1	Cylinder & core	Schlage
1	Removable mullion KR4954 x 154 (field-paint to match frame)	Von Duprin
1	Cylinder & core	Schlage
2	Pulls RM3411 (24" CTC) x 12HD (with finished end caps)	Rockwood
1	Low energy operator 9542 (requires 120VAC)	LCN
1	Wall-mounted actuator 8310-853T – pull side	LCN
1	Jamb-mounted actuator 8310-818T – push side	LCN
1	Operator interface module Br3 (for ACS interface)	BEA
1	Surface closer 4111-CUSH x 30 x 61	LCN
1 set	Weather-stripping – Head, Jambs & Meeting Stile	Door Manufacturer
1	Mullion gasket 5110BL	Pemko
1	Threshold 273x224AFGT	Pemko
2	Sill sweeps 315CN (grey insert) - pull-side	Pemko
2	Power transfer pivots EPT-10	Von Duprin
2	Magnetic door contacts 1078C	Interlogix
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator
1	Stop 446 (power operator leaf)	Rockwood

Function: Door is interfaced with Access Control System for automatic locking and unlocking. Door position status monitored through Access Control System.

When door is secured: Card reader shunts door contacts, retracts electric latches and enables outside actuator; pressing actuator activates power operator. Pressing inside actuator shunts door contact, retracts electric latch and activates power operator. Depressing crash bar shunts door contact. Outside actuator should not function without proper signal from Access Control System.

When door is unsecured: Door contacts are shunted, electric latches are retracted and both actuators are functional. Pressing either actuator activates power operator.

Set 510 OFFICE

	Hinges BB1279	Hager
1	Office function lockset L9056 x L583-363	Schlage
1	Coat hook RM804	Rockwood
1	Stop	Rockwood

Set 812 JANITOR CLOSET

	Hinges BB1279	Hager
1	Storeroom function lockset L9080	Schlage
1	Surface closer 4011-DEL / 4111-DEL-EDA	LCN
1	Kick plate 190S	Hager
1	Stop	Rockwood

Set 814 LAB, CLASSROOM, PREP ENTRY

	Hinges BB1279	Hager
1	Electrified lockset L9092EU-RX - FSE	Schlage
1	Surface closer 4011-DEL / 4111-DEL-EDA	LCN
1	Kick plate 190S	Hager
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic door contact 1078C	Interlogix
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator
1	Stop	Rockwood

Function: Card reader shunts door contact and releases electrified lever trim. Turning inside lever shunts door contact. Door position status monitored through Access Control System.

Set 815 MDF, IDF

	Hinges BB1279	Hager
1	Electrified lockset L9092EU-RX - FSE	Schlage
1	Surface closer 4011 / 4111-EDA	LCN
1	Power transfer pivot EPT-10	Von Duprin
1	Magnetic door contact 1078C	Interlogix
1	Card reader	Security System Integrator
1	Power supply	Security System Integrator
1	Stop	Rockwood

Function: Card reader shunts door contact and releases electrified lever trim. Turning inside lever shunts door contact. Door position status monitored through Access Control System.

Set 816 ELECTRICAL, MECHANICAL, EMR - SINGLE

	Hinges BB1279	Hager
1	Storeroom function lockset L9080	Schlage
1	Surface closer 4011 / 4111-EDA	LCN
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Automatic door bottom 369AA / 3551A	Zero
1	Stop	Rockwood

Set 826 MECHANICAL PAIR

	Hinges BB1279	Hager
1	Storeroom function lockset L9080	Schlage
2	Flush bolts 555	Rockwood
1	Dust strike 570	Rockwood
1	Surface closer 4011 / 4111-EDA	LCN
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Astragal sound seal 8042S-Bk (apply to overlapping astragal)	Zero
2	Automatic door bottoms 367AA	Zero
2	Stops	Rockwood
	Astragal by door manufacturer	

Set 912 NEW MOTHER'S ROOM, SHOWER

	Hinges BB1279	Hager
1	Electrified lockset L9492EU-RX x L283-722 x L583-363 - FSE	Schlage
1	Surface closer 4011	LCN
1	Kick plate 190S	Hager
1	Coat hook RM804	Rockwood
1 set	Sound seals 8145S-Bk – Head & Jambs	Zero
1	Threshold	Flooring Contractor
1	Automatic door bottom 369AA / 3551A	Zero
1	Stop	Rockwood

Set 914 LAB COMMUNICATING DOOR

	Hinges BB1279	Hager
1	Electrified lockset L9095EU - FSE	Schlage
1	Surface closer 4111-DEL-CUSH	LCN
1	Kick plate 190S	Hager
1	Power transfer pivot EPT-2	Von Duprin
1	Magnetic door contact 1078C	Interlogix
2	Card readers	Security System Integrator
1	Power supply	Security System Integrator

Function: Card reader from either side shunts door contact and releases electrified lever trim. Door position status monitored through Access Control System.

END OF SECTION 087100

SECTION 087113 - AUTOMATIC DOOR OPERATORS

1.1 PRODUCTS

- A. Power-Assist Door Operators: Surface mounted.
 - 1. Standard: BHMA A156.19.
 - 2. Operation: Power-assisted opening and power-assisted spring closing.
 - 3. Operating System: Electromechanical .
 - 4. Microprocessor control unit.
 - 5. Finish: Matching door hardware.
 - a. Color: Custom color selected by the Architect.
- B. Controls:
 - 1. Push-plate switch.
- C. Accessories:
 - 1. Signage: to comply with college standard.

1.2 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

END OF SECTION 087113

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SECTION 088000 - GLAZING

1.1 SUMMARY

- A. Glass for windows, doors, interior borrowed lites, storefront framing, glazed curtain walls, and skylights.

1.2 QUALITY ASSURANCE

- A. Mockups for aluminum-framed entrances and storefronts and glazed aluminum curtain walls .

1.3 WARRANTY

- A. Laminated Glass: Five years.
- B. Insulating Glass: 10 years.

1.4 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting sealants.

1.5 PERFORMANCE REQUIREMENTS

- A. Engineering design of glass by Contractor.
- B. Windborne-Debris-Impact Resistance of Exterior Glazing: Wind Zone 2 .

1.6 MATERIALS

- A. Silicone Glazing Sealants: Neutral curing, Class 50 or Neutral curing, Class 25 .
- B. Glazing Tapes: Back-bedding-mastic Expanded-cellular type.

1.7 MONOLITHIC GLASS SCHEDULE

- A. Glass Type; GL-1: Clear fully tempered float glass.
 - 1. Thickness: 13mm (1/2 inch)
 - 2. Location indicated on the Drawings.
- B. Glass Type: GL-2: Clear fully tempered float glass
 - 1. Thickness ,6mm (1/4 inch)
 - 2. Location indicated on the Drawings
- C. Glass Type: GL-3: basis of design is Viracon Acuity, fully tempered float glass
 - 1. Thickness 6mm (1/4 inch)
 - 2. Location indicated on the Drawings
- D. Glass Type: GL-4: fire rated glazing indicated in 088813
 - 1. Location indicated on the Drawings
- E. Glass Type GL-5: Clear fully tempered low iron float glass
 - 1. Thickness: 6mm (1/4 inch)
 - 2. Location: Greenhouse

1.8 LAMINATED GLASS SCHEDULE

- A. Glass Type LGL-1:Clear laminated glass; fully tempered float glass
- B. Glass Type LGL-2: 8mm (5/16 inch) low iron laminated glass
 - 1. Location: Greenhouse Roof

1.9 INSULATING GLASS SCHEDULE

- A. Insulated Glass:
 - 1. All glass is heat strengthened
 - 2. All spacers are black for all glazing units
 - 3. All glass on white spandrel to be Low Iron Glass
 - 4. All glazing units to be argon filled

- B. Vision Units:
1. All vision glazing basis of design is: Viracon Acuity Glass
 - a. VGU-1: 1 inch; 6mm (1/4 inch) glass, VNE-63 #2 side, 1/2 inch airspace (argon), 6mm (1/4 inch) glass
 - b. VGU-2: 1 inch; 6mm (1/4 inch) glass, no coating, 1/2 inch airspace (argon), 6mm (1/4 inch) glass; Interior vestibule glazing as indicated on the Drawings.
 - c. VGU-3: 1-15/16 inch; 10mm (3/8 inch) glass, 1 inch airspace, 6mm (1/4 inch) laminated glass, 0.060 inch, PVB 6mm (1/4 inch) glass
 - d. VGU-4: 1-9/16 inch; 6mm (1/4 inch) glass, 3/4 inch airspace (argon), 6mm (1/4 inch) glass, .060 inch clear PVB, 6mm (1/4 inch) glass.
- C. Skylight Glass
1. SKY GU-1: 1.31 inch; 6mm (1/4 inch), VNE-63 with 40% screen 5006 W/V175 White on surface #2, 1/2 inch airspace (argon), laminated glazing 6mm (1/4 inch) glass, 0.06 clear PVB, 6mm (1/4 inch) glass
- D. Spandrel Units
1. SGU-1: 1 inch white spandrel; 6mm (1/4 inch) low iron glass, 1/2 inch airspace (argon), 6mm (1/4 inch) low iron glass, Viraspan V175 on surface #4
 2. SGU-2: 1 inch dark bronze spandrel; 6mm (1/4 inch), 1/2 inch airspace, 6mm (1/4 inch) glass, Viraspan V900 on Surface #4
 3. SGU-3: 1-15/16 inch dark bronze spandrel; 10mm (3/8 inch) glass, 1 inch airspace (argon), 6mm (1/4 inch) glass, 0.060 inch PVB, 6mm (1/4 inch) glass, Viraspan V900 on Surface #4.
 4. SGU-4: 1-9/16 inch dark bronze spandrel; 6mm (1/4 inch) clear glass, 3/4 inch airspace (argon), 6mm (1/4 inch) clear glass, .060 inch clear PVB, 6mm (1/4 inch) clear glass.

END OF SECTION 088000

SECTION 088813 - FIRE-RATED GLAZING

1.1 WARRANTY

- A. Laminated Glass: Not less than five years.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting sealants.

1.3 MATERIALS

- A. Silicone Glazing Sealants: Neutral curing, Class 50.
- B. Glazing Tapes: Back-bedding-mastic Expanded-cellular type.
- C. Supporting steel to be coordinated to conform with rating requirements.

1.4 FIRE-RESISTANCE-RATED GLAZING SCHEDULE

- A. Glass Type : 60-minute fire-resistance-rated glazing with 450 deg F temperature-rise limitation.
 - 1. Basis of Design: TGP; (60-201) Fire frames Clearview system or Pilkington Pyrostop
 - 2. Fire Rated, Butt Glazed, Safety Rated Transparent Wall Panels

END OF SECTION 088813

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SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting flooring.

1.2 PRODUCTS

- A. Moisture Vapor-Emission Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system.
- B. Accessories:
 - 1. Patching and leveling material.
 - 2. Crack-filling material.
 - 3. Cementitious Underlayment: If required to maintain manufacturer's warranty, gypsum hydraulic cement based.

1.3 INSTALLATION

- A. Preinstallation Substrate Testing: By Owner-engaged agency.

1.4 FIELD QUALITY CONTROL

- A. Installation Inspections: By Owner-engaged agency.

END OF SECTION 090561.13

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SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.

1.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

- A. Fire-Resistance Rating: As indicated .
- B. STC Rating: As indicated
- C. Gypsum shaftliner board, Type X moisture- and mold-resistant, Type X .
- D. Non-load-bearing steel framing in manufacturer's standard profiles.
 - 1. Firestop tracks to allow movement.
- E. Finish Panels: As indicated Gypsum board .

1.3 AUXILIARY MATERIALS

- A. Trim accessories.
- B. Steel drill screws.
- C. Track fasteners.
- D. Reinforcing.
- E. Acoustical sealant.

END OF SECTION 092116.23

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SECTION 092216 - NON-STRUCTURAL METAL FRAMING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 QUALITY ASSURANCE

- A. Code-compliance certification of studs and tracks.

1.3 MATERIALS

- A. STC Rating: [As indicated]
 - 1. Laboratories and adjacent corridors: 60
 - 2. Offices: 50
 - 3. Restrooms:] [51, minimum] <Insert rating> 55.
- B. Non-load-bearing steel framing in manufacturer's standard profiles.
 - 1. Firestop tracks to allow movement.
 - 2. 20 or 25 gauge
 - 3. 16 inches o.c.
- C. Finish Panels: As indicated Gypsum board .
- D. Sound attenuation blankets within 6' of ground deck
- E. Steel Framing:
 - 1. Steel studs and tracks.
 - 2. Embossed, high-strength steel studs and tracks.
 - 3. Slip-Type Head Joints:
 - a. Single long-leg track.
 - b. Double tracks.
 - c. Deflection track.
 - 4. Firestop track.
 - 5. Flat strap and backing plate.
 - 6. Cold-rolled channel bridging.
 - 7. Hat-shaped, rigid furring channels.
 - 8. Resilient furring channels.
 - 9. Cold-rolled furring channels.
 - 10. Z-shaped furring.
- F. Suspension Systems:
 - 1. Wire hangers.
 - 2. Flat hangers.
 - 3. Carrying channels (main runners).
 - 4. Furring channels.
 - 5. Grid suspension systems for ceilings.

END OF SECTION 092216

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SECTION 092900 - GYPSUM BOARD

1.1 QUALITY ASSURANCE

- A. Mockups for the following:
 - 1. Levels of exposed gypsum board finish.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Regional materials.
 - 3. Low-emitting adhesives.

1.3 MATERIALS

- A. Interior Gypsum Board:
 - 1. Gypsum board, Type X.
 - 2. Gypsum ceiling board.
 - 3. Mold-resistant gypsum board.
- B. Tile-Backing Panels:
 - 1. Cementitious backer units.
- C. Trim Accessories:
 - 1. Interior.
 - 2. Exterior.
 - 3. Aluminum: Extruded profiles.
- D. Auxiliary Materials:
 - 1. Laminating Adhesive.

END OF SECTION 092900

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SECTION 093013 - CERAMIC TILING

1.1 QUALITY ASSURANCE

- A. Mockup for each type of wall tile installation.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.
 - 2. Low-emitting floor sealer.

1.3 TILE PRODUCTS

- A. Tile Type: Glazed wall tile.
 - 1. Description: Wall tile in restroom areas.
 - 2. Trim Shapes: Coved base, Bullnose wainscot cap, and Bullnose external corner.

END OF SECTION 093013

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SECTION 095113 - ACOUSTICAL PANEL CEILINGS

1.1 QUALITY ASSURANCE

- A. Mockups for each form of construction.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Low-emitting ceilings.

1.3 PERFORMANCE REQUIREMENTS

- A. Engineering design of seismic restraints by Contractor.
- B. Flame-Spread Index: Class A.

1.4 PRODUCTS

- A. Acoustical Panels: Fire-Resistance Rated: .
 - 1. Basis of Design (Montgomery College standard): Armstrong Fine Fissured #1830
 - 2. Refer to Finish Schedule on the Drawings.
 - 3. Modular Size: 24 by 48 inches .
- B. Metal Suspension System: .
 - 1. Basis of Design (Montgomery College standard): USG DX/DXL 15/16" System
 - 2. Refer to Finish Schedule on the Drawings.
 - 3. High-humidity finish.
 - 4. Hold-down clips.
- C. Metal Edge Moldings and Trim: Roll-formed sheet metal .
- D. Acoustical Baffle Ceiling:
 - 1. Truf design, Straight baffle
 - 2. Size: 11.5 inches deep, manufacturers standard lengths typical, custom lengths as required.
 - 3. Baffles suspended from T Grid support system
 - 4. Color: Matte grey
 - 5. T Grid Connection Type: Manufacturers standard
 - 6. Spacing: 15.5" o.c.

1.5 ERECTION TOLERANCES

- A. Main and Cross Runners: Level to within 1/8 inch in 12 feet.
- B. Moldings and Trim: Level to within 1/8 inch in 12 feet.

1.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 095113

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SECTION 095436 - SUSPENDED GRIDS

1.1 QUALITY ASSURANCE

- A. Mockups for each form of ceiling system and finish.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.3 PRODUCTS

- A. Steel Grid Units:
 - 1. Basis of Design: Unistrut Systems
 - a. Location and dimensions indicated on the Drawings.
 - 2. Steel Finish: Shop primed and field finished.
 - a. Refer to section 099123 "Interior Painting" for paint system, preparation, and application requirements .

1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 095436

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SECTION 096513 - RESILIENT BASE AND ACCESSORIES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.
 - 2. Low-emitting flooring (stair accessories).

1.2 PRODUCTS

- A. Resilient Base: Thermoplastic rubber .
 - 1. Style and Location:
 - a. Straight: In areas with carpet .
 - b. Cove: In locations indicated on the Drawings .
 - c. Butt to: In areas indicated .
 - 2. Minimum Thickness: 0.125 inch .
 - 3. Height: 4 inches .
 - 4. Outside Corners: Preformed .
 - 5. Inside Corners: Job formed or preformed.
- B. Resilient Stair Accessories:
 - 1. Stair Treads: Rubber, thermoplastic .
 - a. Surface: Smooth, flat .
 - b. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees .
 - c. Nosing Height: 2 inches .
 - 2. Risers: Integral .
 - 3. Stringers.
 - 4. Landing tile.
- C. Resilient Accessories: Rubber .
 - 1. Transition strips.
- D. Installation Materials:
 - 1. Trowelable leveling and patching compounds.
 - 2. Adhesives.
 - 3. Stair-tread-nose filler.
 - 4. Metal edge strips.

END OF SECTION 096513

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SECTION 096516 - RESILIENT SHEET FLOORING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.
 - 2. Low-emitting flooring.

1.2 PRODUCTS

- A. Basis of Design: Nora; Noraplan Value
- B. Alternate for Laboratories
- C. Rubber Sheet Flooring:
 - 1. Backing: None, unbacked .
 - 2. Wearing Surface: Smooth .
 - 3. Seamless-Installation Method: Heat welded .
- D. Installation Materials:
 - 1. Trowelable leveling and patching compounds.
 - 2. Adhesives.
 - 3. Floor polish.

END OF SECTION 096516

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SECTION 096519 - RESILIENT TILE FLOORING

1.1 PRODUCTS

- A. Alternate for concourse and lobby
- B. Rubber Floor Tile: Homogeneous rubber tile, solid color .
 - 1. Wearing Surface: Smooth .
 - 2. Thickness: 0.125 inch .
 - 3. Size: Indicated on the Drawings .
- C. Installation Materials:
 - 1. Trowelable leveling and patching compounds.
 - 2. Adhesives.
 - 3. Floor polish.

END OF SECTION 096519

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SECTION 096536 - STATIC-CONTROL RESILIENT FLOORING

1.1 PERFORMANCE REQUIREMENTS

- A. Static-Dissipative Properties:
 - 1. Electrical Resistance: Test per ASTM F 150 with 100-V applied voltage ESD-STM-7.1.
 - 2. Static Generation: Less than 300 V.
 - 3. Static Decay: 5000 to zero V in less than 0.25 seconds.
- B. FloorScore certification for LEED V4.
- C. Flooring system is low emitting for LEEDV4.

1.2 PRODUCTS

- A. Static-Dissipative Resilient Floor Coverings:
 - 1. Rubber Floor Tile: Smooth type, .
 - 2. Color, pattern, and dimensions: Refer to Finish Schedule on the Drawings.
- B. Installation Materials:
 - 1. Trowelable leveling and patching compounds.
 - 2. Static-control adhesive: Low VOC for LEED and Low emitting for LEED v4.
 - 3. Grounding strips.
 - 4. Heat-welding bead.
 - 5. Chemical-bonding compound: Low VOC for LEED and Low emitting for LEED v4.
 - 6. Integral-flash-cove base accessories.
 - 7. Maintenance floor tiles inscribed "Conductive floor. Do not wax."

1.3 INSTALLATION

- A. Location: Teaching LAN Room, all Telecom rooms, and as indicated on the Drawings
- B. Installation with oversight by manufacturer's representative.
- C. Seaming Method: Standard .

1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 096536

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SECTION 096623 - RESINOUS MATRIX TERRAZZO FLOORING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.
 - 2. Low-emitting adhesives.
 - 3. Low-emitting sealers.
 - 4. Low-emitting flooring.

1.2 QUALITY ASSURANCE

- A. Installer Qualifications: A contractor member of NTMA from the state where the project is located as selected and approved by the Architect and the Owner .
- B. Mockups.
- C. Location: Restrooms and corridors as indicated on the Drawings.

1.3 EPOXY-RESIN TERRAZZO

- A. Terrazzo Topping Thickness: 3/8 inch typical or as indicated .
- B. Mix: NTMA-formulated design .
 - 1. Color: two colors to be determined by the Architect.

1.4 STRIP MATERIALS

- A. Divider Strips: L-type angle.
 - 1. Exposed Material: Aluminum.
- B. Control-joint strips.
- C. Accessory strips.

END OF SECTION 096623

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SECTION 096723 - RESINOUS FLOORING

1.1 QUALITY ASSURANCE

- A. Mockups: For each resinous flooring system.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting flooring.

1.3 PRODUCTS

- A. Resinous Flooring and Integral Cove Base :
 - 1. System Characteristics:
 - a. Color and Pattern: As selected by Architect from manufacturer's full range .
 - b. Wearing Surface: Manufacturer's standard wearing surface .
 - c. Overall System Thickness: 1/8 inch .
 - 2. System Components:
 - a. Primer: 100 percent solids .
 - b. Waterproofing Membrane: 100 percent solids .
 - c. Reinforcing Membrane: .
 - d. Body Coat(s):
 - 1) Resin: Methyl methacrylate .
 - e. Grout Coat:
 - 1) Resin: Methyl methacrylate .
 - f. Topcoat: Sealing or finish coats.
 - 1) Resin: Methyl methacrylate .

1.4 FIELD QUALITY CONTROL

- A. Core sampling by Contractor.

END OF SECTION 096723

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SECTION 096813 - TILE CARPETING

1.1 WARRANTY

- A. Materials and Workmanship for Carpet Tile: 10 years.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.
 - 2. Low-emitting flooring.

1.3 PRODUCTS

- A. Location: refer to Finish and Room Finish Schedules on the Drawings.
- B. Carpet Tile :
 - 1. Fiber: 100 percent nylon 6, 6 or 100 percent nylon 6 .

END OF SECTION 096813

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SECTION 099113 - EXTERIOR PAINTING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4:
 - 1. Low-emitting exterior applied products.

1.2 PAINT, GENERAL

- A. MPI-listed products.

1.3 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.4 EXTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Water-based light industrial coating system.
- B. Steel and Iron Substrates:
 - 1. Water-based light industrial coating system.
 - 2. Quick-dry enamel system.
- C. Galvanized-Metal Substrates:
 - 1. Water-based light industrial coating system.

END OF SECTION 099113

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SECTION 099123 - INTERIOR PAINTING

1.1 QUALITY ASSURANCE

- A. Mockups for each color and finish.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting paints and coatings.

1.3 PAINT, GENERAL

- A. MPI-listed products.

1.4 SOURCE QUALITY CONTROL

- A. Testing: Owner engaged.

1.5 INTERIOR PAINTING SCHEDULE

- A. CMU Substrates:
 - 1. Institutional low-odor/VOC latex system.
- B. Steel Substrates:
 - 1. Institutional low-odor/VOC latex system.
- C. Wood Substrates: .
 - 1. Institutional low-odor/VOC latex system.
- D. Gypsum Board Substrates:
 - 1. Institutional low-odor/VOC latex system.

END OF SECTION 099123

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SECTION 099600 - HIGH-PERFORMANCE COATINGS

1.1 QUALITY ASSURANCE

- A. Mockups for each finish.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting paints and coatings.

1.3 MATERIALS, GENERAL

- A. MPI-listed products.

1.4 SOURCE QUALITY CONTROL

- A. Testing: Owner engaged.

1.5 EXTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Location: Exterior railing pickets and posts
- B. Galvanized-Metal Substrates:
 - 1. Pigmented polyurethane over vinyl wash primer and epoxy primer system.

1.6 INTERIOR HIGH-PERFORMANCE COATING SCHEDULE

- A. Location: Restroom areas above tile wainscoat
- B. Gypsum Board Substrates:
 - 1. Epoxy system.

END OF SECTION 099600

SECTION 101100 - VISUAL DISPLAY UNITS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.

1.2 WARRANTY

- A. Materials and Workmanship for Porcelain-Enamel Face Sheets: Life of building.

1.3 PRODUCTS

- A. Visual Display Board Assembly: Markerboard panels.
 - 1. Assembly: Field or factory.
 - 2. Frames and Trim: Factory-applied aluminum .
 - 3. Mounting: Direct to wall .
 - 4. Accessories: Chalk tray.

1.4 MATERIALS

- A. Visual Display Panels:
 - 1. Markerboard Panel: Faced with porcelain enamel .
- B. Aluminum Finishes: Clear anodic .

END OF SECTION 101100

SECTION 101200 - DISPLAY CASES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Low-emitting adhesives.
 - 2. Low-emitting composite wood products.

1.2 PRODUCTS

- A. Display Cases:
 - 1. Cabinets: Extruded-aluminum Glazed-panel box.
 - a. Cabinet Frame and Trim: Manufacturer's standard hardwood species.
 - 2. Mounting: Surface mounted Recessed Floor mounted.
 - 3. Aluminum Finish: Clear anodic .
 - 4. Base: None Minimal base, for full-height case .
 - 5. Glazed Doors: Sliding .
 - 6. Adjustable tempered-glass shelves.
 - 7. Illumination system.

END OF SECTION 101200

SECTION 102113.17 - PHENOLIC-CORE TOILET COMPARTMENTS

1.1 SUMMARY

- A. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.
 - 1. Toilet-Enclosure Style: Ceiling hung.
 - 2. Urinal-Screen Style: Wall hung, flat panel Post to ceiling.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.3 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: ASTM E84.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

1.4 COMPONENTS

- A. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides , with no-sightline system.
- B. Urinal-Screen Post: Match pilasters .
- C. Brackets (Fittings):
 - 1. Full-Height (Continuous) Type: Manufacturer's standard heavy duty design; stainless steel .
- D. Phenolic-Panel Finish:
 - 1. Facing Sheet Finish: One color and pattern in each room.
 - 2. Color and Pattern: As selected by Architect from manufacturer's full range , with manufacturer's standard .

1.5 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.

END OF SECTION 102113.17

SECTION 102239 - FOLDING PANEL PARTITIONS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Recycled content.

1.2 WARRANTY

- A. Materials and Workmanship: Two years.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Seismic bracing of attachment to structure above.
- B. Flame-Spread Index: 25 or less.

1.4 OPERABLE ACOUSTICAL PANELS

- A. Basis of Design: Skyfold; Classic 55
- B. Panel Operation: Vertically operated, electrical, continuously hinged panels.
- C. STC: Not less than 55.
- D. Panel Weight: 10 lb/sq. ft. maximum.
- E. Panel Thickness: Minimum dimension of 3 inches.
- F. Panel Materials:
 - 1. Frame: Steel .
- G. Hardware: Manufacturer's standard hinges .
- H. Finish Facing: Markerboard .
- I. Location: Planetarium

1.5 ELECTRIC OPERATORS

- A. Key-operated, remote-control stations.
- B. Obstruction-Detection Devices: Sensor edge .

1.6 ACCESSORIES

- A. Work Surfaces: Porcelain steel marker/projection surface .

1.7 FIELD QUALITY CONTROL

- A. NIC Testing: By Owner -engaged agency.

1.8 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

END OF SECTION 102239

SECTION 102600 - WALL AND DOOR PROTECTION

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Certified wood.
 - 2. Low-emitting adhesives.
 - 3. Low-emitting composite wood products.

1.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Class A.
- B. Accessibility requirements of authority having jurisdiction.

1.3 PRODUCTS

- A. Corner Guards:
 - 1. Surface-Mounted, Plastic-Cover Type: cut to fit opening dimension from top of wall to base height of base, using one-piece aluminum retainer, and PVC-free.
- B. Other wall protection elements to be determined.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

1.1 WARRANTY

- A. Silver Spoilage for Mirrors: 15 years.

1.2 PRODUCTS

- A. Public-Use Washroom Accessories:
 - 1. To be determined
 - a. Owner Furnished Contractor Installed (OFCI) accessories to be determined.
 - 2. Grab bar.
 - 3. Mirror unit.
- B. Public-Use Shower Room Accessories:
 - 1. Shower curtain rod.
 - 2. Shower curtain.
 - 3. Folding shower seat.
 - 4. Robe hook.
- C. Underlavatory guards.
- D. Custodial Accessories:
 - 1. Utility shelf.
 - 2. Mop and broom holder.

END OF SECTION 102800

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SECTION 104413 - FIRE PROTECTION CABINETS

1.1 PRODUCTS

- A. Fire-Protection Cabinets:
 - 1. Type: Fire extinguisher .
 - 2. Cabinet Construction: Nonrated .
 - 3. Mounting: Recessed Semirecessed and Surface mounted.
 - 4. Door Style: Flush opaque panel, frameless, with no exposed hinges.
 - 5. Finish:
 - a. Steel: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.

END OF SECTION 104413

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SECTION 104416 - FIRE EXTINGUISHERS

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 WARRANTY

- A. Materials and Workmanship: Six years.

1.3 PERFORMANCE REQUIREMENTS

- A. Fire Extinguishers: Complying with NFPA 10 and approved, listed, and labeled by FM Global.

1.4 PRODUCTS

- A. Portable Hand-Carried Fire Extinguishers:
 - 1. Multipurpose dry-chemical type.
 - 2. Other types to be determined.
- B. Mounting brackets.

END OF SECTION 104416

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SECTION 111319 - STATIONARY LOADING DOCK EQUIPMENT

1.1 WARRANTY

- A. Dock Levelers:
 - 1. Structural Assembly: 10 years.
 - 2. Hydraulic System: Four Five Insert number years.

1.2 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

1.3 PRODUCTS

- A. Stationary Loading Dock Lifts: MH 29.1.
 - 1. Rated Capacity: 8000 lb.
 - 2. Platform Surface: Nonskid, safety-tread heavy hot-dip galvanized deck plate.
 - 3. Platform Size: 96 inches long by 96 inches wide.
 - 4. Guard Rails: Fixed.
 - 5. Bridge Material: Nonskid, safety-tread, hot-dip galvanized-steel plate.
 - 6. Bridge: 42 inches
 - 7. Bridge Locations: Ends.
 - 8. Vertical Travel: 54 inches.
 - 9. Travel Speed: 8 fpm.
 - 10. Operation: Manufacturers standard Hydraulic.
 - 11. Scissors Configuration: Single leg.
 - 12. Mounting: Surface.
 - 13. Finish: Manufacturer's standard prime-paint or baked-on factory finish.

END OF SECTION 111319

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SECTION 115300 - MISCELLANEOUS LABORATORY EQUIPMENT

1.1 SUMMARY

- A. Equipment Basis of Design: See Drawings for Equipment List
- B. Section Includes:
 - 1. Autoclave (EQ-03)
 - 2. Cabinet, Small Parts
 - 3. Cabinet, Tall Corrosive Storage
 - 4. Cabinet, Tall Flammable Storage
 - 5. Cabinet, Under-counter Corrosive Storage
 - 6. Cabinet, Under-counter Flammable Storage
 - 7. Cable Tray
 - 8. Canopy Hood
 - 9. Drying Rack
 - 10. Gas Cylinder Restraints
 - 11. Gas Cylinder Corral Storage
 - 12. High Purity Water Unit
 - 13. Ice Flaker (EQ-02)
 - 14. Point Exhaust with Snorkel (EQ-01)
 - 15. Shelving, Floor Mounted Polymer
 - 16. Shelving, Floor Mounted Wire
 - 17. Shelving, High Density Wire
 - 18. Shelving, Tall Metal Storage
 - 19. Sink, Hand Wash
 - 20. Sink, Scullery, Double Compartment
 - 21. Sink, Scullery, Single Compartment
 - 22. Sink, Service
 - 23. Storage, Bin
 - 24. Table, Shop

1.2 WARRANTY

- A. Manufacturer's Warranty: Furnish manufacturer's written material and labor warranty signed by an authorized representative using manufacturer's standard form agreeing to furnish materials and labor required to repair or replace work which exhibits material defects caused by manufacture or design and installation of product. "Defects" is defined to include but not limited to deterioration or failure to perform as required.
- B. Installer's Warranty: Furnish installer's written workmanship warranty signed by an authorized representative using installer's standard form agreeing to provide labor required to repair or replace work which exhibits workmanship defects. "Defects" is defined to include but not limited to deterioration or failure to perform as required.

END OF SECTION

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MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

SECTION 115313 - LABORATORY FUME HOODS

- A. 4 FOOT ADA BENCH FUME HOOD (FH-01)
- B. 4 FOOT BENCH FUME HOOD (FH-02)
- C. 5 FOOT ADA BENCH FUME HOOD (FH-03)
- D. 5 FOOT BENCH FUME HOOD (FH-04)
- E. 8 FOOT ADA FUME HOOD (FH-05)
- F. 4 FOOT FLOOR MOUNTED FUME HOOD (FH-06)

END OF SECTION 115313

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SECTION 115500 – PLANETARIUM EQUIPMENT

PART 1 - GENERAL

1.1 PROJECT DESCRIPTION

- A. The project is to provide, install, train for and support a technology package for the Planetarium.
- B. The Planetarium takes the form of multi-use domed theater but is also used for lecture and visualization by various Science, Engineering, and Math studies and may be used as a special events space. As such, the facility must support use by all these disciplines.
- C. The design is based on inclusion of a thirty (30) foot diameter dome, tilted at twelve (12)-degrees from horizontal.
- D. Unless otherwise noted, a substituted component may be proposed and included, but only if approved in advance by Planetarium design consultant and Owner. Note some items may not be substituted.

1.2 SECTION INCLUDES

- A. Planetarium Technology Package including the following components:
 - 1. Article 2.1 30' TILTED PROJECTION DOME AND INSTALLATION
 - 2. Article 2.2 MASTER CONTROL SYSTEM
 - 3. Article 2.3 PLANETARIUM CONTROL CONSOLE
 - 4. Article 2.4 LED COVE LIGHTING SYSTEM
 - 5. Article 2.5 ELLIPSOIDAL PUBLIC ADDRESS SPOTLIGHTS AND HOUSE LIGHT DIMMING
 - 6. Article 2.6 DIGITAL AUDIO SYSTEM WITH SUBWOOFER
 - 7. Article 2.7 POWER CONDITIONING, SEQUENCING, AND BATTERY BACKUP
 - 8. Article 2.8 ASSISTIVE LISTENING SYSTEM
 - 9. Article 2.9 INSTRUCTIONAL AND EVENT PRESENTATION PACKAGE
 - 10. Article 2.10 DIGITAL ALL-DOME PROJECTION SYSTEM
 - 11. Article 2.11 REMOVABLE FRONT OF THEATER PRESENTATION LECTERN

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to this section.

1.4 RELATED SECTIONS

- A. Division 26 sections for connections to fire-alarm systems, wiring, disconnect switches, and other electrical materials required to complete Immersive Planetarium equipment installation.

1.5 SUBMITTALS

- A. Submit under provisions of Section 013300.
- B. Product Data: For each item of Planetarium equipment indicated. Include the following:
 - 1. Manufacturer's model number.
 - 2. Accessories and components that will be included for project.
 - 3. Clearance requirements for access and maintenance.
 - 4. Utility service connections for power; include roughing-in dimensions.

- C. Shop Drawings: For Planetarium equipment not adequately described by product data or for change/substitution requests. Include plans, elevations, sections, roughing-in dimensions, fabrication details, utility service requirements, and attachments to other work.
 - 1. Samples for Initial Selection: None needed in this package.
 - 2. Samples for Verification: None needed in this package.
- D. Coordination Drawings:
 - 1. For Planetarium equipment. If the work varies in any way from the Design Drawings and Specifications.
- E. Operation and Maintenance Data: None needed in this package.
- F. Product Schedule: For each Planetarium equipment item, include the following:
 - 1. Designation indicated on Drawings.
 - 2. Manufacturer's name and model number.
 - 3. List of factory-authorized service agencies including addresses and telephone numbers.
 - 4. Warranty: Samples of special warranty.

1.6 QUALITY ASSURANCE

- A. UL or CE Certification: Provide electric equipment and components that are evaluated by UL or CE for fire, electric shock, and casualty hazards according to applicable safety standards, and that are UL certified for compliance and labeled for intended use.
- B. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Regulatory Requirements: Install equipment to comply with the following:
 - 1. NFPA 70, "National Electrical Code."
- D. Preinstallation Conferences: Conduct conference at project site. Minimum is one for the dome plus one for all other systems.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of construction contiguous with Planetarium equipment by field measurements before fabrication.

1.8 COORDINATION

- A. Coordinate planetarium equipment layout and installation with other work, including layout and installation of lighting fixtures, HVAC equipment, and fire-suppression system components.
- B. Coordinate locations and requirements of utility service connections.
- C. Coordinate sizes, locations, and requirements of the following:
 - 1. Overhead equipment supports.
 - 2. Equipment bases.
 - 3. Floor depressions.

1.9 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.10 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include copies of warranties from manufacturers for each type.

PART 2 - PRODUCTS

2.1 30' TILTED PROJECTION DOME AND INSTALLATION

A. SCOPE

- 1. The work covered by the specifications consists of furnishing materials, plant labor, equipment necessary to the fabrication, manufacture, delivery, and complete installation of a 30 ft. (180 degree) hemispherical planetarium projection dome. The dome shall be designed and fabricated in accordance with the specifications, as well as exact diameter of the dome for this project as specified in Section P, along with applicable drawings and subject to the terms and conditions of the contract.
- 2. Projection surface: Perforated aluminum sheet with factory prime coat, followed by a final coat of paint on site after installation.

B. WORK INCLUDED IN THE CONTRACT

- 1. Supply of all materials and labor required for the design and manufacture of a hemispherical projection dome with a perforated projection surface of painted aluminum.
- 2. Preparation of complete shop, assembly and erection drawings, which shall be subject to approval by the owner with respect to general design.
- 3. Preparation of a list of installation requirements, such as storage of materials, installation conditions (heat, light, power, ventilation, etc.) as well as an estimate of erection time.
- 4. Attendance of at least one job-site co-ordination and scheduling meeting at time of dome delivery or prior to dome installation, at the manufacturer's cost. Any such further meetings as may be required by the owner, for efficient prosecution of the work. For these additional meetings the travel and lodging cost is to be paid by owner.
- 5. The provision of manufacturer's personnel to install the dome screen.
- 6. Prior to any manufacturing, provide all samples, procedures and demonstrations as specified for approval by owner
- 7. Design and supply of the base tension ring of the dome, including the interface with the structural support ring and anchor bolts/eye bolts provided in the building by the owner.
- 8. Delivery of all materials, special tools and accessories for the dome projection screen to the site in manufacturer's protective packaging.
- 9. Provisions of a skilled painter, experienced in onsite painting of dome screens, for the final painting of the dome projection surface.

C. WORK EXCLUDED FROM THE CONTRACT

- 1. The structural support for the base ring of the dome screen will be provided by the architect as part of the building. Also location of work point in center of tension ring and at an elevation equal to that of the tension ring with quadrant lines on the floor representing (N-S-E-W) for all field measurements to be taken.
- 2. Acoustic treatment, lights and miscellaneous metal work are not part of this dome, but reasonable co-operation and coordination must be given to other contractors, also, section 11.0 Installation Conditions of Theater.

3. The storage of the dome material can be supervised by the manufacturer's personnel if requested, at an additional cost. However, protection of, actual storage space for, receiving of, customs clearance for and location adjacent to dome room of dome materials is the responsibility of the owner /GC. The manufacturer is to provide the owner /GC with details of storage space required.
4. All painting of the building behind and below the dome is not considered part of the projection dome screen.
5. The dome manufacturer will provide the scaffolding for installation. In case of a sloped or stepped floor, a temporary false floor is required; the dome manufacturer will supply at an additional cost. This project specifies a flat floor, so no false floor will be necessary.
6. Supply and setting of all support ring or columns to support the dome. Provision of 14 equally spaced anchor bolts in the support ring/load bearing wall of the room. In the event the dome is suspended from the ceiling the provision of 12 equally spaced closed eyebolts in the ceiling, capable of supporting the dome from suspension chains. In the case of a suspended dome provisions must be made for lateral support of the dome at an elevation equal to the tension ring.

D. STRUCTURAL INTEGRITY

1. The manufacturer shall provide the owner with a certified drawing or statement of the total weight of the dome and its distribution around the dome base ring which rests on the structural support ring, columns or eyebolts provided by the owner.
2. The manufacturer shall be responsible for the structural design of the complete dome screen systems including the structural frame and panels, sizing of all members and detailing of connections to support structure or eyebolts as supplied by owner.
3. Prior to commencing fabrication, the manufacturer shall provide to the owner design drawings. However, at an additional cost, if requested prior to contract signing, structural information from a certified professional engineer can be provided.
4. This design information will be submitted to the structural engineers and the owner for building and/or the competent safety code authorities for acceptance.

E. DESIGN AND MANUFACTURE

1. The projection dome shall be self-supporting and capable of maintaining its hemispherical characteristics when supported by its tension ring as required by the design of the theater.
2. The hemispheric shell consists, in part, of an aluminum structural rib network system of
 - a. Twenty-eight (28) evenly spaced ribs, with a depth of 7" and sufficient number of cross-members to maintain its correct shape. The inside diameter of the dome screen shall be as specified elsewhere, departing not more than plus or minus 12.7mm from the nominal radius.
 - b. The ribs shall be accurately formed and reinforced in accordance with the manufacturer's drawings. The ribs shall be fabricated from aluminum alloy 6061-T6 and 6063-T5, or other suitable material acceptable to the owner.
3. A girt system shall be incorporated to maintain proper rib spacing. Sizing and spacing shall be as indicated on manufacturer's drawings as approved by the owner.
4. The structural gage of the dome shall be sufficiently stiff so that deflection and settlement of the structure will not lead to deformation of the screen panels, based on the stiffness of the support system provided by the owner.
5. A circular compression ring shall be provided and located at the zenith or apex of the dome, to accommodate the terminal points for the main ribs and the perforated top circle. The compression ring shall be fabricated from aluminum alloy 6061-T6, or other suitable material acceptable to the owner.
6. An aluminum base tension ring shall be provided at the base of the hemisphere, which shall be so constructed that the ring will support the dome and provide the necessary connection points around its periphery. The base tension ring shall be aluminum alloy 6061-T6 or other suitable material, sized and reinforced in accordance with the manufacturer's drawings.
7. The projection surface shall consist of 57 perforated panels which shall be 0.040 gauge aluminum alloy type 5052-H32 containing 0.062 in. diameter holes on 0.125 in. staggered centers, to provide approximately 22% void area with a minimum of a 20% void after final painting.

8. The perforated panels shall be formed or stretch-formed over a compound die to correspond to the required section of a sphere. Trimming of the panels to their final configuration shall be accomplished in compound fixtures at manufacturer's factory.
9. The aluminum cove trough for LED lighting shall consist of an 8 in. wide base with wood insert, and a 4 in. high fascia.
10. Fixed ladders shall be fastened to the rib backside allowing for varying dome elevation and speaker access for maintenance.
11. A cable tray surrounding the rear of the dome shall consist of a 12 in. wide base with wood insert and 4 in. high fascia to reduce visibility of conduits, cables, and accessories at the base of the dome.

F. SEAMS AND JOINTS

1. Seams between adjacent panels will be overlapped jointed.
 - a. Option 1: Overlapped Seam construction, the seams, where the panels join, shall be overlapped by no more than 29mm and shall have a patented opaque flat black material of minimum thickness between the layers. The panels shall be secured to the ribs using low profile aluminum rivets. Vertical and horizontal seams shall not be located where there are no structural elements available for support.
 - b. Option 2: Patented Ultimate Seam construction, the horizontal seams to be treated differently from vertical seams in such a manner as to appear to have no overlap, using a crimped edge method that places the top panel in the recessed strip of the bottom panel. This method will create a seam where the light reflective surfaces of both panels are flush.
 - c. Option 3 – Ulteria Seam: The Ulteria seam is an extension of our patented Ultimate seam in which the vertical seam is constructed in the same manner as the horizontal seam. Using a crimped edge method on both the vertical and horizontal axes, all light reflective surfaces are flush with one row of counter sunk rivets.
 - d. Option 4 – Ulteria Plus: The Ulteria Plus seaming consist of edge to edge panel placement on both the vertical and horizontal axes that are custom fit onsite and fastened with two rows of flush counter sunk rivets.
2. Provide a small finished sample section approximately 1000mm x 1000mm demonstrating joint construction in an area where four (4) adjacent panels meet for inspection, at manufacturer's plant.

G. QUALITY ASSURANCE

1. Uniformity of the color and the reflectivity of the dome surface over the entire area of the dome screen are of vital importance. To this end the dome manufacturer shall include a quality assurance program as an integral part of his proposal. This program shall clearly address the points which follow, as well as any others which the manufacturer considers pertinent.
2. A list of people on the quality assurance team with their qualifications and experience, if required by the owner.
3. Methodology and equipment to be used to ensure uniformity of color and reflectivity of surface.
4. Using painted on site panels, procedures for controlling paint quality and characteristics, methods for controlling application and drying.
5. The manufacturer shall submit after drawing approval, two (2) small samples (approximately 200mm x 280mm) of screen surface finish. Accepted samples can be used as reference for acceptance of the dome screen.
 - a. NOTE: Acceptance of any such samples shall not constitute or imply acceptance of the completed screen as provided in Paragraph 14.0 thereunder.
6. If any corrective measures are needed, due to color variation or reflectivity they will be made in the final painting of the screen. Any other corrective work needed must be performed prior to any finish work in the dome room.
7. If for any reasons, satisfactory repairs or touch-up cannot be made to bring the dome screen within the required uniformity, repainting will be performed by the dome manufacturer.

H. PREPARATION AND FINISH OF DOME STRUCTURE

1. The structural rib network, girts and pipe-members shall be thoroughly degreased to provide a clean, adhesive surface prior to painting. All structural elements shall be given a factory-applied coat of flat black paint.
2. Any damaged paint on surfaces (caused by shipping) shall be touched up with matching flat black paint before panel installation is started.

I. PROJECTION SURFACE OF THE COMPLETED DOME

1. The inside surface of the dome screen is to be painted with the overall reflectivity as specified in the project criteria, Paragraph 16.0. The seams are to be virtually unnoticeable and the panel-to-panel differences invisible during projection. The final surface must be at least as good as that of the samples previously accepted by the owner. Refer to Paragraph 7.5.
2. The screen surface shall diffuse incident light with no spectral component while retaining the specified reflectance, with absence of gloss at all incident angles. Under normal projection.
3. The patented seam backing material between the panels supplied by the manufacturer must be such that reflectance of the seam areas does not change over a period of at least five (5) years from acceptance. However, this may be greatly affected by the general air filtration and handling of the theater system, for which the manufacturer cannot be held responsible.
4. The projection surface is to be factory primed then painted-in-place, by a factory technician with a non-bridging flat coating, with the reflectivity in accordance with the project criteria, Paragraph 16.0.

J. ACCEPTANCE OF WORK BY OTHERS

1. Architect will provide the dome screen manufacturer complete design information concerning the architectural support for the base tension ring of the dome.
2. Having accepted the structural support or eye bolts for the base ring of the screen, and the condition of the room meet with sections 11.0 and 12.0 of the specifications, the dome manufacturer shall commence the dome installation work.

K. INSTALLATION CONDITIONS

1. Erection of the structural elements of the dome shall not commence until the theater space is in clean and dust free condition. This includes all scaffolding, decking and flooring, also, suitable power supply and temporary or permanent work lighting must be in place.
2. The theater space shall, for all intents and purposes, be complete to the satisfaction of the dome manufacturer prior to commencement of erection of the projection dome screen. Any obstruction or contact with the dome framework must be corrected immediately by others at no cost to the dome manufacturer. No seating, carpeting, or other interior finish work shall be commenced prior to completion of the dome installation.
3. The dome skin shall not be installed until after the following conditions have been met:
 - a. The manufacturer's supervisor is satisfied that electrical work, loudspeakers, mechanical work including all air-conditioning and filtering, painting and acoustical insulation material behind the projection screen have been installed and all work completed.
 - b. The heating and ventilation system has been purged of all construction dust.
 - c. All exposed concrete surfaces have been cleaned and sealed.
 - d. The theater has been thoroughly dusted and cleaned, including vacuuming of scaffolding. This state of cleanliness must be maintained during the entire installation.
 - e. Permanent temperature and humidity control must be operational to maintain the conditions as specified by the manufacturer.
 - f. Activities of other trades working within the theater shall be restricted so as to maintain dust free conditions during installation of the screen surface and subject to approval by dome manufacturer's supervisor.
4. It is vitally important that the dome screen receive its final surface paint in a properly heated, or cooled dust free environment. The owner shall ensure that, during the period when painting is taking place, the theater space where the dome screen is installed, is properly enclosed, heated and/or air conditioned at an appropriate temperature, in accordance with conditions to be specified by the dome manufacturer.

L. ERECTION

1. On-site installation of the projection dome is to be accomplished by the dome manufacturer.
2. Standard equipment for the installation shall be provided by the dome manufacturer. Subject to section 3.0
3. All fasteners and hardware for on-site assembly shall be furnished by the dome manufacturer, including spacers or suspension chains for mounting and leveling the tension ring to the structural support ring and columns or eyebolts supplied by the owner as part of the building.
4. Final painting of the projection surface after assembly will be accomplished by the manufacturer of the screen, using non-bridging coating of correct and approved reflectivity. This shall be applied by a factory technician experienced in painting hemispherical screens. Such expert personnel are to be supplied by the manufacturer and are included in the contract price.
5. Before the perforated panels are installed, the dome structure is to be touched up with flat black paint by the dome manufacturer. As per section 8.0
6. The dome manufacturer shall co-ordinate dome installation with the construction manager so as not to delay the building construction schedule. All parts and components for the dome screen shall be capable of being carried or moved through standard double door openings into the theater space, if located on the ground floor.
7. Note that the theater must be completely clean before dome erection. This includes the tops of duct work, catwalks, etc. All exposed concrete surfaces shall be sealed before the dome skin material is moved into the theater space. Refer to Paragraph 11.3.
8. Should the finish on the projection surface be soiled, marred or scratched in any way by the manufacturer's installation work, during or prior to the completion by the manufacturer, then it is the responsibility of the manufacturer to fully correct such disfigurement.
9. The dome supplier shall include with the dome shipment an overstock of perforated panel material, from the same order and batch, so as to be able to replace any defective or damaged panels prior to installation of the panels. This overstock shall not be less than one (1) cut and painted spare panels per row.

M. DRAWINGS

1. After receipt of order the projection dome manufacturer shall submit complete shop drawings; erection drawings including structural framing, screen construction, scaffolding requirements, theater environmental conditions, and accessory installation details to the owner and consultants for approval prior to fabrication of the dome.

N. ACCEPTANCE

1. Final acceptance of the surface will be performed, using a projector as light source, by the owner and any consultant retained by the owner. Final acceptance is based on the following screen criteria:
 - a. Surface: proper contour and absence of local defects
 - b. Color uniformity
 - c. Correct reflectivity
 - d. Invisibility of seams (joints)
 - e. If a final acceptance cannot be done, then a preliminary inspection report must be signed

O. WARRANTY

1. Manufacturer shall provide warranties as follows:
2. Two years covering reflectivity and uniformity of screen surface as finally accepted, subject to Paragraph 9.3.
3. Five years covering the structural integrity of the structural frame.
 - a. Any structural defects or panel deformations which occur during the above-mentioned periods shall be repaired or otherwise made good by the manufacturer at his expense.

P. PROJECT SPECIFIC CRITERIA

1. Inside diameter of projection surface: 30 Ft. (9.14m)
2. Included Angle: 180 Degrees

3. Diameter at this point: 30 Ft. (9.14m)
4. Surface Reflectivity: (To Be Determined)
5. Maximum weight to be supported or suspended on structural tension ring: 2,000lbs – 3,000lbs.
6. Dome Tilt: 12 degrees

Q. DOME MAINTENANCE

1. In order to keep the dome screen from discoloring quickly; the following is a recommended preventative maintenance:
 - a. Maintain an operating temperature of 72° and a humidity range of 45% to 55%. Also, we recommend changing the filters in the air filtering systems once every 2 months. The best cleaning program is to vacuum clean the dust from the backside of the dome once a year. When climbing on the backside of the dome it must be done with extreme caution in order to eliminate any possibility of damaging the panels. Most stains can be removed using a typical household cleaner; such as, Fantastic or 409 spray cleaner (do not spray directly on the dome, spray on a clean white, lint free cloth). If the discoloration on the projection surface is too dark for spot cleaning, the best recommendation we have is to repaint the projection surface. Please feel free to contact Astro-Tec with any questions.

2.2 MASTER CONTROL SYSTEM

- A. Objective: Provide an automated computer-based control system to enhance the ease of presenting shows/lessons. Automated show presentation shall allow volunteer participation in the presentation of shows.
- B. Please note house lighting (provided by other) is under control of this system through DMX512 protocol. This centralizes automated control of the entire audience experience.
- C. Control System Specifications
 1. This system shall include custom, touch screen programming for control of all audio, video, and lighting systems as follows:
 - a. DSP based digital audio processor with network control.
 - b. All-dome projection system with network control.
 - c. LED cove light system with Art-Net control.
 - d. Control of auxiliary lighting (i.e. vestibule, house, step and spotlights) via DMX.
 - e. Blu-Ray player with network control.
 - f. Instructional Package projector, switcher, and audio levels.
- D. System Requirements
 1. The Master Control System shall be of a design allowing drag and drop control and automated programming of show control via graphic user interface.
 2. The Master Control System must provide network, serial, 16-bit Art-Net and DMX-512 and 8-bit DMX-512 control communications to other Planetarium devices.
 3. The software screens can be user-updated to add and delete devices as needed by the user. The Master Control System device interface ports can be redefined via software. As the Planetarium device collection changes, the interfaces are repurposed as opposed to obsolete.
 4. Shows and presentations can be programmed via drag and drop timeline editing as well as by step time cue list programming.
 5. Network bi-directional control to/from the full dome projection system is required.
 6. All serially controlled devices are to be controlled via a network to serial server.
 7. A programmable manual control panel shall be provided with interfacing to the master control system. The panel must be no more than 2RU in height and must be 19" rack mounted. This panel must provide a minimum of 3 100mm faders for Master, Full dome Projection, and Instructional Package audio level control and 4 push buttons for audio preset recall.
 8. 19 inch, or larger, wide screen Color TFT LCD touch screen Display, Black Housing, 1920 x 1080 minimum resolution, at least 160 Degree Off-Axis Viewing Angle. Located at Console rack.

9. Color, icon-based wireless handheld touch screen tablet shall be provided and programmed to allow remote control of all Planetarium systems (Apple or Android acceptable).
10. The Master Control System shall include a CAT5/6 KVM extension kit from the control system computer located in the Equipment Room Audio Rack to the Operator's Console and 19" touch screen display.
11. Shall include all necessary cabling, connectors, software, network switches, and interfaces to provide a fully functional system.
12. System shall turn lights to full on and mute audio when switch closure is sent from alarm system. Cable by another provider is to be landed in the Planetarium Equipment Rack.
 - a. Specified Model: AstroFXCommander Planetarium Control System
 - b. Note: No substitution due to integration with the full dome projection system

E. Required Services

1. Shall include all offsite and on-site engineering, assembly, fabrication, graphics production, programming, testing; and all onsite installation, programming, testing, documentation and training.
2. Customized touch screen layout and programming for compatibility with Planetarium and other classroom system components. Planetarium Technology Contractor shall provide the requirements for these graphics and programming.
3. Planetarium Technology Contractor shall provide a copy of bound and labeled owner's manuals, documentation, serial numbers, flowcharting, and engineering documents in hard copy that are indeed "as built" versions. Upon conclusion of installation and testing the Planetarium Technology Contractor shall provide two full days of training for Planetarium operation, programming and maintenance. This training shall be made available so as to be attended by staff and volunteers.

2.3 PLANETARIUM CONTROL CONSOLE

- A. Planetarium Technology Contractor shall provide and install components for the Planetarium Control Console, which shall be constructed of a "hardened" and lockable design based on the details in drawing PL.05.
- B. Planetarium Technology Contractor will integrate, install, test and present to the Owner a working Planetarium Control Console featuring the following components.
 1. Up to Two 24" Monitors for control of the OFE full dome projection system. (Included in Section 2.8).
 2. 19" touch screen monitor for Master Control System. (Included in 2.2).
 3. Rack Mounted Audio Mixer (Included in 2.6).
 4. Rack mounted Decora style mic input. (Included in 2.6).
 5. Switchable rack light featuring white or red LED illumination.
 6. Rack Mounted Blu-ray player (Included in 2.6)
 7. Rack Mounted Power Conditioner and Sequencer.
- C. Custom woodwork and finish is to be laminate with PVC edge-banding. Finish is to be determined by architect, if no finish is selected, use Wilsonart Graphite Nebula.

2.4 LED COVE LIGHTING SYSTEM

- A. Objective 1: To provide a continuous full-color RGBW all-dome lighting system allowing for any mix of full spectral color hues complete with the ability to program fades between all mixes.
- B. Objective 2: RGBW cove light system will also provide white lighting for instruction or work in the interior of the dome.
- C. Cove lights shall be controlled by the Master Control System (Section 2.02) with customizable, touch screen controls

- D. Any color on any individual fixture must be independently controllable including white, to allow dimming below the Instructional Projection image.
- E. The system shall provide integrated and synchronized operation with full dome projection systems. The LED lighting shall receive a wide variety of commands from the projection system host or wireless tablet controller. Any color on any individual fixture must be independently controllable directly from the system including white without needing the use of lighting controller presets. This enables full synchronization of the lighting system with full dome projection presentations.
- F. Cove lighting shall use new, energy efficient, easily replaceable and cost effective one-foot 64-bit (16-bit per color) LED lighting fixtures.
- G. Installed product(s) shall be composed of DMX LED fixtures. The light sources will be quad-color LED's as opposed to individual red, green, blue and white LED's. This system will provide wash cove lighting, in that each color can be faded up and down in individual one-foot segments or as a group to provide full dome lighting. Effects include all sunrise-sunsets, chases, light curtains, dome light washes, and chaotic random effects.
- H. This package shall include all LED fixtures, silent convection cooled power supplies (no fans), mounting hardware, and 16-bit per color lighting controller.
- I. System must include one single gang wall switch mounted near the entry door allowing basic on/off control of lighting.
 - 1. Specified Model: AstroFXAurora RGBW Advanced System

2.5 ELLIPSOIDAL PUBLIC ADDRESS SPOTLIGHTS AND HOUSE LIGHT DIMMING

- A. Objective: To provide shadowless spotlighting for speaker support. Shall be controlled by the Planetarium Control System (Section 2.2)
 - 1. Two LED ellipsoidal spotlights with adjustable focus, gobo slot, shutters, DMX and power daisy-chaining. Mounted at locations shown on Drawing PL.01. 19° beam angle. Shall include color frame, safety cable, cord and NEMA 5-15P plug. Black finish.
 - a. Specified Model: Chauvet E-160WW
 - 2. 120v NEMA 5-20 duplex outlets to be provided by electrical contractor as noted on PL.01

2.6 DIGITAL AUDIO SYSTEM WITH SUBWOOFER

- A. Objective: To provide a 5.1 sound system that amplifies and supports spoken instructional messages and that also allows for presentation of fully produced shows in stereo or six-channel surround sound format with pre-recorded soundtracks.
- B. Sound System Specifications (Refer to Rack Layout Drawing PL.07)
 - 1. All audio equipment shall be located in the Equipment Room Audio Rack and Console Rack and shall be controlled by the Master Control System. Multipair shielded cable shall be used to connect console audio with the control room.
 - 2. One hardwired dynamic cardioid handheld microphone with switch.
 - a. Specified Model: Shure SM58S
 - 3. Two wireless microphone systems with headset, handheld and lavalier elements. Rack mounted units to be located within console audio rack.
 - a. One wireless handheld transmitter and rack mount receiver
 - 1) Specified Model: Shure GLXD24R/B58A
 - b. One wireless lavalier cardioid microphone with bodypack transmitter and rackmount receiver.
 - 1) Specified Model: Shure GLXD14R/85

- c. One headset microphone for connection to bodypack transmitter with 4-Pin Mini Connector (TA4F).
 - 1) Specified Model: Shure WH20TQG
- d. One antenna and power distributing frequency manager for GLX Series Receivers.
 - 1) Specified Model: Shure UA846Z2/LC
4. One telescoping boom mic stand. Black.
 - a. Specified Model: Hosa MSB-521BK
5. Two 25' flexible mic cables. Black. Four inner conductors & shield.
 - a. Specified Model: Conquest Sound S2BN 25 Black 25' mic cable
6. One rack-mounted Blu-ray player with RS-232 remote control and balanced XLR outputs.
 - a. Specified Model: Denon DN-500BD MKII
7. One stereo rack-mount analog audio mixer with 10 channels including 4 mic inputs, 3 stereo inputs, Bluetooth and 2 Aux Sends.
 - a. Specified Model: Denon DN410X.
8. Planetarium Control Console to Equipment Room Audio Rack Interconnect Cable.
 - a. A multipair 22-gauge cable shall connect the Planetarium Control Console Rack to the Equipment Room Audio Rack. This multipair cable shall terminate in an EDAC multipin connector on each end. All Mic/Line level audio signals entering and leaving both racks shall enter via these connectors except as indicated on flowcharts. This is to simplify installation of any future equipment. A ten-foot service loop shall be neatly tied off on the side rails or bottom of the rack.
9. A fully balanced ¼" patchbay system with at least 30 points shall allow manual routing of any audio component in the system. The rear of this patch bay must be hardwired to EDAC E3 connectors as opposed to using plugs and jacks. The top row jacks shall be half-normalled to the bottom row jacks, unless otherwise noted on the accompanying wiring flowchart. Note that all connections to this patch bay use black single pair audio cable, shielded as opposed to a multipair cable. This is to simplify installation of any future equipment. A ten-foot service loop shall be neatly tied off on the side rails of the rack.
 - a. Specified Model: Bittree 30pt 1/4" B30DC-HNSST/E3 M2OU7L
10. Six fully balanced 24" ¼" patch cables to match patch bay.
 - a. Specified Model: Bittree LPC 2400-110.
11. DSP-based digital audio processor system as follows:
 - a. DSP digital processor will provide channel routing, equalization, limiting, frequency crossover and all other processing for audio formats from mono thru stereo and 5.1 channel audio.
 - 1) Twelve balanced analog inputs.
 - 2) Eight balanced analog outputs
 - 3) DSP module with subwoofer crossover to send only frequencies below 80Hz to the subwoofer system.
 - 4) This processor must be capable of running Planetarium Consultant provided audio configuration files.
 - 5) This processor must be expandable via Cat 5/6-based solutions (BLU-Link, Dante, etc.)
 - a) Specified Model: BSS Soundweb London BLU-100
 - b. Note: No substitution due to integration with the fulldome projection system
12. Equipment Room Audio Rack w/ caster base - All sound, video, and control system equipment (except for equipment to be located in the Planetarium Console) shall be integrated into one 35U x 32" deep professional black powder coat steel equipment rack located in the Equipment Room. Rack system shall include: all necessary power distribution, and filler panels. No front or rear door.
 - a. Specified Model: Lowell LER-3532-LRD with accessories.
13. Two digital amplifiers. Technical specification must meet or exceed the specs of the models specified below. The exact amp speaker assignments shall follow the wiring flowchart in drawing PL.08.
 - a. Specified Model: Crown DCI 4/300. Unit A.
 - 1) Input 1 Left (L) front speaker channel.
 - 2) Input 2 (R) Right front speaker channel.
 - 3) Input 3 Left rear (Ls) speaker channel.
 - 4) Input 4 Right rear (Rs) speaker channel.
 - b. Specified Model Crown DCI 4/300. Unit B.
 - 1) Input 1 Center Speaker channel.

- 2) Input 2 (Unused).
- 3) Input 3 & 4 bridged Subwoofer.
14. Five speaker locations plus one 18" subwoofer speaker systems to be installed on slab, to support 5.1 channel audio. Technical specification must meet or exceed the specs of the models specified below. The exact amp speaker assignments shall follow the wiring flowchart in Drawing PL.08.
 - a. Left Front, Right Front, Center, Left Surround, and Right Surround speaker channels. Single 12" two-way speaker systems with passive crossover. Coverage Pattern: 140°x60°.
 - 1) Specified Model: Klipsch Pro KPT-250-II
 - b. One single- 18" subwoofer speaker system. Mounted on slab.
 - 1) Specified Model: Klipsch Pro KI-118-SW
 - c. Audio System Speaker Layout: See Drawing PL.02 for speaker locations and installation angles.

2.7 POWER CONDITIONING, SEQUENCING, AND BATTERY BACKUP

- A. Power Sequencers, Conditioners, and Filters for 20-amp power conditioning units with sequenced remote key switch shall be provided for audio equipment.
 1. Provide power sequencers/conditioners in the following locations:
 - a. In Planetarium Control Console Rack. Connected to key switch in top of Planetarium Equipment Rack.
 - b. Located in Equipment Room Audio Rack. Powers amplifiers. Turn-on/off control connected to key switch in top of Planetarium Equipment Rack
 - 1) Specified Model: Furman CN-2400S
 2. Provide UPS power backup units in the following locations:
 - a. In Planetarium Control Console Rack (750VA)
 - 1) Specified Model: APC Smart-UPS 750VA LCD RM 2U 120V
 - b. In Equipment Room Audio Rack (1.5 kVA)
 - 1) Specified Model: APC Smart-UPS 1500VA LCD RM 2U 120V

2.8 ASSISTIVE LISTENING SYSTEM

- A. System must meet current ADA specifications. 2010 ADA compliance specs are used here as reference. 121 seats are used in equipment selection below. If number of seats changes, adjust the number of receivers accordingly based on current ADA specs.
 1. Listen Technologies LT-800-072-01 Transmitter with rack mount kit. Mount this feature in audio rack in Console.
 2. Listen Technologies LR-4200-072-P1. Intelligent DSP RF Receiver Package consisting of:
 - a. Five Intelligent DSP RF Receivers (72 MHz).
 - b. Five LA-430 Intelligent Earphone/Neck Loop Lanyard.
 - c. Five LA-401 Intelligent Ear Speaker.
 - d. Five LA-365 Rechargeable Li-ion Battery
 - e. One LA-381-01 Intelligent 12-Unit Charging Tray
 - f. One LA-304 Assistive Listening Notification Signage Kit.

2.9 INSTRUCTIONAL AND EVENT PRESENTATION PACKAGE

- A. This is provision and installation of a fully expandable instructional/classroom/event video/graphic system capable of projecting computer data graphics and text, as well as useful for distance learning and video conferencing. See Drawings PL.10 for wiring diagrams of this system.
- B. Planetarium Floorboxes: Three floorboxes are included in the system for connecting HDMI devices, adding mics for panel discussions, network connectivity and potential distance learning applications.
 1. Floorbox Locations:
 - a. Stage Left. (See drawing sheet PL.01 for exact location)

- 1) Specified Model: FSR FL-500P-6-B
 - 2) For grade applications, use the FSR FL-GRD2 or FSR FL-GRD4 pour pan as a foundation before box installation.
 2. Each floorbox shall have a NEMA 5-20 power receptacle installed on side #1. Provided by electrical contractor
 3. Each floorbox shall include insert plates with two XLR (D3F) audio inputs and one XLR (D3M) monitor output installed on side #2 with the Mic inputs and Monitor Output terminating at the Console Mixer.
 4. Each floorbox shall have a HDMI Decora-insert installed on side #4. Inputs shall terminate at the Equipment Rack.
 - a. Specified Model: Celerity Universal Fiber Optic HDMI Cables
 5. Network connectivity to campus network to be provided by IT contractor.
- C. Operator's Console Computer Input Interface.
1. Pop-up table box with AC duplex outlet, black cover and trim ring for guest speaker laptop presentations.
 2. Shall include one snap-in connector with HDMI (audio and video), and one data RJ45 jack for Cat6.
 - a. Specified Model: FSR T3-AC2-BLK
 3. Single Input or Switchable Scaler with HDMI Output for Console Input Interface to be provided for legacy video interfacing.
 - a. Specified Model: DVIgear DVI-3540a
- D. Blu-ray Player
1. Included in Audio System
- E. Instructional Package Video Projector
1. There will be an instructional projector located next to the rear all-dome projection projector.
 2. Projectors must have a resolution of at least 1080p (1920 x 1080) with additional support for additional resolutions. (16:9, 4:3 selectable PC, 16:9 video).
 3. Projector shelves at projection portal (Noted on Drawing PL.02) to be provided by dome manufacturer.
 4. Mounting hardware provided by Technology Package Contractor.
 5. Serial or network control and HDMI video to Instructional Projector shall be by a transmitter and receiver extender system that utilizes a single Cat5e/6/6a cable, and sends 1080p video, audio and bi-directional RS-232 up to 100m, allowing commands and data to flow in both directions.
 6. Projector shall contain lamp-less Solid-State technology that requires no maintenance for 20,000 hours or more.
 7. Projector Lens - Zoom lens for Instructional Video Projector. For Zoom lens 1080p (1920 x 1080) resolution. Suggested Range 1.5 – 3.0:1
 - a. Specified Model: Panasonic PT-RZ570
- F. Instructional Package Surround Sound Decoder/Switcher
1. The switcher is a multiple input, single HDMI- output active switcher for all video sources to be routed to the Instructional Package Video Projector. Using compatible video and audio connectors and any necessary adapters or video converters, the decoder/switcher passes both video and audio to allow multiple computer-video inputs to be switched to the Instructional Package Video Projector.
 - a. The switcher may be controlled via the front panel buttons. A rear panel serial port provides RS-232 control. Included rack-mount kit.
 - b. This decoder converts digital multichannel audio from one of the HDMI inputs to analog 5.1/7.1 audio for surround sound playback of Instructional Package sources. Audio to be mixed in DSP between sources.
 - c. Sources to be switched are:
 - 1) Stage Left HDMI Input

- 2) Console PC HDMI Input
- 3) Blu-ray Player
- d. Decoder is to be located in Equipment Rack
 - 1) Specified Model: Denon DN-700AV

G. HDMI Fiber Optic Cables

1. Shall include necessary professional grade fiber optic cables to connect computer interfaces to switcher and switcher to video projectors.
2. Shall meet current standards for transmitting HDMI 2.0 signals up to or exceeding 4K resolution.
3. Sources to be cabled via fiber-optic cables are:
 - a. Stage Left HDMI to Equipment Rack switcher
 - b. Console Rack PC Input to Equipment Rack
 - c. Blu-ray Player to Equipment Rack
 - d. Equipment Rack Switcher to Projector.
 - 1) Specified Model: Celerity Universal Fiber Optic HDMI Cables

2.10 DIGITAL ALL-DOME PROJECTION SYSTEM

- A. Package provider shall install existing Owner Furnished Equipment specified below and re-fit for a dual-cove mounted Projection System for use as a video and computer graphics all dome projection system. Shall include computer graphics and audio servers.
- B. Planetarium Package provider shall provide the Owners all owners' manuals for purchased systems within 30 days of contract award.
- C. Project Specific Criteria:
 1. 360° by 180° all dome projection.
- D. Projector shelf at projection portals to be provided by dome manufacturer.
 1. Projector Mounting Shelf must meet following requirements:
 - a. Must be vibration and flex free
 - b. Must be able to support 500 lb. (227 kg)
 - c. Minimum of 36 in (914 mm) wide, i.e. ±18 in (447 mm) from the centerline
 - d. The interior Planetarium wall must be cut at the top so as to be parallel to the base of the dome.
 - e. There must be 16 in of unobstructed space around the back and sides of the projector to allow for proper air flow.
- E. Auto Alignment.
 1. As provided with the existing Spitz SciDome HD and associated hardware and software.
- F. Image generator system:
 1. As provided with the existing Spitz SciDome HD and associated hardware and software.
 2. Internet connectivity provided by Client/IT Contractor.
- G. Projection System
 1. As provided with the existing Spitz SciDome HD and associated hardware and software.
 2. Two (2) DLP based Video Projectors.
 3. New lenses, if needed, for the existing projectors to function properly in the cove mounted configuration.
 4. New video signal and control cabling, if needed, to the new cove mounted projector locations.

5. Up to 8,000 ANSI lumens per projector.
 6. 2560x1600 resolution per projector.
 7. Contrast ratio 7,500:1.
 8. Lamp based light source.
 9. Projector mounting hardware for installation in Planetarium cove.
- H. Power Sequencers, Conditioners, and Filters for 20-amp power conditioning units with sequenced remote key switch shall be provided for audio, video and production equipment.
1. Provide UPS power backup units in the following locations:
 - a. At Each Projector Location (1kVA)
 - 1) Specified Model: APC Back-UPS Pro BR100MS

2.11 REMOVABLE FRONT OF THEATER PRESENTATION LECTERN

- A. This unit should be provided as follows:
- B. Shall be built with appropriate large casters to support the weight of the unit.
- C. Shall include internal standard 19" 12-space rack.
- D. Finish is to be laminate with PVC edge-banding in Architect selected finish.
 1. Specified Model: Middle Atlantic L2 Lectern

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Planetarium equipment level and plumb, according to manufacturer's written instructions and drawings from Planetarium Technology Consultant.
- B. Complete equipment assembly and termination where field assembly is required.
- C. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.
- D. All materials and equipment provided by the Technology Package Contractor are to be new and unused.
- E. Consultant will review the credentials of bidders. Bidders must be certified, and manufacturer approved for provision and installation of the provided products.
- F. Variations from the specification MUST be approved by the Consultant prior to installation.
- G. Wiring practices unless herein specified to the contrary shall be in strict conformance with "Appendix III, Installation Practices," Sound System Engineering Second Edition, Don and Carolyn Davis, Sam/Bobbs-Merrill, Indianapolis.
- H. Fastenings and supports for all fixed equipment and components including conduit and cables to provide a safety factor of 3 or better.
- I. Installation with all precautions necessary to prevent against electromagnetic and electrostatic hum.
- J. All precautions necessary to assure adequate equipment ventilation.
- K. Precautions to assure the safety of users shall be implemented as required by applicable codes.

- L. Microphone and 600-ohm lines fully insulated from each other and from their conduit.
- M. All balanced audio connections on connectors, terminals, patchbays and electronics are to be as follows:
 - 1. Pin 2 Positive. Wired with wire pair color or red or white.
 - 2. Pin 3 Minus. Wired with wire pair black.
 - 3. Pin 1 Shield. Wired with wire pair ground.
- N. All speaker connections are to be made as follows:
 - 1. Positive Output. Wired with wire pair color white.
 - 2. Minus Output. Wired with wire pair color black.
- O. Lines inside conduit free of any splices.
- P. Any splices approved by Consultant must be connectorized or on terminal blocks and inside labeled boxes.
- Q. Acceptable splices are:
 - 1. Speaker wire: Neutrik NL-4 connector or terminal block.
 - 2. 22AWG audio wire: XLR connector or terminal block.
- R. All conduits shall have pull strings installed by another provider (not in this contract) prior to arrival on site by Planetarium Technology Contractor.
- S. All wiring to building network switches to be provided by other.
- T. Wiring joints and connections made with rosin-core solder or approved mechanical connections.
- U. Cables free from wiring damage.
- V. Switches, connectors, jacks, receptacles, conduits, outlets and cable terminations clearly, logically, and permanently marked.
- W. Cooperation with other trades to achieve well-coordinated and satisfactory order.
- X. Job site shall always be adequately staffed.
- Y. Same individual in charge of work throughout execution, unless illness, loss of personnel or other circumstances beyond the control of the Technology Package Contractor intervenes.
- Z. Job site and all equipment and materials left clean and free of marks and blemishes.
- AA. Technology Package Contractor will provide any and all tools, scaffolds, special hoists and dollies as needed or required for the installation of the sound system equipment or may arrange for these to be provided by another party.

3.2 IDENTIFICATION AND LABELING

- A. Provide permanent intelligible identification on, or adjacent to all controls, patching jacks, I/O connection points, and the like. This identification will clearly and distinctly indicate the function of the item and will be numbered or lettered to correspond with the function, circuit and use consistent with the Consultant's drawings.

- B. All labeling shall use machine printed labels that match naming and numbering on Consultant's drawings. Cable labels shall be covered and adhered with clear heat shrink to prevent future peeling.

3.3 SYSTEM INITIAL TESTS AND ADJUSTMENTS

- A. Provide all necessary equipment and perform initial tests. Adjust or modify as necessary to provide system performance conforming to specifications.
- B. VOM shall be used to test continuity and phase of all new wiring and connections with the understanding that the system will function fully as designed.
- C. Hum and noise of all systems shall be inaudible at normal operating gain settings.
- D. Control functions shall be checked for proper operation, from controlling devices to controlled devices.
- E. Adjust, balance, and align equipment for optimum quality and to meet the manufacturer's published specifications. Establish and mark normal settings for each level control with permanent machine printed labeling.
- F. Verify the following before beginning actual tests and adjustments on the System.
 - 1. All electronic devices are properly grounded.
 - 2. All powered devices have AC power from the proper circuit. All dedicated AC power circuits are properly wired, phased, and grounded.
 - 3. Insulation and shrink tubing are present where required.
 - 4. Dust, debris, solder splatter, etc. is removed.
 - 5. All cable is dressed, routed, and labeled; all connections are properly made and consistent with regard to polarity.
- G. Grounding System Tests.
 - 1. Measure the DC resistance between the technical ground in any equipment rack or console and the main building ground. Resistance should be 0.15 ohms or less.
 - 2. Verify that the EC has connected the technical ground to building ground at only one location with 4 AWG or larger wire.
 - 3. Measure the DC resistance between the signal ground at any connector plate and the conduit system.
 - 4. Identify and correct any problems if within the Audio System scope of work; notify the Construction Manager if a problem is in a related area of work.
 - 5. System shall be completely free of hum, parasitic oscillation, ground loops, RF interference, and any audible noise and distortion problems.
- H. Cable and Fiber.
 - 1. Test all cables as installed for shorts between conductors or to building ground and opens.
 - 2. Certify all data cables installed by the Technology Package Contractor to Category 5e or better.
 - 3. Document all tests and complete measurement results including wire number, date, test equipment used, operator, and test results. If any problems are detected in testing, correct the problem, and retest.
- I. Audio System Tests.
 - 1. Perform the following tests and adjustments, supplying all test equipment required. Set for slow meter damping and C weighting as required. Make corrections necessary to bring the system(s) into compliance with the specifications.
 - 2. Adjust the gain of each active device to provide optimum signal-to-noise ratio and 18 to 20 dB headroom. Record input and output levels at each step in the signal chain.
 - 3. Check system to assure freedom from oscillation or stray RF pickup.

4. Apply a sinusoidal sweep signal to each loudspeaker system, sweeping from 50 to 5000 Hz at a level 10 dB below full amplifier output, and listen for rattles or objectionable noise. Notify Construction Manager and coordinate to correct any rattles or noise that is discovered.
5. Check the polarity of all loudspeakers with an electronic polarity checker, and by applying music program or pink noise signal to the system while walking through the transition areas of coverage from one loudspeaker to the next. Transition should be smooth with less than +/-3db shift in source from one loudspeaker to the next.
6. Demonstrate a measured SPL of 95db continuous for the Planetarium systems with precision sound level meter four feet above floor height, using the "C" scale. The system shall be driven with a full bandwidth pink noise.

J. Video System Tests:

1. Verify performance of all video connecting cables, as specified herein. Continuity tests are not acceptable. Replace any defective cable prior to continuing tests.
2. Perform video signal parameter tests on individual items of equipment, and the work as a whole in accordance with EIA, SMPTE and AES Recommended Practices and other recognized standards as listed under REFERENCES.

3.4 REFERENCES

- A. National Fire Protection Association (N.F.P.A.)
- B. National Electrical Code (N.E.C.)
- C. National Electric Safety Code (N.E.S.C.)
- D. American National Standards Institute (ANSI)
- E. Electronics Industries Association (E.I.A.)
- F. Telecommunications Industries Association (T.I.A.).
- G. American Society for Testing Materials (A.S.T.M.).
- H. Building Seismic Safety Council (B.S.S.C.)
- I. International Standard ISO 31-0:1992(E), Quantities and units – Part 0: General principles.
- J. International Standard CEI/IEC 27-3:1989, Letter symbols to be used in electrical technology.
- K. AES14-1992 (r1998), AES standard for professional Audio equipment – Application of connectors, part 1, XLR-type polarity and gender.
- L. AES26-2001 (revision of AES26-1995), AES recommended practice for professional Audio - Conservation of the polarity of Audio signals.
- M. Shields and Grounds: Safety, Power Mains, Studio, Cable and Equipment, (special excerpt) The June 1995 issue of the Journal of the Audio Engineering Society.
- N. Audio System Design and Installation, by Phillip Giddings, published by Sams.
- O. Sound Reinforcement Handbook, by Gary Davis and Ralph Jones, published by Hal Leonard Publishing Corporation.
- P. Sound System Engineering, 2nd edition, by Don & Carolyn Davis, published by Sams.

3.5 DEMONSTRATION AND ACCEPTANCE TESTING

- A. General: Technology Package Contractor will simultaneously work with Architect, Consultant and Owner selected commissioning representative, to demonstrate operation of each major component of the system
- B. At their option, the Owner will contract and pay for a third-party consultant to perform system testing. This cost is not included in the Contractor's contract.

3.6 ADDITIONAL ADJUSTMENTS AND TESTS

- A. If need for additional adjustment becomes evident during demonstration and testing, Technology Package Contractor's work will be continued until the system will function fully as designed.

3.7 TRAINING

- A. Provide a minimum of two, eight -hour days of prepared and organized training sessions for the benefit of the Owner's personnel. Demonstrate the location, wiring, operation and capabilities of each system component.

END OF SECTION

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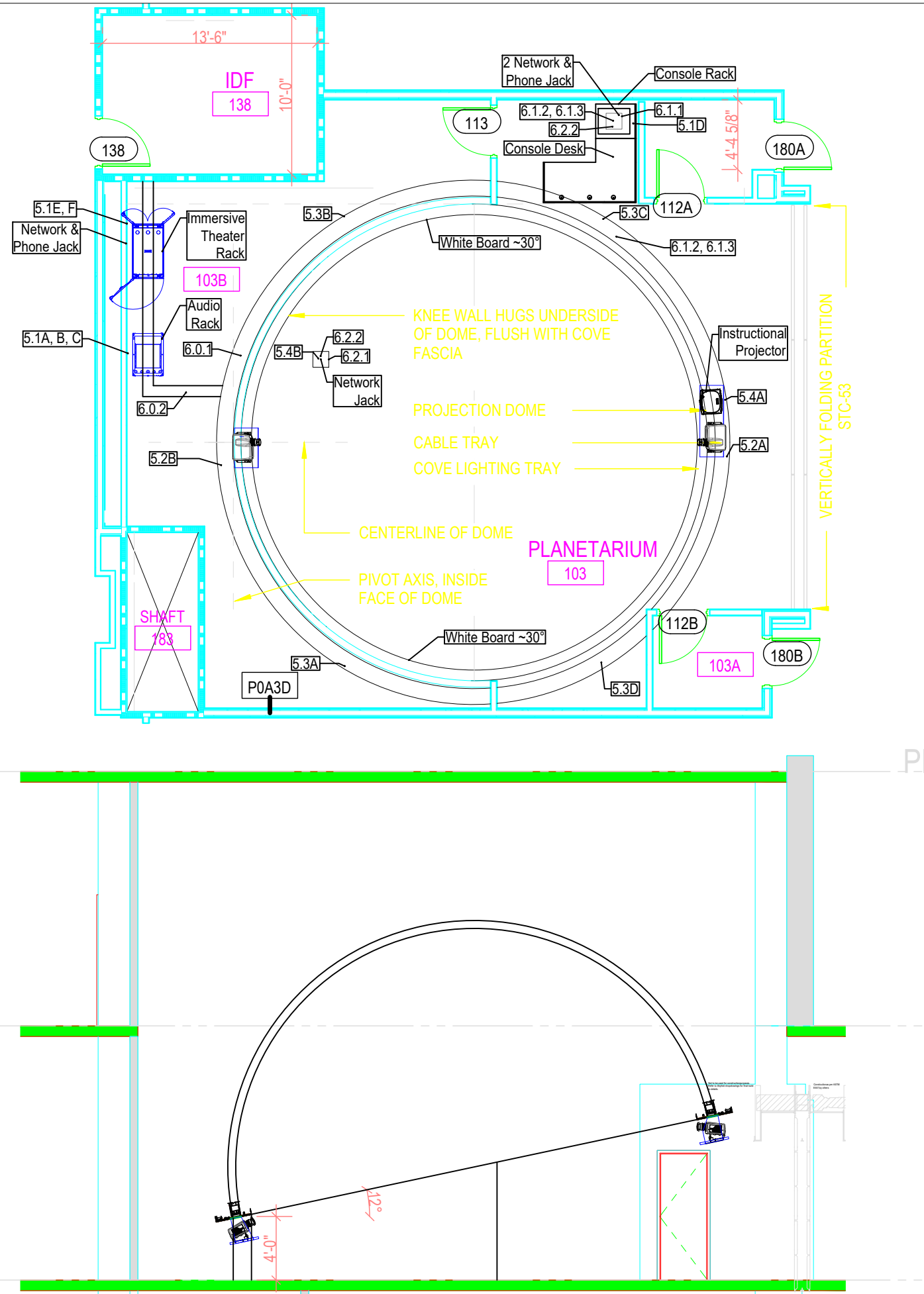


Table 5.1 Summary of Power Specifications Equipment Racks

Circuit Reference	Location	Circuit Power	Phase	Box/Connection
5.1 A	Planetarium Equipment Room Audio Rack Power	20A	Clean AV	Single-gang with NEMA 5-20R
5.1 B	Planetarium Equipment Room Audio Rack Power	20A	Clean AV	Single-gang with NEMA 5-20R
5.1 C	Planetarium Equipment Room Audio Rack Power	20A	Clean AV	Single-gang with NEMA 5-20R
5.1 D	Theater Console Rack	20A	Clean AV	Double-gang box with NEMA 5-20R
5.1 E	Planetarium Equipment Room Immersive Theater Rack Power	20A	Clean AV	Single-gang with NEMA 5-20R
5.1 F	Planetarium Equipment Room Immersive Theater Rack Power	20A	Clean AV	Single-gang with NEMA 5-20R

Table 5.2 Immersive Theater Projection System

5.2 A	Immersive Theater Video Projector at 180° Behind Projection Dome	20A	Clean AV	Double-gang with NEMA 5-20R *
5.2 B	Immersive Theater Video Projector at 0° Behind Projection Dome	20A	Clean AV	Double-gang with NEMA 5-20R *

Table 5.3 Summary of Power Specifications Specialty Lighting

5.3 A	LED Cove Light Power located at 300° behind Projection Dome	20A	Non AV	Single-gang with NEMA 5-20R *
5.3 B	LED Cove Light Power located at 60° behind Projection Dome.	20A	Non AV	Single-gang with NEMA 5-20R *
5.3 C	Ellipsoidal Stage Light behind Projection Dome at 120°	20A	Non AV	Single-gang with NEMA 5-20R *
5.3 D	Ellipsoidal Stage Light behind Projection Dome at 240°	20A	Non AV	Single-gang with NEMA 5-20R *

Table 5.4 Summary of Power Specifications Presentation Package

5.4 A	Instructional Package Video Projector behind Projection Dome 185° Projector	20A	Clean AV	Single-gang with NEMA 5-20R *
5.4 B	Stage Left Floor Box	20A	Clean AV	NEMA 5-20R

* Electrical Box Mounted to Cable Tray Around Dome Exterior.

Table 6.0 Planetarium Equipment Room to Back of Theater Projection Dome

Reference	Origin	Termination	Size
6.0.1	Cable Tray around the outer perimeter of the Projection Dome (Provided by Dome Vendor)		12" Wide
6.0.2	6.0.2 Equipment Room Cable Tray		8" Wide

Table 6.1 Summary of Conduit Specifications: Planetarium Equipment Room

Reference	Origin	Termination	Size
6.1.1	12" x 12" Floor Box located beneath Theater Console Rack		Box
6.1.2	From Floor Box 6.1.1 beneath Theater Console.	Stub out at 6.0.1 Cable Tray around Projection Dome	4"
6.1.3	From Floor Box 6.1.1 beneath Theater Console.	Stub out at 6.0.1 Cable Tray around Projection Dome	4"

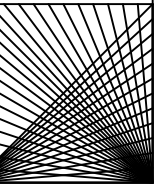
Table 6.2 Summary of Conduit Specifications: Planetarium Floor

Reference	Origin	Termination	Size
6.2.1	Stage Left Floor Box		Box
6.2.2	From 6.2.1 Floor Box located at Front of Theater Stage Left	Into side of Floor Box 6.1.1 beneath Theater Console.	1.25"

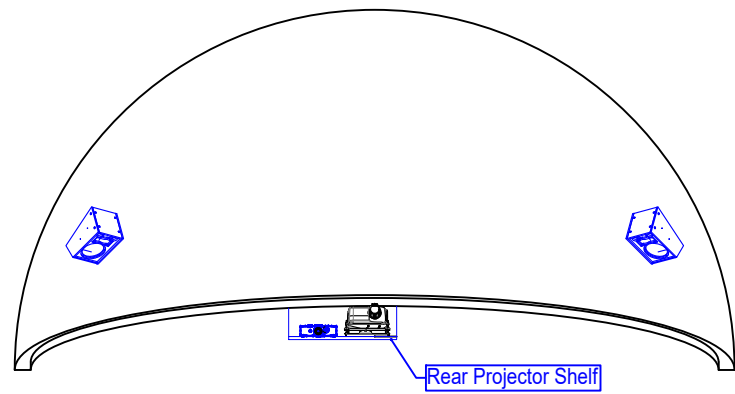
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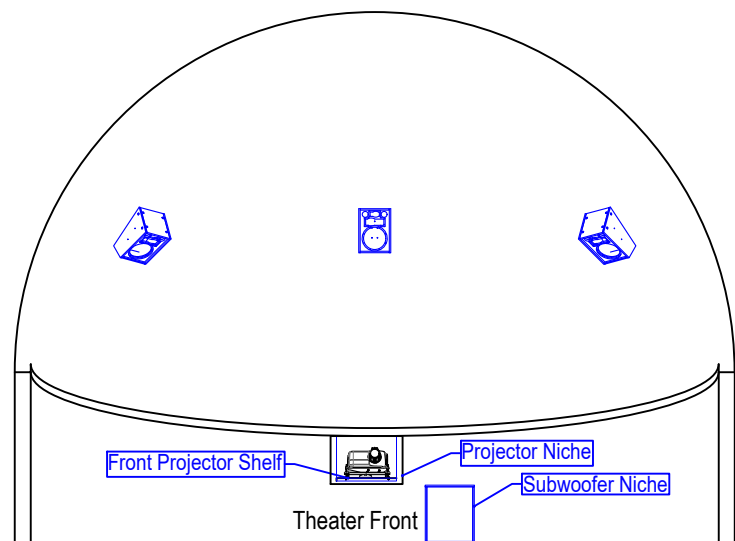
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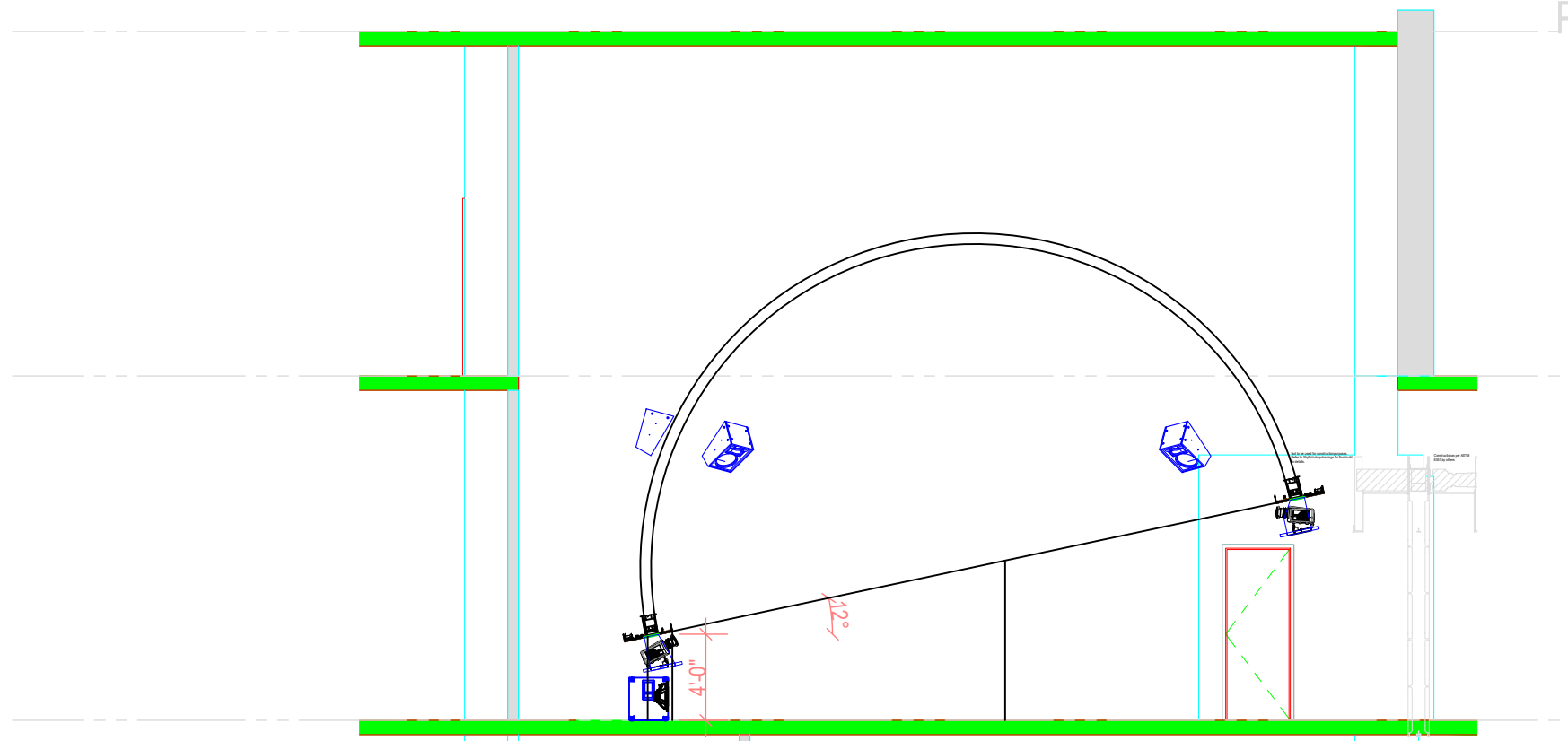
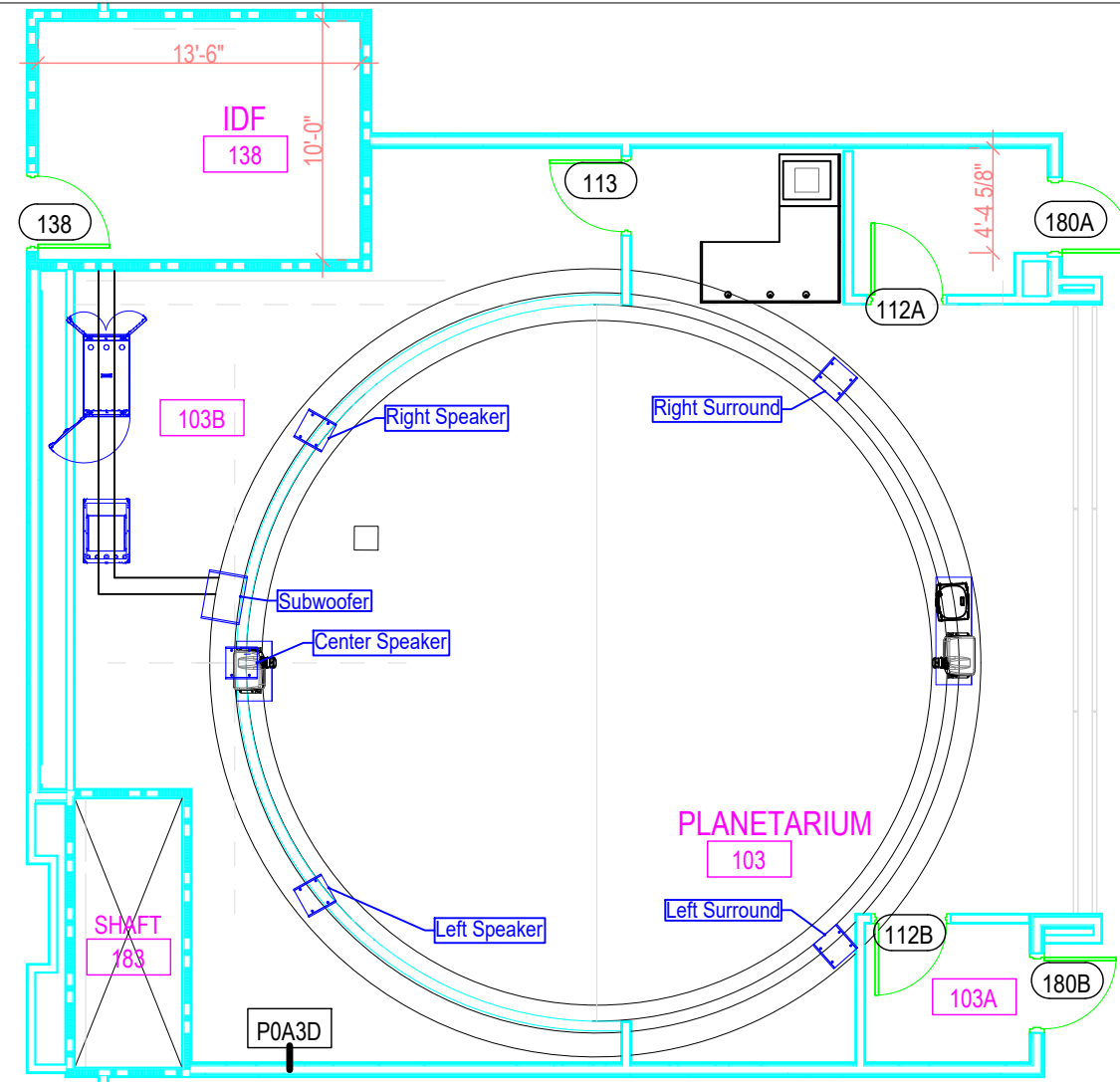
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Theater Back



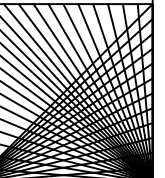
Theater Front



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SECTION 122413 - ROLLER WINDOW SHADES

1.1 PRODUCTS

- A. Manual, chain-and-clutch operating mechanism.
 - 1. Locations indicated on the Drawings
- B. Roller Mounting Configuration: Single roller .
- C. Installation Accessories: Front fascia, Closure panel and wall clip, Side channels and bottom (sill) channel or angle (for areas where blackout shades are located).
- D. Shadeband Materials: Complying with NFPA 701.
 - 1. PVC Free
 - 2. Light-Filtering Fabric: Acrylic-coated fiberglass.
 - 3. Blackout Fabric: Fiberglass with acrylic backing .
- E. Product Safety Standard: WCMA A 100.1.

1.2 INSTALLATION

- A. Locations indicated on the Drawings.
- B. Outside of jamb installation.
- C. Factory-authorized representative to train Owner's personnel.

training seems unnecessary



shades to have multiple locking positions

END OF SECTION 122413

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SECTION 123553 – GENERAL REQUIREMENTS FOR LABORATORY CASEWORK AND FUME HOODS

1.1 LABORATORY SERVICE FIXTURES (SECTION 12309)

- A. Specific scope of each type will be determined during the construction document phase. In general Laboratory Service Fixtures shall include:
1. Domestic Hot and Cold Water Fixtures.
 2. Pure and Ultra-Pure Water Fixtures.
 3. Laboratory Gas Fixtures
 4. Single Outlet Turret
 5. Electrical Service Fixtures to be provided under Division 16 - Electrical
 6. Fume Hood Service Fixtures
 7. Barrier Free Swing-Down Eye Wash/Emergency Shower
 8. Barrier Free Swing Deck Mounted Eyewash
 - a. Acceptable manufacturers:
 - 1) Water Saver Faucet Company, Chicago, IL
 - 2) Chicago Faucets, Des Plaines, IL.
- B. Refer to Fume Hood Section for Laboratory Fume Hood Fixtures
- C. Service Modules to be pre-piped and pre-wired.

1.2 LABORATORY CASEWORK AND FUME HOODS (SECTIONS 123553.13, 123553.19 AND 115313)

- A. Casework is composed of a combination of wood (Section 123553.13) and metal casework (Section 123553.19). Specific scope of each will be determined during the construction document phase. In general the casework type will be as follows:
- B. Metal Laboratory Casework (Section 123553.19): Metal casework, and stainless steel casework will be provided at areas indicated on drawings.
1. Metal Laboratory Casework includes:
 - a. Acid storage cabinets for use under fume hoods
 - b. Solvent storage cabinets
 - c. Adjustable shelving systems
 - d. Miscellaneous fillers and panels required for a finished installation
 2. Steel casework shall be manufactured from 25%-40% recycled steel with a VOC-free, acid-resistant powder coat finish
 3. Standard for quality and design: Kewaunee Scientific Corporation
- C. Fume Hoods (Section 115313): This Section includes, but is not limited to, all materials, labor and equipment, complete with all anchors and related accessories, necessary to furnish, deliver and install:
1. Chemical Fume Hoods, Pre-Piped and Pre-Wired
 - a. VAV air system and Open By-Pass type, as indicated on drawings and equipment list.
 - b. All hoods shall meet testing criteria established in ANSI/ASHRAE 110-2016.
 - c. The interior lining of the hood must be resistant to the materials and chemicals to which it will be

exposed.

d. Working surface shall be molded epoxy resin.

e. Air Flow Monitors for shall be provided by the VAV Control Contractor.

2. Local Point Exhaust (Snorkels)

3. Standard for quality and design: Kewaunee Scientific Corporation

1.3 WOOD LABORATORY CASEWORK (SECTION 123553.13): All casework to be wood casework, unless noted otherwise on drawings.

A. Wood Laboratory Casework includes:

1. Floor mounted, sitting and standing height, base cabinets with swinging doors, drawers and open shelves
2. Wall hung swinging glass door cabinets
3. Wood Aprons
4. Full height cabinets, with full glass and solid wood swinging doors
5. Adjustable shelving systems
6. Multi-science tables, utility tables and instructor demonstration tables
7. ADA work stations
8. Wall mounted shelving systems
9. Reagent rack assemblies
10. Miscellaneous fillers and panels required for a finished installation

B. Wood Laboratory Casework systems shall contain hardwoods, veneers and plywood which originate from managed forests that are 100% sustainable, with formaldehyde glue level well below that required by HUD and OSHA standards. The use of FSC certified sustainable woods, and glues containing no added urea formaldehyde shall contribute toward LEED credits.

C. Environmentally Friendly Veneer shall be vertically matched, plain sliced, white oak.

D. Renewable-resource core panels: End, top and bottom panels, drawer head, and doors shall be manufactured from annually-renewable, Green Spec approved, eco-friendly fiberboard core panels.

E. Drawer body and shelf shall be manufactured from 25%-40% recycled steel, coated for durability with an acid-resistant, VOC-free, powder coat finish.

F. All panel parts shall be protected with an acid-resistant, clear-coat finish, applied with an environmentally friendly flat line process that releases no volatile organic compounds (VOCs) into the atmosphere.

G. Casework system shall meet SEFA 8-W performance standards including five-knuckle stainless steel hinges and 150-pound load capacity drawer.

H. All countertops and back splashes to be phenolic resin, unless noted otherwise. Stainless steel countertops shall be provided at autoclave and greenhouse areas.

I. All sinks and cup sinks shall be black modified epoxy resin, drop-in sink, unless noted otherwise. Refer to Division 15, for stainless steel sink requirements.

1. Standard for quality and design: Kewaunee Scientific Corporation.

END OF SECTION

SECTION 123553.19 - WOOD LABORATORY CASEWORK

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 wood laboratory casework.
- B. Related Requirements:
 - 1. Refer to Section 123553 General Requirements for Laboratory Casework and Fume Hoods for all References, Approved manufacturers, Materials, Hardware, Finishes, Installation, etc.
 - 2. Section 123553.03 Flexible Laboratory Casework Systems

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND PRODUCTS

- A. Refer to Section 123553 for approved manufacturers.

2.2 CASEWORK DESIGN

- A. Comply with SEFA 8-W "Laboratory Grade Wood Casework."
- B. Minimum standards for work within this Section: Construct in accordance with Premium Grade of the Architectural Woodwork Standards, latest edition unless otherwise specified herein.
- C. Flush overlay style.
- D. Rigid and self-supporting cabinets suitable for use in an assembly or as individual, stand-alone units, with joints securely glued and cabinets clamped under pressure during assembly to ensure secure joints and cabinet squareness.
- E. Joints: Doweled and glued or mortised and tenoned secured with glue and countersunk screws.
- F. Square edged door and drawer fronts overlapping the openings on all four sides. In elevation, hold the reveal between end panel and door or drawer edge to a maximum of 1/8 inch wide. Hold spaces between abutting doors and drawers to a maximum of 1/8 inch wide, both horizontally and vertically, and shall be accurate and uniform, forming a continuous reveal throughout full length of assembled casework. Hold the reveal between top of cabinet and door or drawer edge to a maximum of 1/4 inch wide. Trim and sand smooth with all edges and corners radiused.
- G. Testing of Casework, Tables, and Shelving: Meet or exceed SEFA 8-W.

2.3 CASEWORK FABRICATION

- A. General: Include completely enclosed vertical posts. Include the items of cabinet construction listed. Exclude provisions for doors in open shelf cabinets or cubbies.
- B. Floor Mounted Base Cabinets:
 - 1. End Panels:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Provide a minimum of 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, for the attachment of drawer and shelf slides or shelf clips.
 - d. Attach to top frame, bottom, intermediate rails, and toespace rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - e. For sink cabinets containing an under-mount sink, provide support rails secured between end panels with leveling screws to support sink.
 - 2. Backs:
 - a. Unexposed interiors and exteriors: Minimum 3/16 inch hardboard.

- b. Exposed interiors and unexposed exteriors: 1/4 inch veneer core plywood.
 - c. Exposed exterior backs: 3/4 inch veneer core plywood.
 - d. Provide removable vertical split backs on all base cabinets, except units with security panels and sink cabinets, to allow access to service piping from the front of the unit.
 - e. All sink cabinets to have partial height back panels to allow passage of the drain line and piping to the service chase.
3. Bottoms:
- a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 edgebanding.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
4. Toespace Rail:
- a. Install between end panels to provide a minimum toespace of 2-1/4 inches deep by 4 inches high.
 - b. Type 2 hardwood or fir, 3/4 inch by 4 inch.
- C. Top Frames:
- 1. Full frame consisting of front, rear, and side members. Join frame members with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 2. Front member: Type 1 hardwood or Type 2 hardwood with 1/8 inch), Type 1 hardwood edgebanding. Minimum 1 inch by 2-1/2 inch.
 - 3. Rear member: Type 1 or Type 2 hardwood. Minimum 1 inch by 2-1/2 inches.
 - 4. Side members: Type 2 hardwood. Minimum 3/4 inch by 1-1/2 inch.
 - 5. Attach top frame to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 6. Intermediate Rails:
 - a. Provide between drawers and doors, and between drawers at all security panels.
 - b. Type 1 hardwood, minimum 3/4 inch thick.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 7. Security Panels:
 - a. 1/4 inch thick medium density fiberboard let into intermediate rails.
 - b. Provide on all base cabinets with locks, between drawers and door, and between drawers.
 - 8. Vertical Dividers:
 - a. 1-1/2 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch. Type 1 hardwood edgebanding.
 - c. Attach to bottom, front top rail, and rear top rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 9. Adjustable Shelves:
 - a. Provide one shelf per cupboard unit. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Fit dividers and end panels with stud type shelf brackets for adjustment Adjustable on 1-1/4 inch centers. Groove shelves at brackets to prevent movement.
 - d. Front edge of shelf to be within 1 inch of inside face of door. split-depth of shelf so that front section can be removed to allow for taller storage.
 - 10. Sliding Shelves:
 - a. Where indicated provide bottom shelf on drawer slide.
 - b. Provide drawerslides at 200# full extension.
 - 11. Hinged Doors: particleboard, MDF or combination core with 1/8 inch, Type 1 hardwood edgebanding.
 - 12. Drawers:
 - a. Drawer box (back, sides, and subfront): Minimum 1/2 inch 9 ply Baltic Birch veneer core plywood or 1/2 inch, Type 2 hardwood. Attach back, subfront and sides with 5/16 inch dowels and glue or multiple dovetail and glue.
 - b. Bottom: 1/4 inch hardboard. Dado bottom into back, subfront and sides sealed with hot melt glue around drawer bottom perimeter.
 - c. Removable drawer head: 3/4 inch hardwood plywood, particleboard, MDF or combination core with 1/8 inch Type 1 hardwood edgebanding.

- d. For student drawers/doors with combination lock (provided by owner) provide stainless 4"x4" steel strike plate and locking hardware.
 - e. Provide all drawers/doors with aluminum label holder.
- D. Student Tables:
- 1. Steel Frame:
 - a. Provide adjustable height steel frame with low profile support apron, if required.
 - c. Tables to have 1" thick phenolic countertop.
 - d. Provide with pullout write-up shelf where indicated on contract drawings.
 - b. Provide tables with heavy duty swivel casters with breaks where indicated on contract drawings.
- E. Wall and Upper Cabinets:
- 1. End Panels:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch Type 1 hardwood edgebanding.
 - c. Provide 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, to receive shelf clips.
 - d. Attach to top, bottom, and bottom rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 2. Backs:
 - a. 1/4 inch veneer core plywood.
 - b. Rabbetted backs and provide unexposed exterior hanger rails at the top and the bottom.
 - 3. Bottoms:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 4. Tops:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 5. Adjustable Shelves:
 - a. Full width with one adjustable shelf for cabinets up to 26 inches high and two adjustable shelves for cabinets up to 37 inches.
 - b. 1 inch veneer core plywood.
 - c. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - d. Adjustable on 1-1/4 inch centers.
 - e. Front edge of shelf to be within 1 inch of inside face of door.
 - f. On wall mounted cabinet shelving with no doors provide with removable seismic rail.
 - 6. Hinged Solid Doors: particleboard, MDF or combination core with 1/8 inch, Type 1 hardwood edgebanding.
 - 7. Hinged Framed Glass Doors:
 - a. Frame: Minimum 3/4 inch by 2-3/4 inch, Type 1 hardwood.
 - b. Glass: Tempered safety glass.
 - c. Assemble frame with mortise and tenon joints secured with glue.
 - d. Provide extruded vinyl retaining molding designed so glass can be replaced without tools.
- F. Tall Cabinets:
- 1. End Panels:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch Type 1 hardwood edgebanding.
 - c. Provide 2 rows of drilled holes in each end panel, 1-1/4 inch on centers, to receive shelf clips.
 - d. Attach to top, bottom, and bottom rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 - 2. Backs: 1/4 inch veneer core plywood.
 - 3. Bottoms:
 - a. 3/4 inch veneer core plywood.

- b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 4. Bottom Toe Space:
 - a. 3/4 inch by minimum 4 inch, Type 1 hardwood or fir.
 - b. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 5. Tops:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 6. Fixed and Adjustable Shelves:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Provide five full width shelves. Center shelf to be fixed by attaching to end panels with doweled and glue or mortise and tenon joints secured with glue and countersunk screws. Four shelves to be adjustable.
 - d. Adjustable on 1-1/4 inch centers.
 - e. Front edge of shelf to be within 1 inch of inside face of door.
 - f. On tall cabinet shelving with no doors provide shelving with removable seismic rail.
 7. Hinged Solid Doors: combination core with 1/8 inch, Type 1 hardwood edgebanding.
 8. Hinged Framed Glass Doors:
 - a. Frame: Minimum 3/4 inch by 2-3/4 inch, Type 1 hardwood.
 - b. Glass: laminated safety glass.
 - c. Assemble frame with mortise and tenon joints secured with glue.
 - d. Provide extruded vinyl retaining molding designed so glass can be replaced without tools.
- G. Tall Cabinets, Cubbies
 1. End Panels:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch Type 1 hardwood edgebanding.
 - c. Attach to top, bottom, and bottom rail with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 2. Backs: 1/4 inch veneer core plywood.
 3. Bottoms:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels and vertical dividers with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 4. Bottom Toe Space:
 - a. 3/4 inch by minimum 4 inch, Type 1 hardwood or fir.
 - b. Attach to end panels with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 5. Tops:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Attach to end panels and vertical dividers with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
 6. Fixed Shelves:
 - a. 1 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch, Type 1 hardwood edgebanding.
 - c. Shelves to be fixed by attaching to end panels or vertical dividers with dowel and glue or mortise and tenon joints secured with glue and countersunk screws.
 - d. Front edge of shelves to be within 1 inch of front edge of cabinet.
 7. Vertical Dividers:
 - a. 3/4 inch veneer core plywood.
 - b. Exposed edges: 1/8 inch Type 1 hardwood edgebanding.

- c. Attach to top and bottom with multiple dowels and glue or mortise and tenon joints secured with glue and countersunk screws.
- H. Knee Space:
 - 1. Perimeter Rails: 3/4 inch by 4-1/8 inches solid Type 1 hardwood. Groove rails for "Z" irons or drill for top attachment.
 - 2. Reinforcing Cross Rails: 3/4 inch by 4-1/8 inches solid hardwood glued into front and back rail grooves and pinned at intervals not more than 33 inches on centers. Reinforce cross rails with glue blocks.
 - 3. Leg: 2 inch by 2 inch solid, Type 1 hardwood. Provide legs with leveling glides and a 2 inch high black covered vinyl or rubber shoe around leg base.
 - 4. Leg stretcher rails with 1-1/4 inch by 2-1/2 inch solid Type 1 hardwood. Connect by mortis and tenon and stove type bolt, washer and square nut..
 - 5. Back Panel: 3/8 inch veneer core plywood with 1/8 Type 1 hardwood edgebanding. Provide all panels with bottom 6 inches fixed and the top portion removable. Attach removable portion using stainless steel screws and finishing washers.
 - 6. Drawers. Provide as noted on the Drawings. Drawer unit, hardware, and suspension same as specified for base unit drawers.
- I. Filler Panels:
 - 1. Provide filler panels or scribe strips at exposed to view areas between back of cabinets and walls, between backs of cabinets at end of island or peninsula benches, and at any other area necessary to enclose gaps. For floor mounted cabinets provide all filler panels with bottom 6 inches fixed and the top portion removable.
 - 2. 3/8 inch veneer core plywood with 1/8 inch, Type 1 hardwood edgebanding.
 - 3. Secure to frame and/or cabinet back and wall with metal angle and oval head screws with finishing washers.

2.4 ADJUSTABLE SHELVING

- A. For nominal dimensions and general requirements refer to Section 123553.
- B. For Wall Assemblies refer to Section 123553.
- C. For Island Frame Assemblies refer to Section 123553.13
- D. Shelf Requirements:
 - 1. Wood shelving: Provide 1/8 inch solid hardwood facer on all exposed edges.
 - 2. Provide with rear retaining lip 1/2 inch thick by 2 inch high, solid hardwood attached to rear edge of shelving with screws, maximum 12 inches on center. Top shelf assemblies do not require retaining lip.
 - 3. Provide all shelving with removable seismic rail.

2.5 HARDWARE

- A. Refer to Section 123553.

2.6 METAL FINISH

- A. Refer to Section 123553.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Section 123553.

END OF SECTION

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 :
 - 1. Certified wood.
 - 2. Low-emitting adhesives.
 - 3. Low-emitting composite wood.

1.2 QUARTZ AGGLOMERATE COUNTERTOPS

- A. Front: Straight, slightly eased edge .
- B. Backsplash and End Splash: Beveled edge.
- C. Countertops: 3/4-inch- thick, quartz agglomerate.

1.3 INSTALLATION

- A. Install on plywood subtops and supports with adhesive.

END OF SECTION 123661.19

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SECTION 124816 - ENTRANCE FLOOR GRILLES

1.1 COMPONENTS

- A. Recessed Aluminum Foot Grilles:
 - 1. Aluminum Finish: Mill.
 - 2. Tread Rail Top Surface: Carpet insert.
- B. Basis of Design: Construction Specialties; PediTread G4 .
 - 1. Conform with College Standard
- C. Frame: Same material and finish as foot grille.
- D. Support System: Extruded-metal support system for drainage pit applications.
 - 1. Drainage Pit: 1 inch

END OF SECTION 124816

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SECTION 129300 - SITE FURNISHINGS

1.1 SUMMARY

- A. Benches.
- B. Bicycle racks.
- C. Trash receptacles.
- D. Removable Bollards.

1.2 MATERIALS

A. Steel and Iron:

- 1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- 2. Steel Pipe: ASTM A 53, or ASTM A 135.
- 3. Tubing: ASTM A 500.
- 4. Mechanical Tubing: ASTM A 513, or ASTM A 1011/A 1011M and ASTM A 500; zinc coated internally and externally.
- 5. Sheet: ASTM A 1011/A 1011M.
- 6. Perforated Metal: Manufacturer's standard perforation pattern.
- 7. Expanded Metal: ASTM F 1267.
- 8. Malleable-Iron Castings: ASTM A 47/A 47M.

B. Stainless Steel:

- 1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
- 2. Pipe: ASTM A 312/A 312M, Schedule 40.

C. Plastic: Recycled polyethylene.

D. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, concealed, recessed, and capped or plugged.

1.3 PRODUCTS

A. Bench: Subject to compliance with requirements, provide the following:

- 1. Landscape Forms, 800-430-6209, www.landscapeforms.com, Plexus Bench (backed).
 - a. Type: Plexus bench (backed-straight three-unit group) (see plans for number and locations)
 - b. Material/Finish: Material/finish: Tubular steel. Panels- wire grid. Colors per campus standards.
 - c. Mounting: Surface mount per manufacturer s instructions.

B. Bicycle Racks:

- 1. Landscape Forms, 800-430-6209, www.landscapeforms.com, Ring Bicycle Rack
- 2. Type: Ring Bicycle Rack (see plans for number and locations)
- 3. Material/finish: per campus standards.
- 4. Mounting: embedded, per manufacturer s instructions.

C. Trash and Recycling Receptacles:

1. Landscape Forms, 800-430-6209, www.landscapeforms.com, Plexus Litter Receptacle
2. Type: Plexus Litter Receptacle (Side open, 30 gallon)
3. Material/finish: Tubular steel. Panels- wire grid. Lid: Spun metal. Color-matched polyethylene liner. Colors per campus standards.
4. Mounting: per campus standards.

D. Removable Bollards:

1. Landscape Forms or equivalent
2. Type: Removable bollards, 2 at fire lane at New York Avenue.
3. Material/finish: Per campus standards.
4. Mounting: per manufacturer instructions.

E. Finishes:

1. Steel and wire mesh: Powder-coated, color per campus standard.
2. Stainless Steel: Directional Satin No. 4.

1.4 INSTALLATION

- A. Installation Method: Set cast-in support posts in concrete footing or Surface anchors as required.

END OF SECTION

SECTION 133413 – GREENHOUSE & RELATED EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide the greenhouse structure and included equipment listed herein, of the size and dimensions indicated on the drawings. Finished size of greenhouse shall not vary from dimensions shown on bid drawings.
- B. Manufacturer to furnish materials and equipment necessary for the greenhouse system described in this section and contract drawings. Equipment to be hung in place only; no hook-ups of any kind.
- C. No fabrication of the structure or ordering of equipment shall be done until drawings and equipment have been approved. Foundation dimensions shall conform to approved greenhouse drawings.
- D. This portion of the specifications does not cover the furnishing of labor or materials for the greenhouse concrete, grouting, masonry work of any description, plumbing, electrical (either power supply or control wiring), utility connections, flashing or counter-flashing; however, these items all should be coordinated with the Greenhouse Manufacturer. All the work called out in this paragraph shall be performed under other sections of the specifications and drawings by other trades than the greenhouse contractor.

1.2 QUALITY ASSURANCE

- A. Standards: Comply with National Greenhouse Manufacturer's associated standards, latest edition and the requirements set forth in these specifications of these specifications.
- B. The greenhouse shall be erected by the greenhouse manufacturer or by a qualified contractor approved in writing by the manufacturer. The greenhouse erection contractor shall have at least five years' experience in building glazed structures of the type specified. The General Contractor shall have all site conditions correct and ready prior to greenhouse erection. No masonry, foundation, or footer installation shall be made prior to approval of greenhouse plans.

1.3 SUBMITTALS

- A. Product data: Within 30 days after award of the Contract, submit: manufacturer's product specifications, technical product data, and standard data and installation recommendations for each component in full size PDF.
- B. Shop Drawings: A complete set of shop drawings including details shall be submitted by the greenhouse manufacturer for approval prior to fabrication. Submittals shall also include structural calculations and data on all equipment, glazing and doors supplied by greenhouse manufacturer. A project-specific wiring diagram complete with a control diagram, load schedule, equipment sequencing chart, and wiring layout, will also be required submittal.
- C. Project Data: Accessories: Submit manufacturer's product specifications, shop drawings, and rough in diagrams, details, installation instructions and general product recommendations, Contractor shall submit a materials list for all manufactured products and/or materials proposed to use in the work. List shall include:
 - 1. Name of the item.
 - 2. Manufacturer of the item.
 - 3. Manufacturer's catalog number.
 - 4. Hardware.
 - 5. Accessories
- D. Submit samples of the following:
 - 1. Glazing panels.

2. Aluminum framing members.
 3. Gaskets.
- E. Fastening materials, screws, bolts, adhesives, etc. shall be included as part of the greenhouse package.
- F. O&M Manuals: Provide the facility operating and maintenance manuals on all equipment. O&M manuals shall be full size PDF.
- G. Warranty: Provide warranty to the original Customer of the products set forth in the Purchase Agreement that all products manufactured will be free from material defects in materials and workmanship for a period of twelve (12) months after the date of substantial completion.

1.4 DESIGN CRITERIA

- A. Submit structural calculations for greenhouse signed and sealed by a Professional Engineer licensed to practice in the state of actual construction for review by the Architect.
- B. Structural Performance: Except as noted, and as minimum, conform to the requirements and recommendations of both the "Standard for Design Loads in Greenhouse Structures" and its "Commentary" published by the National Greenhouse Manufacturers Association, 1998 Edition (NGMA Standards). Aluminum members shall be designed in accordance with the Aluminum Association's design manual "Specifications of Aluminum Structures."
- C. Design Loads:
1. Dead load including equipment
 2. Snow Load - 30 PSF
 3. Wind Loads - 120 MPH
 4. Seismic Zone - C ($S_s=0.16$ and $S_1=0.1$)
- D. Applicable building code is uniform building code as adopted by local jurisdiction.
- E. Load Combinations:
1. D.L. + S.L.
 2. D.L + W.L.
 3. D.L. + $\frac{1}{2}$ S.L +W.L. OR ($\frac{1}{2}$ W.L +S.L.)
- F. Engineering Certification: Submittals shall meet structural requirements as well as all other applicable local or state building codes for building permits as indicated on the drawings. Foundation design shall be by others. Plans and calculations shall be signed and sealed by a licensed engineer in the state of project code jurisdiction.
- G. Any additional IBC required load combinations.

1.5 DELIVERY STORAGE AND HANDLING

- A. Product materials during delivery, storage and handling to comply with manufacturer's directions and as required to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Winandy Greenhouse Company
- B. Ludy Greenhouse Manufacturing
- C. Van Wingerden Greenhouse Company

- D. Approved equals as per substitution criteria and architect review.

2.2 MATERIALS

- A. Aluminum.
- B. Extrusions:
 1. Primary Framing: Alloy 6061-T6 or 6005-T5
 2. Secondary Framing: Alloy 6063-T6 or 6005-T5
 3. Sheet: Alloy 3003-H14
 4. Plates: Alloy 6061-T6 or 6005-T5
 5. Finish: Dark Bronze Anodize

2.3 ALUMINUM STRUCTURE: Greenhouse manufacturer's extruded aluminum posts (side, gable, partition, end and corner) truss framing, rafters and purlins. All frame members and fasteners will be visible. Design shall provide for uniform and set pattern, conforming to spacing indicated. Where design requirements can be met through use of manufacturer's standard components, such components shall be utilized. Mono-slope free standing.

- A. Connections shall be made with stainless steel fasteners below 1/4" and aluminum plates with all field connections to be bolted.
- B. Post-Aluminum posts shall be furnished and placed through the length of the greenhouses and across all partitions and gables. Posts shall be properly punched or drilled to receive fittings for attaching aluminum sills, purlins, gutters and rafters.
- C. Anchor Bolts: Provided stainless steel expandable type anchor bolts or epoxy type anchors. Provide complete with nuts and washers.
- D. Rafters: Provide aluminum rafters extending unbroken from eaves or gutters to ridges.
- E. Trusses: Where trusses occur, the rafters described above shall be part of the top chord of the truss. All other truss members and connecting plates shall be aluminum shear will be allowed. Truss members and connecting plates shall be sized to meet required design criteria.
- F. Aluminum knee bracing in the plan of the truss and column line is to be allowed in order to meet loading criteria.
- G. Roof Purlins: Provide purlins for roof, bolted to top chord as required for load distribution. Vertical framework girts: provide girts for sidewalls, gable and partitions if applicable. Prefabricate all purlins and girts for attachment of glazing bars and connecting lugs.
- H. Wall Sills: Seat an extruded aluminum wall sill on all foundations. Sill shall be capable of receiving either side sash or fixed glazing as required.
- I. Condensation System: Provide system of integral gutters in roof framing and glazing bars designed to collect condensation and weep moisture to the exterior. Under gutter drip channel shall collect gutter condensate.
- J. Glazing Members: Provide extruded aluminum glazing bars held in place with stainless self-tapping screws. Place extruded aluminum glazing bars in the roof of sufficient size and mechanical properties to carry design loads specified. Bars shall be spaced to properly receive glass glazing. Bars shall extend in one piece from gutter to ridge (on slopes without roof vents) and shall be supported by purlins. Extruded aluminum glazing bars of sufficient size and section modulus to carry design loads specified shall be placed in gables, extending from the wall sill to gable rafter. Provide camber on both top and bottom of bar for fastening purposes.

K. Gables and Partitions: Gables and partitions with fixed glazing from sill to gable rafter, except at door openings, shall be constructed using extruded aluminum shape as indicated on the drawings. Partition systems (if present) shall be designed and detailed to provide for different movement of greenhouse frames and supports anticipated under specified loading conditions.

L. Glazing Materials:

1. Roof: 5/16" Clear Laminated Glass, Low Iron (Vitro Starphire; Pilkington Optiwhite; Guardian UltraClear)
2. Vertical Exterior Walls: 1/4" Clear Tempered Glass, Low Iron (Vitro Starphire; Pilkington Optiwhite; Guardian UltraClear)
3. Partitions: None present.

2.4 FINISH: Dark Bronze Anodize

2.5 GREENHOUSE DOORS AND FRAMES

A. Product: MS-400 Entry Series with required aluminum frames manufactured by Cross Aluminum Products Inc., 1770 Mayflower Rd., Niles, Michigan 49120.

B. Door Opening Size: [refer to drawings]

C. Door Assembly:

1. Door Stile: To be aluminum alloy 6063; temper to be T5 with a minimum 1/8" wall thickness.
2. Stile and Rail Thickness: To be 1 3/4" thick tubular extrusion.
3. Stile Width: 4-1/2"

D. Rail Widths:

1. Top Rail [4"]
2. Mid Rail [4"]
3. Bottom Rail: [8"]

E. Pattern: To be smooth.

F. Aluminum:

1. ASTM B 221, alloy and temper to be 6063 T-5 or similar alloy and temper recommended by manufacturer for optimum finish results and consistency.

G. Internal Reinforcement:

1. ASTM B 308, for structural aluminum.

H. Fasteners:

1. Material: Aluminum, 18-8 Stainless Steel, or other non-corrosive materials compatible with items being screw applied.
2. Exposed:
 - a. Type: Fasteners exposed will be Philips flathead fasteners unless provided by other supplier.
 - b. Finish: Fasteners to match appropriate finish on standard doors and frames.
3. Concealed: To be standard according to manufacturer's standards.

I. Weather stripping:

1. Wool pile:
 - a. Material: Solid Propylene Base with resilient fibers and center fin strip.
 - b. Color: Manufacturer's standard black color.

J. Glazing:

1. Reference section Glazing accessories (08 85 00).
2. Door Glazing: Interlocking door glazing to be screw fastened and removable from interior with NORSEAL® V710 and/or V740 moisture seal foam tape applied to both interior and exterior sides of door. Exterior glazing to be non-removable.
 - a. Material: To be 1/8" thick extruded channels-6063-T5.
 - b. Color: To match finish of door.
3. Frame Glazing: Exterior side Snap-in glazing. Frame gasket to be flush glaze extruded rubber compound; EPDM.
 - a. Material: To be aluminum extruded channels-6063-T5.
 - b. Color: To match finish of frame.
4. Door Glass Stops:
 - a. Profile: 1/8" thick interlocking flush fit screw-applied extruded aluminum-stops with color matching door finish and removable from interior. Exterior glass stops to be non-removable.

K. Hardware:

1. Hardware Preparation: To be fabricated at factory according to hardware templates provided.
2. Hardware Installation: To factory install all applicable and supplied hardware to doors and frames.
3. Hardware Reinforcement: To provide necessary reinforcement for proper longevity and hardware function; ASTM B 209 and/or ASTM 308.
4. Hardware Finish: [Dark Bronze]

L. Single acting RHR door(s) shall have:

1. 1 each continuous hinge(Rotan type)
2. 1 each cylinder to be provided and install by hardware section
3. 1 each ADA compliant lockset
4. 1 each closer
5. 1 each threshold, ADA
6. 1 each door sweep]

M. Fabrication:

1. Job Preparation:
 - a. Preliminary Analysis: Job drawings to indicate door types, sizes, vision lite configuration(s), and finishes.
 - b. Fulfill Custom Requirements: Follow through on any specific deviations from standard requirements.
2. Assembly:
 - a. Product Operation: Measure, cut, and fabricate required materials for designated job.
 - b. Product Refinement: Smooth rough cut edges.
 - c. Arrangement: Place prepared structural fasteners inside door to conceal from view.
 - d. Reinforcement Preparation: To apply necessary structural and hardware reinforcement in beneficial areas of doors and frames where needed.
3. Door Joinery:
 - a. Mortise and Tenon application with screw applied internal slide-fit clips for horizontal rails. 3/8" tie rods bolted to door stiles through horizontal rail spline creating hairline joinery.
4. Fitting:
 - a. Placement: Product materials to fit accurately in appropriate locations.
 - b. Alignment: Doors to be in proper alignment with intended elevations.
5. Tolerances: Doors and/or frame elevations will not deviate from last revised and approved drawings.

N. Framing Systems:

1. Framing Members: Manufacturer's standard aluminum extruded profiles with required thickness for load support.
 - a. Vertical Jamb Sizes: 1 3/4" x 4 1/2"
 - b. Header Sizes: 1 3/4" x 4 1/2"
2. Clips and Reinforcements: Manufacturer's standard high strength aluminum: ASTM B 221 and/or ASTM B 308.
3. Fasteners and Accessories: Manufacturer's standard non-bleeding and non-corrosive material congruent to adjacent material.
 - a. Exposed Fasteners: To be stainless steel Philips flathead screws with appropriate finish: ASME B 18.6.4
 - b. Concealed Fasteners: To be manufacturer's standard.
4. Assembly:
 - a. Framing members are separate aluminum pieces cut to length and mechanically fastened from either spline or clip systems.
 - b. Joinery to be hairline.
 - c. Sommer and Maca Silicone 88R or Dow Corning® 795 Sealants applied on applicable areas.
 - d. Framing elevations to be identified according to final approved drawings.
5. Anchoring:
 - a. Appropriate anchoring fasteners to be secured no more than 18" apart on entire frame opening.
 - b. Frame headers to receive no less than 2 anchoring fasteners.
 - c. Add extra fasteners where hardware and hinge may require more.

O. Doorstop:

1. To be #CDM-32.
 - a. Wall Thickness: To be 3/16" thick for receiving applicable hardware.
 - b. Profile Height: To be no less than 5/8" high.
2. Snap-in: Fits standard manufacturer's door jamb profiles.
3. To receive weather strip around acting door leafs.
 - a. Wool pile: Solid Propylene Base with resilient fibers in a standard black color.

P. Hardware Preparation:

1. Intramural Work: Hardware preparation according to hardware suppliers' templates.
2. Field Work: Refer to manufacturers' installation instructions.

Q. Side Lites and Transoms:

1. Factory-assembled to largest allowable shipping size.
2. Identified in concealed locations according to final approved elevation numbers.

R. Finishes:

1. Standard Anodic Finishes:
2. Dark Bronze: Architectural Class 1, AA-M12C22A44, 0.7 mils.

2.6 INSECT SCREENS:

- A. Screens shall be provided for all roof and ventilation openings in the greenhouse compartments and corridors.
- B. Screen rail shall be minimum of 5/16" x 7/8" mill finish extruded aluminum with a groove to receive a vinyl insert to hold 16 mesh x 18 mesh aluminum steel screen mesh in place. Screens will allow for rescreening of units in the field. Screens will have brushes at vent rack arm locations.

- C. Screens must be able to be removed from the inside.
- D. Any single located, non-pad inlet louvers (shutters) shall be equipped with externally mounted screen box without least twice the screen area to shutter area.

2.7 GREENHOUSE ENVIRONMENTAL CONTROL

- A. Furnish and install a Wadsworth Control Systems, Inc. multiple zone capability greenhouse environmental control system utilizing touch screen capability for ease of use.
- B. The computerized control system shall be housed in a corrosion resistant gasketed cabinet.
- C. The cabinet shall have a built in polycarbonate window for quick view of the main screen.
- D. The cabinet shall have a key locked door. With ability to access wiring behind the touchscreen for electrical hookup.
- E. An industrialized 7" touchscreen.
 - 1. Overall dimensions are 7.17" x 4.77" shall be made of one piece of continuous glass extending a 1/2 inch beyond the touchable screen area for easy access to edges of the viewing area.
 - 2. Active touch area of 6.0" x 3.6" (screen size of 7.0" diagonal) with a screen resolution of 800 x 480pixels (WVGA) including a capacitive touch sensor allowing simultaneously tracking two points with a minimum touch diameter of 0.28".
 - 3. The screen shall be backlit with white LED for easy viewing in dark locations. Brightness shall support good viewing in sunlight.
 - 4. Input power shall be low voltage consisting of 5VDC – 2A.
 - 5. Supported connections include
 - a. Connection to the I/O modules through built in RS-485 port.
 - b. Internet connectivity is possible through a RJ-45 connector of 10/100/1000 Mbps Ethernet connector or Wi-Fi dipole Antenna of 2.4GHz, 2dbi with SMA connector (802.11 b/g).
 - 6. The central processing unit (CPU) of the controller is a 1GHz ARM Corex-A9.
 - 7. Memory storage:
 - a. 4GB iNAND Flash Internal storage for operating system
 - b. 512MB DDR3 RAM built-in program
 - c. 16GB micro SD card for greenhouse environmental settings and data
 - 8. The operating system running is Android OS v4.2.2.
 - 9. Operating environmental conditions
 - a. Temperature: 32°F - 113°F (0°C - 45°C)
 - b. Relative humidity 10% - 90% non-condensing.
- F. A Graphical User Interface (GUI)
 - 1. Main screen showing each greenhouse zone temperature and color indication for active heating, cooling or set point behavior.
 - 2. Main screen showing weather data including picture identification of current conditions.
 - 3. Direct access to each zones equipment list and live data from the main page.
 - 4. Up to 4 user definable time periods per zone.
 - 5. Up to 3 levels of alarm settings per zone: Informational, Warning & Critical. Allowing any type of alarm to trigger the Alarm relay. With the ability to monitoring: high/low temperature, high/low relative humidity, power failure, and fire.
 - 6. User configurable sensor types for greenhouse environmental analysis. Sensors types include: 0-5VDC, 4-20mA, 0-5VDC pulse counter, or self-generating 0-5VDC signals.
 - 7. Equipment state evaluation every 1-second. Sensor state evaluation every 5-seconds.
 - 8. All data written to user expandable micro SD cards.

9. Data charting for previous 7-days. User selectable data sets with equipment run status overlay, 2-finger zooming.
10. Weather station data is visible on all non-system setting screens.
11. Zone data is visible on all screens pertaining to that individual zone.

G. Contactor Panel:

1. UL recognized contactor panel in a NEMA rated enclosure.
2. Input/Output Module
 - a. Power is 24VAC/DC – 1A.
 - b. Two communication ports supporting RS-485 with MODBUS communication protocol. Lightning protection for each port.
3. Inputs:
 - a. Eight (8) analog input channels with 12-bit resolution and overvoltage protection.
 - b. One (1) isolated digital input channel.
4. Outputs:
 - a. Twelve (12) output channels capable of providing 24VAC at 120mA for relay activation.
 - b. One (1) dedicated alarm relay to signal alarm condition.
 - c. Two (2) 0-10VDC analog output channels capable of sourcing 100mA.

H. Settings for the I/O Module are stored on non-volatile EPROM memory.

1. Real Time Clock for keeping accurate time and date.
2. Indicating lights for each power source and network activity.

I. Twelve (12) DPDT relays for controlling equipment per I/O module.

J. Override switches for easy override control for each output relay.

K. Contactors as required per user's equipment

L. Remote access and control software option shall be provided and loaded on to owner's Pentium grade PC capable of running the software. USB interface with RS485 protocol from computer to greenhouse controller. Must be Cloud capable.

2.8 WEATHER STATION:

A. Furnish and install a weather station including instruments, instrument mounting tee, mast, and mast supporting and guying means: Computer Weather Station, Wadsworth Control Systems part number Part # M-4825 or approved equal.

B. Include instruments as enumerated in table below:

Sensor	Technology	Calibrated Accuracy		Range		Resolution	
		English	Metric	English	Metric	English	Metric
Solar Shielded Temperature	IC transistor band-gap	±1.8°F	±1°C	-40°F to 212°F	-40°C to 100°C	0.056°F	0.1°C
Solar Shielded Humidity	IC capacitive	±2.5%RH	±2.5%RH	0-100%RH	0-100%RH	0.17%RH	0.17%RH
Light	Silicon cell pyranometer	±8%	±8%	0-17,500 fc	0-175 mW/cm ²	50 fc	2mW/cm ²
Wind Speed	Digital tachometer	±0.17 MPH	±0.27 km/h	0-120 MPH	0-195 km/h	0.34 MPH	0.55 km/h
Wind Direction	Digital resolver	±11.25°	±11.25°	0-360°	0-360°	±22.5°	±22.5°
Precipitation	Impedance	N/A	N/A	Yes/No	Yes/No	Yes/No	Yes/No

C. Instrument mounting tee shall be constructed of galvanized steel tee with down-leg sized to fit over the end of 2"x 2" square structural steel tubing. NEMA-3 Rain shedding construction with covered wiring

compartment containing screw terminals to interface sensors to signal cable for attached control that reads the sensors.

D. Mast is 2" x 2" square tube, galvanized 15 gauge steel.

E. Mast Supporting and Guying Means

1. Mounting foot of 1/4" x 2" welded steel bar to be embedded in 8" diameter concrete footing.
2. Stabilizer bracket of 1/4" x 2" steel bar and 1" galvanized steel pipe welded into an assembly to stabilize mast against gable or side wall of greenhouse structure.
3. 1/8" Stainless steel wire rope, turnbuckles and clamp on mounting ears of 1/4" x 2" galvanized steel to form an assembly suitable for guying mast.

2.9 VENTILATORS:

- A. Two lines of thermostatic electric motorized side wall ventilators in the greenhouse to be furnished of extruded aluminum and with hook and continuous sockets designed so that if a center section of ventilator is damaged, that section can be removed without dismantling and sliding out the entire length or run of ventilators.

2.10 ELBOW ARM VENTILATING OPERATOR:

- A. Designed to handle single or double glass glazed vents in length runs up to the 50'-0" maximum length operable by standard 1" or 1 1/4" shaft pipe and elbow arms. Longer runs for plastic panel glazed vents can be operated.
- B. Gear box that is internally lubricated for low maintenance.
- C. 115 VOLT TE Motor for All Weather Operation.
- D. All electrical components are readily available and U.S. Standard.
- E. Built-In down and up limits stops for safety of operation and external primary travel limits.
- F. Pre-wired to reduce cost & ease of installation.
- G. Readily interfaceable with most greenhouse computer systems.
- H. Adjustable Automatic Controls.
- I. Installable without dismantling existing shafting.
- J. Winandy Greenhouse Co., Inc. "Atlas" Vent Machine or equal.

2.11 TGU / FIBERLANE MOTORIZED SHADE CLOTH SYSTEM (FOR ROOF AREA):

- A. General System Standards: TGU independently motorized shading, cooling and heat retention curtain system(s) designed for size as shown on the drawings. Curtains are to travel simultaneously from truss to truss and have a peaked or "roofline" profile with a flat top. Curtains are to be suspended from U.V. stabilized reinforcing tape and suspension hooks which slide on stainless steel, monofilament wires. All curtains are to come sewn to size complete with sealed edges and suspension hooks. Curtain fabric to be Ludvig Svensson or Trevira (flame retardant) Polyester & aluminum 50% shade factor, 57% energy savings.
- B. Motor and Controls: Each system to be independently operated by one TGU motor. Motor is to be U.L. or CSA approved. Primary and backup limit switches for each travel direction can be integrally mounted into the motor. Control panel is to be prewired for computer hookup, equipped with a manual override switch.

- C. Drive System: Drive cables to be stainless steel. Drive cables are to be a continuous length without any splices. Driveline is to contain one driveline drum per drive cable which provides simple adjustment if required.
- D. System Hardware: All rotating components, i.e. bearing brackets and pulleys are to utilize pre-greased double sealed ball bearings. All hardware is to be corrosion protected by either galvanizing or plating.
- E. System Sealing: Proper sealing of the curtain system at the trusses is to be accomplished using truss mounted lead edge and fixed edge aluminum extrusions.
- F. Cloth: Ludvig Svensson or Trevira flame retardant

2.12 MOTORIZED ROOF BLACKOUT:

- A. Cloth: Obscura white/black flame retardant.
- B. Same operating driveline as above shade system.

2.13 ROLL-UP SIDE CURTAIN SYSTEM:

- A. South Side Rollup system featuring blackout flame retardant cloth, drive line tube system powered by integral tube motor, 115 V, external travel limit switches, computer interface for greenhouse control system.
- B. The drive tubes shall be supported by nylatron roller brackets at each truss.
- C. The motor shall move the entire mechanism by rotating the drive shaft.
- D. Stationary and lead edge of each cloth panel shall seal to aluminum extrusion, remaining edges of each panel shall be provided with fabric seal.
- E. Cloth: Obscura white/black flame retardant

2.14 EXHAUST FAN(S):

- A. Exhaust fan shall be direct drive mounted in square wall box with fully adjustable wall collar for depth penetration.
- B. Precision balanced aluminum propeller with advanced tear drop blade allow for exceptionally low noise and minimum air turbulence.
- C. Frame and orifice constructed of all welded heavy gauge steel.
- D. Deep rolled streamline orifice for maximum efficient performance.
- E. Heavy wall steel tube frame for extra strength.
- F. Motor shall be total enclosed continuous duty with steel ball bearings. Finish shall be charcoal baked finish or architect's choice of additional finishing available at additional charge.
- G. OSHA internal guard.
- H. Gravity backdraft damper.
- I. Two year comprehensive warranty.
- J. Acme Engineering and Manufacturing FQ30WCP/H8, ¼ horsepower, 208, 3-phase, 8310 CFM at .1" SP; finish; Acme RAL8014, Sepia brown.

K. Each fan to be equipped with VFD mounted in NEMA4X enclosure.

2.15 HAF FAN:

A. Provide 2 – 12" diameter, 1/15 HP, 115V/single phase horizontal air flow basket fans with three-bladed propeller, heavy duty PSC totally enclosed motor, two-piece plastic coated wire guard, two-piece rotational hanging bracket. (Schaefer VK12)

2.16 HIGH PRESSURE FOG SYSTEM:

A. Pump Module:

1. High pressure pump model HUMMINGBIRD as manufactured by MicroCool c/w (208-240) volt, 1 phase TEFC motor, VFD (Variable Frequency Drive) control, with integral smart controller, pressure tracking transducer, UL 508A tagged electrical panel, NEMA 3R.
2. Pump to be constant duty variety, positive displacement operating at 84 Bar / 1200 psi.
3. Low inlet water pressure safety switch.
4. LCD display with information and actions. Four touch buttons for entering parameters.
5. Hand/off/Auto capability.
6. Flush capability to allow all water in the line to recirculate back through the UV unit for additional sterilization capabilities.
7. Primary sediment filter and integrated UV light for water treatment. RO water must be used as per specifications.
8. Powder coated frame and components all corrosion free materials suitable for exterior installation. Unit to be equipped with both inlet and outlet water, solenoid valves and gauges.

B. Atomization Units:

1. MicroCool Cubes shall be strategically positioned to provide even distribution of humidification or as detailed on drawings.
2. Cubes shall be, round steel construction with aluminum grill type end caps and shall be c/w integral fan, pulse timer and fitted with (1,2 or 3) stainless MicroCool Focus nozzles.
3. Cubes shall be powder coated black square stainless-steel construction with anodized end caps and fitted with (1, 2 or 3) stainless MicroCool Focus nozzles.

C. Nozzles And Anti-Drip Check Valves:

1. Nozzles shall be MicroCool Focus (4,6 or 8) 316 SS and shall have a 316 stainless steel impeller.
2. All nozzles shall be fitted with anti-drip check valves c/w Buna rubber "O-ring" to prevent dripping after pump shutdown and integral polypropylene filters to minimize nozzles blockage from line debris.
3. Nozzles shall have a 12mm removable knurled orifice cap to allow for complete disassembly and cleaning.
4. MicroCool Focus Nozzle Flow and performance data can be provided on request.

D. Manifold Lines & Drain Lines:

1. Flexible manifold, nylon core with spiraled fiber reinforcement and black urethane cover, ¼" (6 mm) I.D. shall be used to connect atomization lines to the high-pressure pump(s).
2. Flexible manifold line shall be tested to 2000 psi (138 bar) and have a maximum working pressure rating of 1,750 psi (120bar).
3. Flexible manifold line shall be field jointed with brass reusable hose fittings as per manufacturer's specific instructions.
4. 304L Stainless tubing, 3/8" (0.028" wall), ½" (0.035 wall), or ¾" (0.035 wall) shall be used between the fog pump & the fog lines.
 - a. Line shall have a minimum 6,000 psi (415 bar) burst pressure rating.

- b. Lengths of SS atomization line shall be jointed exclusively with stainless steel compression unions and fittings. Under no circumstances shall dissimilar metal unions be used.

E. Fittings And Accessories:

- 1. All fittings shall be of compatible materials and approved by the pump manufacturer for use with this system.
- 2. All accessories shall be of compatible materials and approved by the pump manufacturer for use with this system.

F. Reverse Osmosis:

- 1. R.O. source to pump by main building system installed by Mechanical Contractor.

2.17 GROWTH LIGHTS:

- A. Provide 8 – 1000 watt high pressure sodium horticultural growth lights with high pressure sodium Agro bulb and 115V ballast hung from galvanized steel channel mounting track with adjustable 4' chain drops. Growth lights shall feature polished, anodized aluminum reflector with microscopically faceted surface, which results in uniform diffused light pattern in a dust-repellent nature. Reflectors shall provide average beam spread of approx. 60 degrees. Ballast and reflector shall be unitized and self-contained for wet location use.
- B. Greenhouse manufacturer will also include relay in electrical cabinet for lights. Control wiring and power wiring by Division 16.

2.18 FERTILIZER INJECTOR:

- A. Water driver non-electrical fertilizer injector featuring injection ranges 1:4000 to 1:20, interchangeable lower ends, adjustable ratios during operation, mixing chamber design to ensure thorough mixing. (Dosmatic SuperDos30 or equal). NOTE: To be delivered to Plumber for installation in non-potable water line.

2.19 UNIT HEATER:

A. Standards- All unit(s) shall include:

- 1. ETL design certification for use in both the US and Canada to the ANSI Z83.8 - latest revision, standard for "Gas Unit Heater and Gas-Fired Duct Furnaces" for safe operation, construction, and performance

B. Mechanical Configuration:

- 1. Condensing furnace section with 93% minimum efficiency provided by an indirect-fired tubular heat exchanger with individually fired tubes coupled to a secondary recuperative heat exchanger for maximum heat recovery.

C. Venting/Combustion Air Arrangement:

- 1. The unit shall be separated combustion. The venting shall be a power exhausted arrangement with a separate combustion air intake pipe connection to allow for fresh combustion air from outside the conditioned space. The unit shall be tested to insure proper ignition when the unit is subjected to 40 mile per hour wind velocities. The unit shall also include a factory mounted differential pressure switch designed to prevent main burner ignition until positive venting has been proven.
- 2. Venting shall be Schedule 40 PVC. For Canadian installations, all vent pipe and components must be approved to ULC S636.

D. Unit Casing:

1. The unit heater(s) casing shall be constructed of not less than 20 gauge aluminized steel with minimization of exposed fasteners.
2. All exterior casing parts shall be cleaned of all oils and a phosphate coating applied prior to painting. The exterior casing parts shall then be painted with an electrostatically applied baked-on gray-green polyester powder paint (7-mil thickness) for corrosion resistance.
3. The unit shall be furnished with horizontal air deflectors. The deflectors are adjustable to provide for horizontal directional airflow control (up or down).

E. Furnace Section:

1. The heat exchanger(s) shall be made of 409 stainless steel tubes and headers. Each heat exchanger tube shall be individually and directly flame-fired. The heat exchanger tube shall be crimped to allow for thermal expansion and contraction. The flue collector box shall be made of 20 gauge AL29-4C stainless steel.
2. The thermal efficiency of the unit(s) shall be a minimum of 93% efficient for all air flow ranges through the use of a secondary recuperative heat exchanger. The secondary heat exchanger shall be constructed of AL29-4C stainless steel to withstand the corrosive environment of condensing gas fired equipment.
3. The heat exchanger(s) seams and duct connections shall be certified to withstand 0.9" W.C. external static pressure without burner flame disturbance.
4. The burner(s) shall be in-shot type, directly firing each heat exchanger tube individually and is designed for good lighting characteristics without noise of extinction for both natural and propane gas.
5. The ignition controller(s) shall be 100% shut-off with continuous retry.
6. The gas pressure shall be between 6-7" W.C for natural gas.
7. The solid state ignition system shall directly light the gas by means of a direct spark igniter each time the system is energized.
8. The unit gas controls shall be provided with the following:
9. Single-stage gas controls with a single-stage combination gas control, an ignition control. The unit fires at 100% full fire based on a call for heat from a room thermostat.
10. An automatic reset high limit switch mounted in the air stream to shut off the gas supply in the event of overheating.
11. An automatic reset high limit switch mounted on the power exhaustor housing to shut off the gas supply in the event of overheating flue gas temperatures.
12. A condensate drain line overflow switch that senses if the condensate line is clogged and shuts the unit heater down. The switch is factory mounted inside the unit cabinet and wired to the unit controls.
13. An energy-saver control utilizes stratified ceiling air to heat the space at floor level before turning on the gas controls. Its operation is independent of the room thermostat and should have a higher set-point than the room thermostat. The Stat is factory mounted outside the unit and wired into the contractor convenience box.
14. A time delay relay that delays the start of the air mover to allow the heat exchanger a warm-up period after a call for heat. The time delay relay shall also continue the air mover operation after the thermostat has been satisfied to remove any residual heat in the heat exchanger.
15. The unit must be field adjusted for 0-2000 feet elevation above sea level. See units installation manual for instruction for altitude adjustments.

F. Electrical:

1. All electrical components shall carry UL, ETL, or CSA certification.
2. A low voltage terminal board shall be provided for direct wiring connection to an external thermostat or controller.
3. A Contractor Convenience Package that consists of an external junction box featuring simple connection of supply power wiring internally, thermostat wiring to terminals externally, an On/Off switch, a single 115V outlet for connection of an external condensate pump, and status indicator lights to display the operational state of the unit shall be factory mounted on the rear panel of the casing.
4. A single 115V to 24V step down transformer shall be provided for all unit controls.

G. Air Mover:

1. The motor horsepower shall be 1/8 H.P.
2. The motor wiring shall be in flexible metal BX conduit.
3. The motor shall be controlled by a time delay relay.
4. Propeller models shall meet the following requirements:
5. The motor type shall be Single-Speed, Totally Enclosed (TE).
6. The air mover motor shall be a 115V motor.

H. Mounting:

1. The unit shall be equipped with tapped holes to accept 3/8"-16 threaded rod for suspension.

I. Accessories:

1. The following field installed accessory control devices shall be provided with the unit:
 - a. A condensate drain kit consisting of one threaded PVC elbow and two specially designed condensate traps to allow the unit to operate and drain properly.

PART 3 - EXECUTION

3.1 MANUFACTURERS RECOMMENDATION

- A. This contract will require that given work or materials shall be installed in accordance with the manufacturer's printed instructions.
- B. The Contractor will obtain for his use at the site in executing the copies of all bulletins, circulars, catalogs, or other publications of the manufacturer of the latest application or installation instructions and details. Furnish one copy of the manufacturer's brochures to the Owner.

3.2 PREPARATION

- A. Examine areas and conditions under which greenhouse work is to be installed. Notify contractor in writing of conditions detrimental to proper and timely installation of work.
- B. Coordinate and furnish anchorages, setting diagrams, templates and directions for installation of anchorages. Coordinated delivery of such items to project.

3.3 ERECTION

- A. Erect greenhouse and related components in accordance with manufacturer's written instructions and final shop and erection drawings, and as directed by manufacturer.
- B. Erector shall be an experienced crew at installing that manufacturer's product.

3.4 INSTALLATION EQUIPMENT

- A. General: Install equipment in accordance with manufacturer's installation instruction instructions and recognized industry practices to insure intended function. Equipment will be installed in place by the Greenhouse Contractor. All mechanical, electrical and plumbing connection will be performed by electrical, plumbing or mechanical contractor; no hook-ups by greenhouse contractor.

3.5 INSTALLATION

- A. Install the greenhouse with experienced crews of the greenhouse manufacturer, or by independent contract installers approved by the greenhouse manufacturer.

- B. Coordinate the greenhouse skinning with the work of other trades. All service lines to equipment installed under this section shall be by other trades. All permits where required shall be by others.
- C. Grouting: After the greenhouse contractor has placed the wall glazing framing, the masonry contractor shall provide the necessary materials and labor to grout between the wall and the sill to eliminate any discrepancies between the two and produce a finished joint.
- D. Provide all appropriate caulking and sealant materials for a complete installation as required for a weather tight enclosure.
- E. Upon completion of the work, test all equipment for operation during controller initiation and training.

3.6 FLASHING

- A. All flashing and counter-flashing shall be furnished and placed by the Sheet Metal Contractor. All flashing and counter-flashing shall be aluminum. Provide all other materials necessary for complete installation.

3.7 INSTRUCTION

- A. Instruct owner on use of greenhouse and systems.

3.8 INSTALLERS

- A. Greenhouse repairs shall be fully installed by a qualified installer approved in writing by the manufacturer. Qualified installer shall, at a minimum, have been in the business of installing glazed systems for five years, provide references, and be bondable for greenhouse repair work. Qualified installer shall employ a skilled foreperson or lead person, and laborers with appropriate skill levels. Installer shall comply with all shop drawing requirements and written instructions for installation of the greenhouse, glazing and greenhouse equipment. Equipment shall be "hang in place" only with other trades providing mechanical and electrical connections (including all wiring runs, conduit runs, piping runs and end terminations). Installer shall have all required licenses, permits, and meet all governmental requirements.
- B. Verify that field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized

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SECTION 14 24 00 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work of this section includes providing equipment, incidental material, transportation, all permits, all taxes and all labor required for a complete and operable elevator installation and all related maintenance of the newly installed equipment. Where singular reference is made to elevators or elevator components, such reference shall apply to the number of elevators or components required to complete the installation. This specification provides a broad outline of required equipment and does not describe the details of design and construction. Details shall be included in shop drawings required to be submitted in this section. Elevators shall be erected, installed, adjusted, tested and placed in operation by qualified elevator installers.

In order to provide continuity of service and maintenance, certain products and manufacturers have been specified and substitutions will not be allowed.

- B. Related work:
1. Protecting Installed Construction: Temporary use of elevators.
 2. Metal Fabrications: Sill support angles, hoisting beams, divider beams, intermediate rail supports, and pit ladders.
 3. Construction of hoistways, pits, machine rooms, locations that require access and access ladders or required structures.
 4. Hoistways, machine room and mechanical space ventilation, cooling and heating.
 5. Electrical work and lighting of pits, hoistways, machine rooms and mechanical spaces.
 6. Supports, mounting and attachments for guide rails and guide rail brackets, machinery and equipment, buffers and entrance installation. Design equipment, guide rail bracket mounting and attachment to accommodate building design. Where necessary, provide intermediate supports or rail backing.
 7. Electric feeders to disconnect switches or circuit breakers to elevator starter or control panels.
 9. Interface of elevators to building Fire Alarm system and emergency power system.
 10. Conduit to remote locations for elevator intercommunication and alarm systems.
 11. Indicated or required chases and openings.
 12. Finish painting except as noted.
 13. Guarding and protecting hoistway during construction.
 14. Storage space for tools and materials.
 15. Electric power for testing and adjusting equipment.
 16. Telephone and security system interface wiring to control panels.
 17. Sump pits, sump pump and associated devices and removable gratings.
 18. Grouting and sealing of entrances, fixtures and entrance sills.
 19. Installation of security requirements and connection to facility wide monitoring systems upon completion of the elevator installation.
 20. Installation of fire suppression sprinkler and heat detector in elevator pit and smoke detector at the top of the hoistway.
 21. Provide all required Independent Third-Party Elevator Inspections.
 22. Excavation and drilling of well hole and casing.

- C. Low-Emitting Materials: Adhesives, sealants, paints and coatings applied within the building envelope and all composite wood and laminating adhesives (applied on and off site) shall comply with Federal standards for "Indoor Air Quality Management."

1.2 REFERENCES

- A. Applicable Codes (Latest Edition)
 - 1. American National Standard, Safety Code for Elevators and Escalators (ANSI/ASME A17.1).
 - 2. International Building Code (IBC)
 - 3. American National Standard Specification for Making Buildings and Facilities Accessibility to and Usable By Physically Handicapped People (ANSI A117.1).
 - 4. MCC facility wide construction rules and requirements.
 - 6. Authority having jurisdiction (AHJ).

1.3 DEFINITIONS

- A. "Provide": to furnish and install, complete for safe operation, unless specifically indicated otherwise.
- B. "Install": to erect, mount and connect complete with related accessories.
- C. "Supply": to purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": labor and materials required for proper and complete installation.
- E. "Wiring": raceway, fittings, wire, boxes, and related items.
- F. "Concealed": embedded in masonry or other construction, installed in furred spaces, within double partitions or in hung ceilings, in trenches, in crawl spaces or in enclosures.
- G. "Exposed": not installed underground or "concealed" as defined above.
- H. "Indicated," "shown," or "noted": as indicated, shown or noted on drawings or as specified.
- I. "Similar," or "equal": of base bid manufacturer, equal in materials, weight, size, design and efficiency of specified product, conforming with "Acceptable manufacturers."
- J. "Reviewed," "satisfactory," "accepted," or "directed": as reviewed, satisfactory, accepted or directed, by or to the Contracting Officer.

1.4 OPERATION PERFORMANCE

- A. The control system shall provide smooth acceleration and deceleration with 1/4" leveling accuracy at all landings from no load to full rated load in the elevator. The floor-to-floor performance time under the above criteria shall be 15.0 seconds (floor-to-floor time is measured from the start of door close at one floor to 3/4 open at the next floor).
- B. The door open time for shall be 2.3 seconds from start of door open to fully open.
- C. The speed of the elevator shall not vary +/- 10% under loading conditions.

- D. Prior to final acceptance and prior to the termination of the maintenance period, the elevators shall be adjusted as required to meet these performance requirements.

1.5 REPLACEMENT PARTS AND TECHNICAL SUPPORT

- A. Elevator component manufacturers and elevator contractor shall make available to Montgomery Community College (MCC) or their representative all parts required to service and maintain the equipment installed.
 - 1. Elevator manufacturers and elevator contractor shall not have established company policies which would prevent Montgomery Community College (MCC) or their representative from obtaining service parts on a timely basis.
 - 2. In no event shall the elevator contractor or elevator manufacturer charge prices for service parts to the Montgomery Community College (MCC) or their representative that are more than that charged to any other customer of the elevator component manufacturers or contractor, for the same or substantially similar goods in similar quantities.
 - 3. The elevator contractor or elevator manufacturer shall maintain availability of service parts to the Montgomery Community College (MCC) or their representative for a period which matches that of the reasonable life of the elevator equipment.
 - 4. Provide elevator components from manufacturers that provide online and live telephone elevator technical support to any and all elevator installation, service, and maintenance contractors. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any and all elevator installation, service, and maintenance contractors. Elevator component manufacturers shall provide published price lists for all elevator parts and components.
 - 5. Equipment and component systems shall not employ any experimental devices or proprietary designs that could hamper and/or otherwise prohibit subsequent maintenance repairs or adjustments by all qualified contractors. Product support on-site or by phone and factory training shall be available to any subsequent maintenance contractor chosen by the Contracting Officer.

1.6 SUBMITTALS

- A. Shop Drawings and Samples:
 - 1. Shop Drawings: Provide complete shop drawings, to scale. Include layout of pits, machine rooms, overhead requirements, power and heat data for all equipment, static and impact loads, reaction points and required clearances. Provide manufacturers standard catalog literature and brochures of all components scheduled for use as part of this project. Provide cab and fixture drawings for review. If required in conjunction with the permitting process, drawings shall bear a Professional Engineer's Stamp of a PE licensed in the jurisdiction of this project, in plans, sections and elevations and details of the machine room equipment, car enclosures and hoistway entrances.

Include the following information:

- a. Location of the pumping unit and control panel, door controller, solid state motor starter and other components located in the machine room.

- b. Car frame and platform, supporting beams, guide rails, buffers and other components located in the hoistway.
 - c. Weights of components.
 - d. Reactions at support points.
 - e. Maximum vertical and horizontal forces on guide rails.
 - f. Top and bottom clearance and overtravel of car.
 - g. Location of fused, externally operable mainline disconnect switch and shunt-trip circuit breaker (CB) without overcurrent trip, light switches, hands free communication, communication with elevator car device and feeder termination at controller.
 - h. Location of outlets for connection of traveling cables for car lights and telephone in elevator machine room or hoistway.
 - i. Location of hoistway access switches.
 - j. Names of manufacturer, type or style designation of all components provided.
 - k. Catalog cut sheets or drawings showing details of hoistway access switches.
 - l. Provide reference drawings for the Contracting Officer's approval showing details of intended mounting brackets and mounting methods for all new devices (tachometers, rope grippers, etc.) to be attached to existing elevator machines or other existing elevator equipment.
 - m. Machine Room Controller.
 - n. Provide the following drawings for the Contracting Officer's approval:
 - 1. Complete drawings of cab, showing details of construction and the location of car equipment.
 - 2. Complete drawings of signal and control fixtures, showing all switches, push buttons lights, signage and all other components of each signal or control fixture and operating device. Submit design layout with all dimensions and sizes confirming that Call Controls, Visible Signals, Hoistway Signs and Elevator Car Controls will comply with ABAAS 407 (Elevators).
 - 3. Corridor elevations, showing the location of each corridor fixture in relation to the hoistway entrance frames and the finished floor.
 - 4. Other drawings, as required, requested or specified within the document.
2. The manufacturer's name, type or style designation, and the information listed below shall be included on the shop drawings for each elevator. In addition, submit the manufacturer's catalog data for approval.
- a. Solid state motor starter.
 - b. Pumping Unit.
 - c. Microprocessor based controller.
 - d. Landing control device.
 - e. Power door operator assembly.
 - f. Hoistway door interlocks and electrical contacts.
 - g. Buffers including stroke, piston diameter, certified maximum and minimum loads and maximum striking speeds.
 - h. Firefighters' Emergency Operation.
 - i. Signal fixtures, corridor and car operating stations, main floor elevator lobby panel and/or firefighters' service panel.

- j. Door protective device.
 - k. Machine room monitors, diagnostic tools, service tools, data recording and/or printing equipment.
3. Calculations:
- a. Submit the following calculations and data signed and sealed by the qualified professional engineer responsible for its preparation, as applicable to the equipment involved, within three (3) weeks of Notice to Proceed:
 - b. Machine room equipment BTU output.
 - c. Power supply data sheets, indicating equipment power demand; main line fuse and auxiliary circuit breaker or fuse sizes; and other pertinent electrical data, relative to the elevators.
4. Samples: Materials and finishes exposed to public view, 6" by 6" panels or 12" inch lengths as applicable.
5. All costs associated with the submittal packages shall be borne on the contractor. Contractor shall be back charged a fee not to exceed \$1,000.00 for each additional review of incomplete or partial submittal packages.
6. No specifications, drawings, sketches, models, samples, tools, computer programs, technical information or data, written, oral or otherwise, furnished by Contractor to Contracting Officer as part of this proposed project or in contemplation hereof shall be considered by Seller to be confidential or proprietary. Technical documentation shall be submitted to the Contracting Officer to determine equivalency. The system, method, or device shall be approved for the intended purpose by the Contracting Officer prior to being utilized.
7. Provide basic project schedule and billing schedule.
8. Provide a standard submittal register that identifies all items scheduled for submittal and required by this section. Arrange register by specification section and item number for project tracking and coordination. Contractor should provide a submittal package with a table of contents, tabs and/or notes that clearly identify the information provided, where it is located and whether that information has been modified and/or updated since the previous submission in order to expedite the review process and to encourage a collaborative and efficient process for all involved parties.
9. Provide preventative maintenance schedule and "check-in/check-out" procedures. Submit sample service ticket and preventative maintenance records. Electronic maintenance records that do not provide sufficient detail for the Contracting Officer's use shall be modified as required to provide all necessary information. On site records are required.
10. Key Personnel Names: Within 10 days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
- B. Equipment Brochure and Service Manuals:

1. Before acceptance of work, furnish three sets of manufacturer's equipment brochures and service manuals. Assemble manuals in chronological order according to the specification alphanumeric system. Provide manufacturer's standard binders consisting of:
 - a. Equipment and components, descriptive literature.
 - b. Performance data, model number.
 - c. Installation instructions.
 - d. Operating instructions.
 - e. Maintenance and repair instructions.
 - f. Spare parts lists and current price list.
 - g. Lubrication instructions.
 - h. Detailed, record and as-built layout drawings.
 - i. Detailed, simplified, one line, wiring diagrams. Provide one complete set per manual.
 - j. Field test reports.
 - k. Complete set of contract software.
 - C. Machine Room Prints: Provide three complete sets of "as- built" field wiring and straight line wiring diagrams showing all electrical circuits in the hoistway as well as the machine room. One set of these diagrams shall be protected and mounted in the elevator control room as directed.
 - D. Provide one set of all submittals, shop drawings, wiring diagrams and manuals in electronic format for long term document storage.
 - E. Submit documentation that materials comply with LEED requirements referenced.
 - F. Maintenance Control Program (MCP): Provide MCP specifically designed for the equipment included under this contract. Include any unique or product specific procedures or methods required to inspect or test the equipment. In addition, identify weekly, bi-weekly, monthly, quarterly, and annual maintenance procedures, including statutory and other required equipment tests.
- 1.7 QUALITY ASSURANCE
- A. Quality and gauges of materials:
 1. New, best of their respective kinds, free from defects.
 2. Materials, equipment of similar application; same manufacturer, except as noted.
 3. Gauges as noted.
- 1.8 PRODUCT DELIVERY, STORAGE AND HANDLING
- A. Ship in original crated sections of a size to permit passage through available space.
 - B. Obtain approval and schedule delivery of material to meet The Contracting Officer's requirements.
 - C. Storage of equipment and materials shall be coordinated with the Contracting Officer.
- 1.9 WARRANTY

- A. The elevators and associated equipment shall be free of defective material, imperfect work and faulty operation not due to ordinary wear and tear or improper use or care, for a period of one year from final acceptance of each elevator. Defective work shall be repaired or replaced at no additional cost to the Contracting Officer.

1.10 MAINTENANCE SERVICE

- A. Initial Full Service Maintenance: Provide initial 24 month maintenance service during warranty period, by trained mechanics. Maintenance shall commence upon completion and acceptance of all elevator work and shall include examination, adjustment, greasing, oiling, parts replacement due to normal use. Provide 24 hour emergency call back service at no additional charge.
- B. Maintenance Requirements:
 - 1. On a monthly basis, for a minimum of two (2) hours per month, per unit, regularly and systematically examine, adjust, lubricate, clean and, when conditions warrant, repair or replace the following items and all other mechanical or electrical equipment:
 - a. Hydraulic power unit and accessories: pump, motor, valves, operating valves, pulleys, drive belts, flexible hose and fitting assemblies, oil tank, muffler, strainer, sound isolating coupling, plunger, packing gland, scavenger system, piping and other components.
 - b. Controller, selector, and dispatching equipment: All components including all relays, solid state components, resistors, condensers, transformers, contacts, leads, computer devices, selector switches, mechanical or electrical driving equipment, coils, magnet frames, contact switch assemblies, springs, solenoids, resistance grids, hoistway vanes, magnets and inductors.
 - c. Hoistway door interlocks or locks and contacts, hoistway door hangers, tracks, bottom door gibs, cams, rollers and auxiliary door closing devices for power operated doors. Chains, tracks, cams, interlocks, sheaves for vertical bi-parting doors.
 - d. Hoistway limit switches, slowdown switches, leveling switches and associated cams, vanes and electronic components.
 - f. Guide shoes including rollers or replaceable guides.
 - g. Automatic power operated door operators, door protective devices, car door hangers, tracks and car door contacts.
 - h. Traveling cables.
 - i. Elevator control wiring in hoistway and machine room.
 - j. Buffers.
 - k. Fixture contacts, pushbuttons, key switches, locks, lamps and sockets or button stations (car and hall), hall lanterns, position indicators (car and hall), direction indicators.
 - l. The guide rails shall be kept free of rust and dry.
 - m. Examine all safety devices, and conduct an annual no load test. All tests shall be performed in accordance with the provisions of the American National Standard, Safety Code for Elevators and Escalators (ANSI/ASME A17.2), current edition.
 - n. Furnish lubricants compounded specifically for elevator usage.

2. The Elevator Contractor shall not be responsible for the following items of elevator equipment: car enclosure (including removable panels, door panels, car gates, plenum chambers, hung ceilings, light diffusers, light tubes and bulbs, handrails, mirrors, and carpets), hoistway enclosure, hoistway doors, frames and sills.
3. All work is to be performed during regular working hours of regular working days. Emergency calls shall be answered at all hours of the day or night. Should overtime work be required, the Contracting Officer will pay only the actual amount of the premium portion of the wage, the Contractor will pay the basic hourly rate.
4. The Contractor shall check the group dispatching systems and make necessary tests to insure that all circuits and time settings are properly adjusted, and that the system performs as designed and installed.

C. Maintenance Responsibility:

1. The Contractor shall keep the elevator maintained to operate at the original contract speed, keeping the original performance times, including acceleration and retardation as designed and installed by the manufacturer. The door operation shall be adjusted as required to maintain the original door opening and door closing times, within legal limits.
2. The Contracting Officer reserves the right to make inspections and tests as and when deemed advisable. If it is found that the elevator and associated equipment are deficient either electrically or mechanically, the Contractor will be notified of these deficiencies in writing, and it shall be his responsibility to make corrections within 30 days after his receipt of such notice. In the event that the deficiencies have not been corrected within 30 days, the Contracting Officer may terminate the contract and employ a Contractor to make the corrections at the original bidder's expense.
3. Approximately six months prior to the end of the contract term, the Contracting Officer will make a through maintenance inspection of all elevators covered under the contract. At the conclusion of this inspection, the Contracting Officer shall give the Contractor written notice of any deficiencies found. The Contractor shall be responsible for correction of these deficiencies within 30 days after receipt of such notice.

D. The Contracting Officer reserves the right to accept or reject any or all alternates.

E. Diagnostic Tools and Spare Parts: At the completion of the work as specified, the Contractor shall provide items listed. The items shall become the Contracting Officer's property.

1. One complete set of all diagnostic tools and equipment required for the complete maintenance of all aspects of the control and dispatch system. The diagnostic system shall be an integral part of the controller and provide user-friendly interaction between the serviceman and the controls. All such systems shall be free from secret codes and decaying circuits that must be periodically reprogrammed by the manufacturer.
2. Technical Field Adjustment Manuals.
3. A list of vendors for all parts used in the installation.

1.11 ELECTRIC SERVICE

- A. Power: 270/480 volts, 3 phase, 60 hertz. Elevator Contractor to verify.
- B. Lighting: 120 volts, 1 phase, 60 hertz.

1.12 PROTECTION OF PERSONS AND PROPERTY

- A. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the work.
- B. The Contractor shall take reasonable precautions for the safety of, and shall provide reasonable protection to prevent damage, injury or loss to:
 - 1. Employees on the Work and other persons who may be affected thereby.
 - 2. The work, materials, and equipment to be incorporated therein, whether in storage on or off the site, under the care, custody or control of the Contractor or any of his Subcontractors or Sub-Subcontractors.
- C. The Contractor shall comply with all applicable laws, ordinances, rules, regulations and lawful orders of public authority having jurisdiction for the safety of persons, property or to protect them from damage, injury or loss. He shall erect and maintain, as required by existing conditions and progress of the work, all partitions for safety and protection, including posting danger signs, and other warnings against hazards, promulgating safety regulations and notifying using agencies and users of adjacent utilities.
- D. The Contractor shall designate a responsible member of his organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated in writing by the Contractor to the Contracting Officer.
- E. In any emergency affecting the safety of persons or property, the Contractor shall act, at his discretion, to prevent threatened damages, injury or loss.

1.13 NOISE AND VIBRATION

Any noise or vibration due to faulty equipment or workmanship shall be corrected immediately without additional charge.

1.14 PERMITS AND INSPECTION FEES

The Contractor shall obtain without cost to the Contracting Officer, all permits and certificates as required.

1.15 EXAMINATION

- A. In order to discover and resolve conflicts or lack of definition which might create problems, Provider must review Contract Documents, existing site conditions, and existing equipment specified to be retained for compatibility with its product prior to submitting quotation. Site review shall include, but not be limited to adequacy of access, retained equipment, elevator hoistways, pits, machine rooms, overhead clearances, electrical power characteristics, structural supports, etc. Investigation and structural calculations required to determine compliance of existing elevator components including machine support beams, with ASME A17.1, Rule 8.7.2.15.2, are responsibility of Provider. Attach specific, written

exception and/or clarification with quotation. Compliance with all provisions of Contract Documents is assumed and required in absence of written exception. If written exception is acceptable to Purchaser and Consultant, an Addendum to the specifications will be issued and authorized. Purchaser will not pay for change to building structure, structural supports, mechanical, electrical or other systems required to accommodate Providers equipment if not identified before Contract award and authorized as stipulated above.

- B. Submission of quotation is considered evidence that Provider has visited and is conversant with the site facilities, site conditions, requirements of the Contract Documents, pertinent state and local codes, state of labor and material markets, and has made allowance in his quotation for all contingencies. Should Providers investigation of site conditions, or local codes or rules reveal requirements contrary to Contract Documents, or if Provider finds any discrepancies or omissions from Contract Documents, or if Provider is in doubt as to their meaning, he shall contact the Consultant for clarification at least five working days prior to quotation due date.
- C. No oral explanation will be made and no oral instructions will be given before quotation due date. Provider shall act promptly and allow sufficient time for a reply to reach him before submission of its quotation. Any required interpretation or supplemental instructions will be issued in the form of an addendum to the specifications and forwarded to all pre-qualified Providers.
- D. Provide everything necessary for and incidental to the satisfactory completion of work required by Contract Documents. All required preparations and hoisting and movement of new equipment, reused equipment, or removal of existing equipment shall be the responsibility of Provider.

1.16 MATERIALS

- A. Fire Resistance: Treat wood components with fire-retardant treatment conforming to requirements of authorities having jurisdiction and to achieve flame spread rating of 25, ASTM E84.
 - 1. Protect electric wiring with flame retardant and moisture resistant outer covering, run in conduit, tubing or electrical wire ways.
- B. Non-Shrink Grout: Pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing minimum compressive strength of 4000 PSI at 28 days.
- C. Factory Primers and Paints:
 - 1. Primer for steel surfaces: Rust inhibitive, alkyd type.
 - 2. Primer for galvanized surfaces: Zinc chromate, alkyd type.
 - 3. Primer for wood surfaces: Alkyd primer/sealer.
 - 4. Finish paint for metal surfaces: Alkyd type, semi-gloss, enamel.
 - 5. Finish paint for wood surfaces: Alkyd type, semi-gloss, enamel.
- D. Sheet Steel: Cold rolled, commercial quality, Class I, stretcher- leveled, matte finish, ASTM B366.

- E. Stainless Steel: Type 302 or Type 304 that complies with ASTM 167.
- F. Extruded Aluminum: Alloy 6063-T6, ASTM B221.
- G. Wood:
 - 1. Panels: Minimum $\frac{3}{4}$ " thick with particleboard or MDF cores, fire retardant treated. Provide anti-warp backing, registered with local authority having jurisdiction, for elevator finish materials.
 - 2. Fire Retardant Treatment: Comply with applicable code requirements and AWPA Standards for pressure impregnation with fire retardant chemicals to achieve a flame spread rating of 25 or less (Class A), ASTM E84.
 - 3. See architectural finish schedule and drawings for panel design and wood veneer types.
- H. Nickel Silver: Alloy 976, ASTM.
- I. Bronze materials shall be constructed of stretcher-leveled sheets with 60 percent copper and 40 percent zinc that are similar to Muntz Metal. After cleaning, spray with one coat of clear lacquer. For this project all bronze finishes shall match the control sample selected by the Contracting Officer.
- J. Low-Emitting Materials: Adhesives, sealants, paints and coatings applied within the building waterproofing envelope and all composite wood and laminating adhesives (applied on and off site) shall comply with product requirements in Division 1 "Indoor Air Quality Management."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product Suppliers:

In order to provide continuity of service and maintenance, the following product manufacturers have been specified and no substitutions will be allowed.

- 1. Hollister Whitney Elevator Corporation
- 2. G.A.L. Manufacturing Corporation
- 3. Innovation Industries, Inc.
- 4. Motion Control Engineering (MCE)
- 5. Minnesota Elevator Company (MEI)
- 6. Canton Elevator Company
- 7. Schumacher Elevator Company
- 8. EECO Elevator

2.2 OUTLINE OF EQUIPMENT

- | | |
|------------------------------|------------|
| A. Elevator Number: | 1-2 |
| 1. Elevator Use: | Passenger |
| 2. Contract Load, in Pounds: | 3,500 lbs. |
| 3. Contract Speed: | 150 fpm |
| 4. Travel Distance: | 32' - 0" |

5.	Landings:	G, 1*, 2
6.	Number of Stops:	Three (3)
7.	Number of Openings:	Three (3), Front
8.	Machine Location:	Adjacent at lowest landing.
9.	Machine Type:	Direct plunger hydraulic
10.	Type of Control:	Microprocessor
11.	Operation:	Simplex
12.	Main Fire Floor:	1*
13.	Alternate Fire Floor:	G
14.	Car and Hoistway Door Size:	3' - 6" wide by 7' - 0" high
15.	Car and Hoistway Door Type:	Single speed side sliding
16.	Car and Hoistway Door Operator:	Power, (minimum opening speed 2.3 seconds) closed loop operation.
17.	Hoistway Entrance:	As specified.
18.	Cab Enclosure:	As specified.
19.	Door-reversal Device:	Electronic entrance detectors.
20.	Car Operating Panel:	As specified.
21.	Car Position Indicator:	As specified.
22.	Car Direction Indicator:	As specified.
23.	Hall Call Stations:	Single riser.
24.	Hall Position Indicator:	As specified.
25.	Communication System:	ADA, Hands Free Type Telephone
B	Elevator Number:	3
1.	Elevator Use:	Passenger/Service
2.	Contract Load, in Pounds:	4,500 lbs.
3.	Contract Speed:	150 fpm
4.	Travel Distance:	48' - 0"
5.	Landings:	G, 1*, 2-3
6.	Number of Stops:	Four (4)
7.	Number of Openings:	Four (4), Front
8.	Machine Location:	Adjacent at lowest landing.
9.	Machine Type:	Direct plunger hydraulic
10.	Type of Control:	Microprocessor
11.	Operation:	Simplex
12.	Main Fire Floor:	1*
13.	Alternate Fire Floor:	G
14.	Car and Hoistway Door Size:	4' - 0" wide by 7' - 0" high
15.	Car and Hoistway Door Type:	Two speed side slide
16.	Car and Hoistway Door Operator:	Power, (minimum opening speed 2.5 fps) closed loop operation.
17.	Hoistway Entrance:	As specified.
18.	Cab Enclosure:	As specified.
19.	Door-reversal Device:	Electronic entrance detectors.
20.	Car Operating Panel:	As specified.
21.	Car Position Indicator:	As specified.
22.	Car Direction Indicator:	As specified.
23.	Hall Call Stations:	Single riser.
24.	Hall Position Indicator:	As specified.
25.	Communication System:	ADA, Hands Free Type Telephone
26.	Security Card Reader:	As specified.

2.3 MACHINE ROOM EQUIPMENT

- A. Provide equipment to fit space conditions shown.
- B. Tank: Provide welded reinforced steel structure designed to support the tank. Tank shall have surge control to prevent oil leaving tank when elevator descends, protective vent opening and overflow connection. Provide oil heater in tank or comparable means to ensure constant oil temperature and operation of elevator. Capacity of tank shall be sufficient to lift elevator to top landing plus minimum of 10 gallons. Mount pumping unit on double deflection neoprene isolation mounts similar to Mason Industries, type ND or Super W.
- C. Pump: Provide submersible type pump designed to give smooth and quiet operation. Mount pumping unit on double deflection neoprene isolation mounts similar to Mason Industries, type ND or Super W.
- D. Motor: Provide alternate current induction type motor designed for hydraulic elevator starting and running requirements. Provide solid state, soft start style motor starter.
- E. Control Valves: Valves including main, leveling, safety check, up and down direction, lowering valve including down leveling and manual leveling shall be provided. Control valves shall be magnetic type and designed to open and close gradually to give smooth control. Manual shut off valve shall be in line adjacent to pump unit.
- F. Piping: Provide approved steel or wrought iron piping designed for a maximum 400 PSI working pressure. A blow-out proof oil line muffler, silencer and sound isolating couplings shall be provided throughout the oil line.
 - 1. A minimum of two gate valves, one in the pit and one in the machine room.
 - 2. Sleeves, when passing through walls, shall have a minimum 1 inch clearance between piping and sleeve. Fill with fiberglass packing and seal both ends with fireproof non-hardening mastic, 1/4 inch minimum thickness. Sleeves shall be provided by the elevator contractor and installed by others.
 - 3. Oil line shall be wrapped its entire length with 2 lb. PSF of limp mass vinyl similar to Kinetics Loaded Limp Mass Barrier Material, Model KNM and suspended with spring type isolation hangers similar to Mason Industries type 30.
 - 4. Provide in line oil silencer to reduce oil flow transfer noise and pulsations.
- G. Controller: Provide enclosed controller panels with ventilated cabinets and hinged or removable doors. Cabinets shall be designed for wall or machine mounting.
 - 1. Pump motor shall be provided with reduced voltage starting in order to limit starting current of elevator motor. Provide solid state, soft start style motor starter.
 - 2. Provide automatic two-way leveling and releveling to maintain the leveling of the car within + or -1/4 inch of floor.
 - 3. Provide permanently marked symbols or letters identical to those on wiring diagrams adjacent to each component.
 - 4. If the pump motor should run continuously for 20 seconds longer than the period of time necessary to move the elevator (in normal operation) from the bottom floor to the top floor, a time protective device shall return the elevator to the lowest level and park. All control buttons, except car alarm, shall be inoperative.

- H. Selectors: Relay, solid state or moving crosshead type electrically or mechanically coupled to car.
- I. Provide a fire extinguisher in machine room per code requirements.
- J. Beams and Structural Supports: Provide steel beams, channels and bearing plates to support machine, governors and rope hitches. Include any required clip angles, tie rods, etc. as required.
- K. Foundation bolts and templates: Provide template, foundation bolts and hardware for foundation mounting.
- L. Sheaves: Provide steel machined and grooved for diameter of ropes and supported by an "A Frame" type mounting. Provide cable guards designed to withstand shock and prevent ropes from leaving their proper grooves. All bearings are to be shielded or sealed.

2.4 OPERATING SYSTEMS

- A. Simplex Selective Collective:
 - 1. Momentary pressure of car or hall button, other than landing at which car is parked, shall automatically start the car and dispatch the car to the corresponding floor for which that call was registered. If a call is registered at the floor when the car is idle, the doors shall automatically open.
 - 2. When the direction of travel has been established, the car shall answer all calls corresponding to the direction of travel and shall not reverse direction until all car and hall calls, in that direction, have been answered.
 - 3. Calls registered for the opposite direction of car travel shall remain registered and shall be answered after car has completed its calls in the direction of travel.
 - 4. If no car buttons are pressed, and car starts up in response to several down calls, the car shall answer highest down call first and then reverse to collect other down calls.
 - 5. The car shall remain at the arrival floor for an adjustable interval to permit passenger transfer. Doors shall close after a predetermined interval after opening unless closing is interrupted by car door reversal device or door open button in car.
- B. Independent Service: Provide controls to remove elevator from normal operation and provide control of the elevator from car buttons only. Car shall travel at contract speed and shall not respond to corridor calls.
- C. Car Top Operation: Provide per Code requirements.
- D. Fire Service Emergency Recall Operation:

Phase I automatic recall of all elevator will only occur upon activation of smoke detectors in elevator lobbies and elevator machine rooms. No other fire alarm initiating devices will cause elevator recall. The elevator will be recalled to either the primary or alternate floor upon activation of a smoke detector in an elevator machine room or lobby. All elevators in other elevator banks will remain operable. Additional feature of Phase I Emergency Recall Operation will include a three-position switch that shall be:

1. Provided only at the designated level for single elevators or for each group of elevators.
2. Labeled "Fire Recall" and its positions marked "Reset", "Off", and "On" (in that order) with the "Off" position as the center position.
3. Located in the lobby within sight of the elevators in that group and shall be readily accessible.

Phase II Emergency In-Car Operation shall be provided by installing a three-position ("off", "hold", and "on") fire service switch in each car. The switch shall be labeled and provided in the operating panel of each car and shall function in accordance with ASME A17.1 requirements.

The elevator cab shall be provided with a Fire Alarm speaker. The speaker will only be capable of broadcasting a live voice message from the building's fire alarm control panel.

- E. Provide a separate battery powered unit that senses loss of power. Battery shall be 12 volt minimum, sealed nickel cadmium or gel cell construction. When loss of power occurs, elevator shall descend to lowest landing and open doors automatically. After a predetermined time, the doors shall close and the elevator shall remain inoperative until normal power is restored. The door open button shall operate under battery power.
- F. Hoistway Access: Provide hoistway key access switches and required control circuitry and wiring at terminal landings.
- G. Tenant Security Operation (Future Use):
 1. Provide a card reader or proximity reader located adjacent to each hall pushbutton or the car pushbutton control panel or other location, as designated by the Contracting Officer.
 2. The insertion of a magnetic reader card or indication of a proximity reader card allows operation of the elevator system or pushbutton operation.
 3. Fire Service and Earthquake Operation override the Security Service Operation.
- H. Provide elevator control circuitry that automatically shuts off the interior car lighting and fan when the elevators are not in use. Control circuitry shall comply with ASME A17.1, rule 2.14.7.2.2.

2.5 HOISTWAY EQUIPMENT

- A. Well Hole and Casings: Drill holes and provide steel driven well casing of sufficient diameter to allow PVC casing and cylinder to be set plumb on desired centerlines. The bottom of well casing shall be sealed with concrete plug and the PVC casing shall be capped.
- B. PVC Casing: Provide 1/2 inch thick PVC casing inside the well casing. Exterior surface of casing shall be cleaned prior to application of solvent welding material to ensure water tight connections. Provide positive sealing element at the top of the PVC casing to make joints watertight.
- C. Cylinder: Provide equipment as applicable for direct plunger type elevator. Cylinder shall be closed bottom seamless steel pipe with sufficient thickness to sustain 400 PSI test. The external surface shall be coated with heavy, double hot mopped bitumastic or asphaltum compound and allowed to dry prior to installation or double wrapped with

tapecoat. Provide cylinder head with adjustable packing gland which shall prevent excessive oil leakage. The cylinder head shall be provided with means to release air from cylinder and be easily repackable. A collection groove and coupling with run-off tube shall be connected to a scavenger system which shall automatically return oil to the oil reservoir. Provide tubing scavenger line with in-line strainers between the pit and machine room.

- E. Plungers: Polished selected steel tubing of proper diameter turned true and smooth. Secure to car frame and crosshead or stiles with suitable isolated platen/mounting plates. Provide stop rings to prevent plungers from leaving cylinders.
- F. Guide Rails: Planed steel, standard T-sections. Extend rails from pit floor to underside of concrete slab or grating at top of hoistway. Design equipment, guide rail bracket mounting and attachment to accommodate building design. Where necessary, provide intermediate supports or rail backing.
- G. Buffer: Spring type with pipe struts and braces as required. Mount on continuous channels secured to guide rails.
- H. Automatic Terminal Stopping Device: Per Code.
- I. Electrical Wiring: Terminal connections for all conductors at equipment panels, center of hoistway and on elevator car shall be made with terminal blocks or studs having identifying numbers. All conductor connections shall be made with terminal eyelets of the solderless type.
 - 1. Wiring, Duct and Conduit:
 - a. Stranded or solid copper wiring throughout.
 - b. All required new wiring from the controller, selector, dispatch panels, etc., and from the separate outlet for car lights and telephone to all elevator equipment, shall be furnished installed as part of this work. Wiring shall be properly insulated and have a flame-retarding and moisture-resistant outer cover shall be run in galvanized metallic conduit or duct, using strain boxes as required. Interlock wiring from the hoistway riser to each new interlock shall be fire resistant NEC Code type SF-2 or equivalent.
 - c. Conduits or other wiring shall not be exposed in the lobby or other occupied parts of the building.
 - 2. General Wiring Requirements:

Provide a completely properly operating system for each item of electrical equipment required to complete the project. Installations shall be in accord with manufacturer's instructions, the best industry standards and practices and the contract documents.

 - a. Install all wiring and conduit in accordance with National Electric Code requirements and industry standards and practices.
 - b. Rout wire and cable as required to meet project conditions.
 - c. Make installation in a neat, finished and safe manner, according to the latest published NECA Standard of Installation under competent supervision.

- d. Neatly train and lace wiring inside boxes, equipment, and panel boards.
- e. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- f. Riser cables shall have cable supports as required by Code.
- g. Identify all wire and cable as required. Identify each conductor with its circuit number and/or designation.
- h. Connect all conductors. Torque each terminal connection to the manufacturers recommended torque value.
- i. Support conductors installed in vertical raceways at intervals not exceeding those distances indicated in the National Electric Code. Support conductors in pull boxes with strain reducing supports provided for the size and number of conductors in the raceway. Do not splice conductors in pull boxes used for vertical cable support.
- j. Control, communications or signal conductors shall be installed in separate raceway systems from branch circuit or feeder raceways.
- k. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide maximum headroom possible.
- l. Properly ground and bond all electrical conduits and raceways in accordance with National Electric Code requirements.

3. Electrical Cables:

- a. Traveling Cables shall be provided new. Pad cab platforms where cables rub. Provide hardware cloth for full traveling cable movement height between cables and all hoistway divider beams.
 - b. The car operating panel, position indicator, and other electric equipment on the car shall be connected with the controller by means of flexible cable run from the bottom of the car to an approved outlet in the hoistway.
 - c. Cables shall have a flame-retarding and moisture-resistant outer cover, and shall be suitably suspended to relieve strain in individual conductors.
 - d. Each traveling cable shall contain 10% spare wires and in any event not less than one spare wire.
 - e. Traveling cables shall contain at least six (6) shielded twisted pairs and one (1) coaxial cable for use by the Contracting Officer. Provide junction box mounted on the side of the elevator control panel and on the cartop for storage of spare communication wiring. Properly label junction boxes.
- J. Pit Stop Switch: Provide new red colored stop switches to meet Code requirements.
- K. Work Light and Plug Receptacles: Provide on top and bottom of car with lamp guards.
- L. Provide sealed and covered fluorescent type convenience lighting mounted at the top and bottom of the elevator hoistway. Provide three way light switches mounted at the top and bottom of the elevator hoistway.

2.6 DOOR AND ENTRANCE EQUIPMENT

- A. General: Provide entrance assembly with UL 1 ½ hour rating. All entrance frames and door panels shall be of a heavy duty design and provided as specified. Use of manufacturers standard light gauge metals is unacceptable for this project. The elevator interior, entrance frames, door panels, sills and pushbuttons are required to be of heavy duty type construction as required for public use in MCC buildings. Use of products or materials other than those specified is unacceptable. Provide brushed stainless steel, no. 4 metal finish.
- B. Frames: Fabricate from 14 gauge cold rolled furniture steel, bolted to form a one piece unit. A fireproof and sound-deadening material shall be applied to the unexposed side of each frame. Provide handicapped designations at a height of 60" above the floor. Designations shall be flush with inconspicuous mechanical mounting. Provide brushed stainless steel, no. 4 metal finish.
- C. Provide handicapped designations at a height of 60" above the floor.
 - 1. The plaques shall have black numerals and Braille markings on a stainless steel background.
 - 2. Designations shall be flush with inconspicuous mechanical mounting.
- D. Provide elevator identification number on the entrance frame at ground floor.
- E. Sills: Provide stainless steel milled or extruded type with a non-slip surface. Sills shall be properly supported and attached to the building structure.
- F. Struts: Minimum 3" continuous hot rolled or formed steel angle with secure fastening to sill and floor beam above.
- G. Header: Minimum 3/16" thick-formed steel designed to support hangers. Header shall be bolted to supporting struts.
- H. Hanger Cover Plates: Removable, full length No. 14 gauge steel. Covers shall be made in sections for convenient access to hangers.
- I. Fascia: No. 14 gauge steel plates extending from top of header to sill of door above, or beam above if there is no door opening. Provide continuous fascia if front hoistway walls are not built out where openings do not exist.
- J. Toe Guard: No. 14 gauge sheet steel.
- K. Dust Cover: No. 14 gauge sheet steel.
- L. Door Bumpers: Provide on vertical struts at top and bottom.
- M. Doors: Door panels shall be hollow metal flush door construction, 16 gauge furniture steel. Fill with fireproof, Sound deadening material. Provide reinforcement by formed vertical sections running full height of door. Doors shall be provided with two removable, non-metallic gibs, located at the leading and trailing edge of the door panel. Center opening doors shall be provided with full length rubber astragal at leading edge of each door. Provide brushed stainless steel, no. 4 metal finish. Landing designations shall be permanently applied to the inside of each door panel.

Doors shall also be provided with a secondary retention means as required by ASME A17.1, rule 2.11.11.8. All door panels shall be drilled and provided with door access escutcheon access tubes.

- N. Sight guards: Provide for each landing door panel, constructed of No. 16 gauge furniture steel. Finish to match doors. Landing designations shall be permanently applied to the inside of each door panel.
- O. Hanger: Provide two-point suspension sheave type with provisions for vertical and lateral adjustments. Sheaves shall be minimum 2 ¼" in diameter with sealed ball or roller bearings.
- P. Tracks: Cold drawn steel shaped and finished to permit free movement of sheaves. Bottom of track shall be in contact with upthrust roller.
- Q. Closer: Spring or spirator type.

2.7 CAR EQUIPMENT

- A. Car Frame: Welded or bolted steel channel construction.
- B. Platform: Isolated type, steel frame with steel or wood subfloor, fireproof on underside.
- C. Guide shoes: Roller type with three or more sound-deadening rollers with adjustable springs or other method to maintain rail contact.
- E. Leveling Apron: Provide 48 inch or as required by Code.
- F. Hangers and tracks: Same as hoistway entrance doors hangers and tracks.
- G. Door Protection:
 - 1. Electronic Entrance Detector Screen: Provide an electronic door edge device which projects a 3D infrared curtain of light guarding the door opening. The face of the electronic edge shall illuminate RED when closing and GREEN when opening. Arrange to reopen doors if one beam of the curtain is penetrated. Unit shall have Transmitters and Receivers spaced at a minimum distance to provide the maximum amount of protection within the height of the doorway. Systems which have the ability to turn Off or On individual zones within the curtain will not be allowed.
 - 2. Differential door timing feature: Provide adjustable timers to vary the time that the doors remain open in response to a car or hall call. The doors shall remain open for one second in response to a car call and five to eight seconds for a hall call. This time shall be reduced to .5 second if the entrance detector is interrupted. The doors shall remain open as long as passengers are crossing the threshold.
 - 3. Nudging: When doors are prevented from closing for 20 seconds due to failure of the entrance detector or obstruction, the doors shall close at reduced speed and a buzzer shall sound.
- H. Door Operator: Provide a linear type operator, similar to a Wittur, AMD, ECI VFE2500-HL or GAL of Canada type operator, equipped with a closed loop continuous feedback controller. Door operator shall automatically open and close the car and hoistway doors. The doors shall be capable of smooth and quiet operation without slam or shock.

1. Opening speed shall not be less than 2.5 fps with reversal in no more than 2 ½”.
 2. An auxiliary closing device shall automatically close hoistway doors if car leaves the landing zone.
 3. In case of power interruption, it shall be Possible to manually operate car and hoistway doors from inside the cab.
 4. Provide door safety retainers and restricted opening of car doors in accordance with Code requirements.
- I. Car Door Contacts: Electrical contacts shall prevent the operation of the elevator by normal operating devices unless car doors are closed or within tolerances allowed by Code.
- J. Elevator no. 1-2- Car Enclosure: Car enclosure shall be manufactured by an approved company. All return panels, wall panels and door panels shall be of a heavy duty design and provided as specified. Use of manufacturers standard light gauge metals is unacceptable for this project. The elevator interior, entrance frames, door panels, sills and pushbuttons are required to be of heavy duty type construction as required for public use in MCC buildings. Use of products or materials other than those specified is unacceptable. Provide the following features:
1. Approved Suppliers:
 - a. EMCO - Elevator Modernization Company
 - b. Capital Cab Interiors
 - c. Eklund's Elevator Company

Provide the following features as shown and detailed on the Architectural drawings:

2. Shell: The car interior walls shall be formed of 14 gauge steel sheets, assembled together. All walls shall be reinforced for rigidity and present true surfaces free from warp and buckle. The walls shall be designed so that no more than 3/8" deflection is realized with a force of 100 lbf. applied. Wall panels and square corners shall be secured to each other by means of bolts to present a light proof joint. Bolts shall not be visible on the car interior surfaces. All joints that must be field assembled shall be guaranteed against squeaks, and be drawn up tight, with bolts fitted with washers and lock washers. The entire car assembly including frame and platform shall operate entirely free from squeaks and metallic sounds.
 - a. Provide code compliant sound deadening, factory painted on the exterior surfaces of the cab shell walls.
 - b. Welding: Welding metal shall be of the same kind as the parts which are joined. Welds which are exposed shall be the same color and have the same finish as the metals which are joined. Concealed structural or reinforcing members shall be of well finished sheet stock or rolled shapes.
 - c. Finish cab interior and exterior ferrous metal surfaces, as follows:
 1. Provide all interior ferrous metal surfaces, with a minimum of one (1) prime coat and two (2) finish coats of shop applied baked enamel, in a color approved by the Contracting Officer.

2. Provide exterior, cab canopy sheet steel surfaces, with a minimum of two (2) prime coats of shop applied baked enamel.
 3. Properly sand all coats of paint between applications.
- d. Outside Cab Enclosure Height: Refer to Contract Drawings. Provide 8'-0" cab height.
2. Car Interior Components:
- a. Design the elevator to accommodate the car weight, including shell, canopy, car doors, interior components, and flooring.
 1. Interior Panels: Panels shall be removable and of plywood or wood core board construction with rigidize 5WL stainless steel facing and stainless steel reveals below the handrails and plastic laminate facing and stainless steel reveals above the handrails as detailed on the Architectural drawings. Provide mounting method which prevents rattling or vibration.
 2. Ornamental metal components such as handrails, thresholds, binder edges, base vent, ceiling trim, car door facing, posts transoms, and return panels shall be furniture grade and subject to MCC approval of material and finish samples provided. Door transoms, posts, and returns shall be minimum 14 gauge material.
 3. Include all necessary cut-outs for operating devices and recess car operating components with faceplates surface-applied.
 4. All handrails shall match existing in shape, configuration, and mounting.
 5. Provide permanent wall anchors for mounting of temporary protection blankets on the car walls.
 6. All interior finishes shall be mounted and installed on removable type panels that utilize standard z style mounting clips or brackets.
3. Car Doors:
- a. General: Provide car door panels with hanger assemblies and related hardware including header, car door rollers, tracks, and door bottom gibs.
 - b. Provide car door panels of hollow metal flush panel construction, manufactured of 16 gauge cold-rolled stretcher-leveled, furniture grade sheet steel, not less than 1 1/4" thick. Each door panel shall be hung on two point suspension sheave type ball bearing hangers similar to those specified for the hoistway door panels except that each sheave shall be of sound reduced design. The door panels shall be rigid and reinforced for installation of hangers, door operating equipment, door reopening device and hardware, and unlocking zone device. Each door panel shall be guided at the bottom by two nylon or composition gibs engaging door threshold grooves with a maximum clearance of .020". Gibs shall have fire stops bent and be easily replaceable without removing door panels from hangers. Car door panels shall be stainless steel, satin no. 4 finish.

1. The doors shall have their interior surface faced with 18 gauge sheet metal, as shown on the Contract Drawings and approved by the Contracting Officer.
 2. Facing shall be extended around the edges of the panel and returned 3/4" minimum around the outside of the hoistway face.
 3. No seams, screws or binding strips shall be visible from within the car.
- c. Provide a door operator header constructed of at least 3/16" thick steel and shaped to provide stiffening flanges at top and bottom, extending its entire length.
 - d. Provide tracks for hangers comparable to those supplied for the hoistway doors. Tracks shall be fastened to the header at frequent intervals to insure permanent track alignment.
 - e. Provide electrical contacts arranged to operate with the elevator controller so that the elevator cannot be operated unless the doors are closed or within the tolerance allowed by Code.
 - f. Restricted Door Opening: Provide for Code compliant restricted opening of the car or hoistway doors from inside the elevator, if the elevator is outside of the unlocking zone.
4. Sill: Provide stainless steel milled or extruded type with a non-slip surface and machined grooves to accept door guides.
 5. Canopy: Construct canopy panels of 12 gauge cold-rolled stretcher-leveled, furniture grade sheet steel.
 - a. Reinforce the canopy and emergency exit, as required to meet Code.
 - b. Emergency Exit: The canopy shall be provided with a Code compliant, hinged emergency exit, opening clear of the crosshead and car door operator. Emergency exit cover shall be hinged on one side by a full length hinge, and held in place by non-removable fastening devices at each corner opposite the hinged edge, and shall be operable from top of car only, without special tools. All non-hinged sides of the exit panel shall lap the exit opening by 3/4". The emergency exit shall be equipped with electrical contacts which will prevent operation of the elevator when the exit door is open.
 6. Steady Plates: Provide steady plates between the canopy and side stiles to prohibit shake or shifting of the elevator cab during running and door operations. Steady plates shall have a minimum of three (3) post wise adjustments and shall be equipped with rubber isolation.
 7. Car Lighting and Outlets:
 - a. Provide new C.E. Electronics, SKCAB lighting fixtures with SKDIM dimmer control as shown on Architectural drawings.
 1. Provide safety lamp guards on all lamps, as selected by the Contracting Officer.
 2. Maintain a minimum uniform illumination level in accordance with IESNA standard for elevators and ASME A17.1.
 3. Provide a keyed light switch in the main car operating panel to control the elevator interior lighting.
 4. Provide a guarded light fixture on top of the elevator.

5. Provide a 2-pole, 3 wire, GFCI duplex receptacle, rated for 20 amperes and 125 volts on top of the elevator.
 6. Emergency Car Lighting and Alarm System: Provide two LED type units in car for activation upon failure or interruption of normal car lighting. Emergency lighting unit shall provide a minimum illumination of 0.2 foot-candle at 48" above car floor approximately 12" in front of car operating panels for not less than 4 hours. Battery shall be sealed rechargeable lead acid or equal. Battery charger shall be capable of restoring battery to full charge within 16 hours after resumption of normal power. Provide an external means for testing battery, lamps, and alarm bell from inside the elevator car.
8. Finished flooring:
- a. Provide Burke Endura resilient industrial raised rubber flooring.
 1. Prepare the car platform sub-surface, as required, to accept the flooring so that no imperfections are visible.
 2. Top of finished flooring shall be flush with the top of the car threshold.
 3. Provide all required assistance to the flooring contractor and all required standby labor, relative to the installation of the finished flooring in the car enclosure.
9. Ventilation: Provide a single speed, squirrel cage type, centrifugal ventilating blower.
- a. Provide vent slots in base of car.
10. Trademarks: Do not display manufacturers name or trademark on exposed surfaces of materials or components, which can be seen by persons using the elevator.
- K. Elevator no. 3 - Car Enclosure: Car enclosure shall be manufactured by an approved company. All return panels, wall panels and door panels shall be of a heavy duty design and provided as specified. Use of manufacturers standard light gauge metals is unacceptable for this project. The elevator interior, entrance frames, door panels, sills and pushbuttons are required to be of heavy duty type construction as required for public use in MCC buildings. Use of products or materials other than those specified is unacceptable. Provide the following features:
1. Approved Suppliers:
 - a. EMCO - Elevator Modernization Company
 - b. Capital Cab Interiors
 - c. Eklund's Elevator Company

Provide the following features as shown and detailed on the Architectural drawings:

2. Shell: The car interior walls shall be formed of 14 gauge steel sheets, assembled together. All walls shall be reinforced for rigidity and present true surfaces free from warp and buckle. The walls shall be designed so that no more than 3/8"

deflection is realized with a force of 100 lbf. applied. Wall panels and square corners shall be secured to each other by means of bolts to present a tight joint. Bolts shall not be visible on the car interior surfaces. All joints that must be field assembled shall be guaranteed against squeaks, and be drawn up tight, with bolts fitted with washers and lock washers. The entire car assembly including frame and platform shall operate entirely free from squeaks and metallic sounds.

- a. Provide code compliant sound deadening, factory painted on the exterior surfaces of the cab shell walls.
- b. Welding: Welding metal shall be of the same kind as the parts which are joined. Welds which are exposed shall be the same color and have the same finish as the metals which are joined. Concealed structural or reinforcing members shall be of well finished sheet stock or rolled shapes.
- c. Finish cab interior and exterior ferrous metal surfaces, as follows:
 1. Provide all interior ferrous metal surfaces, with a minimum of one (1) prime coat and two (2) finish coats of shop applied baked enamel, in a color approved by the Contracting Officer.
 2. Provide exterior, cab canopy sheet steel surfaces, with a minimum of two (2) prime coats of shop applied baked enamel.
 3. Properly sand all coats of paint between applications.
- d. Outside Cab Enclosure Height: Refer to Contract Drawings. Provide 9'-0" cab height.

2. Car Interior Components:

- a. Design the elevator to accommodate the car weight, including shell, canopy, car doors, interior components, and flooring.
 1. Interior Panels: Panels shall be removable and of plywood or wood core board construction with rigidize 5WL stainless steel facing and stainless steel reveals above and below the handrails as detailed on the Architectural drawings. Provide mounting method which prevents rattling or vibration.
 2. Ornamental metal components such as handrails, thresholds, binder edges, base vent, ceiling trim, car door facing, posts transoms, and return panels shall be furniture grade and subject to MCC approval of material and finish samples provided. Door transoms, posts, and returns shall be minimum 14 gauge material.
 3. Include all necessary cut-outs for operating devices and recess car operating components with faceplates surface-applied.
 4. All handrails shall match existing in shape, configuration, and mounting.
 5. Provide permanent wall anchors for mounting of temporary protection blankets on the car walls.
 6. All interior finishes shall be mounted and installed on removable type panels that utilize standard z style mounting clips or brackets.

3. Car Doors:
 - a. General: Provide car door panels with hanger assemblies and related hardware including header, car door rollers, tracks, and door bottom gibs.
 - b. Provide car door panels of hollow metal flush panel construction, manufactured of 16 gauge cold-rolled stretcher-leveled, furniture grade sheet steel, not less than 1 1/4" thick. Each door panel shall be hung on two point suspension sheave type ball bearing hangers similar to those specified for the hoistway door panels except that each sheave shall be of sound reduced design. The door panels shall be rigid and reinforced for installation of hangers, door operating equipment, door reopening device and hardware, and unlocking zone device. Each door panel shall be guided at the bottom by two nylon or composition gibs engaging door threshold grooves with a maximum clearance of .020". Gibs shall have fire stops bent and be easily replaceable without removing door panels from hangers. Car door panels shall be rigidize stainless steel, 5WL pattern finish.
 1. The doors shall have their interior surface faced with 18 gauge sheet metal, as shown on the Contract Drawings and approved by the Contracting Officer.
 2. Facing shall be extended around the edges of the panel and returned 3/4" minimum around the outside of the hoistway face.
 3. No seams, screws or binding strips shall be visible from within the car.
 - c. Provide a door operator header constructed of at least 3/16" thick steel and shaped to provide stiffening flanges at top and bottom, extending its entire length.
 - d. Provide tracks for hangers comparable to those supplied for the hoistway doors. Tracks shall be fastened to the header at frequent intervals to insure permanent track alignment.
 - e. Provide electrical contacts arranged to operate with the elevator controller so that the elevator cannot be operated unless the doors are closed or within the tolerance allowed by Code.
 - f. Restricted Door Opening: Provide for Code compliant restricted opening of the car or hoistway doors from inside the elevator, if the elevator is outside of the unlocking zone.
4. Sill: Provide stainless steel milled or extruded type with a non-slip surface and machined grooves to accept door guides.
5. Canopy: Construct canopy panels of 12 gauge cold-rolled stretcher-leveled, furniture grade sheet steel.
 - a. Reinforce the canopy and emergency exit, as required to meet Code.
 - b. Emergency Exit: The canopy shall be provided with a Code compliant, hinged emergency exit, opening clear of the crosshead and car door operator. Emergency exit cover shall be hinged on one side by a full length hinge, and held in place by non-removable fastening devices at each corner opposite the hinged edge, and shall be operable from top of car only, without special tools. All non-hinged sides of the exit panel shall lap the exit opening by 3/4". The emergency exit shall be equipped

with electrical contacts which will prevent operation of the elevator when the exit door is open.

6. Steady Plates: Provide steady plates between the canopy and side stiles to prohibit shake or shifting of the elevator cab during running and door operations. Steady plates shall have a minimum of three (3) post wise adjustments and shall be equipped with rubber isolation.
7. Car Lighting and Outlets:
 - a. Provide new C.E. Electronics, SKCAB lighting fixtures with SKDIM dimmer control as shown on Architectural drawings.
 1. Provide safety lamp guards on all lamps, as selected by the Contracting Officer.
 2. Maintain a minimum uniform illumination level in accordance with IESNA standard for elevators and ASME A17.1.
 3. Provide a keyed light switch in the main car operating panel to control the elevator interior lighting.
 4. Provide a guarded light fixture on top of the elevator.
 5. Provide a 2-pole, 3 wire, GFCI duplex receptacle, rated for 20 amperes and 125 volts on top of the elevator.
 6. Emergency Car Lighting and Alarm System: Provide two LED type units in car for activation upon failure or interruption of normal car lighting. Emergency lighting unit shall provide a minimum illumination of 0.2 foot-candle at 48" above car floor approximately 12" in front of car operating panels for not less than 4 hours. Battery shall be sealed rechargeable lead acid or equal. Battery charger shall be capable of restoring battery to full charge within 16 hours after resumption of normal power. Provide an external means for testing battery, lamps, and alarm bell from inside the elevator car.
8. Finished flooring:
 - a. Provide Burke Endura resilient industrial raised rubber flooring.
 1. Prepare the car platform sub-surface, as required, to accept the flooring so that no imperfections are visible.
 2. Top of finished flooring shall be flush with the top of the car threshold.
 3. Provide all required assistance to the flooring contractor and all required standby labor, relative to the installation of the finished flooring in the car enclosure.
9. Ventilation: Provide a single speed, squirrel cage type, centrifugal ventilating blower.
 - a. Provide vent slots in base of car.
10. Trademarks: Do not display manufacturers name or trademark on exposed surfaces of materials or components, which can be seen by persons using the elevator.

2.8 SIGNALS AND FIXTURES

- A. Provide "Traditional" custom signal fixtures. The intent is not to furnish the new state-of-the-art plastic bezel mounting design. Provide metal disc type pushbutton modules with an illuminated LED halo. All operating panels and fixtures shall utilize Blue Light Emitting Diodes (LED) technology for illumination and acknowledgement.

In order to insure continuity of maintenance and use of similar components that are familiar to the in-house elevator maintenance and technical staff, provide car and hall fixtures as manufactured by Innovation Industries, Inc. or GAL Equipment Manufacturing Corporation.

- B. Car Operating Panels:
1. Provide one, swing return panel and car operating station integral with the front of the elevator cab. Provide round metal disc button with blue LED illuminated halo's numbered to conform to floors served. Buttons shall light to show registration and extinguish when car stops in response to a call. The panel shall include an emergency stop switch, alarm bell button, DOOR OPEN and DOOR CLOSE button. All operating controls shall be located no higher than 54" for side approach and 48" for front approach above the car floor, 35" for stop switch and alarm button. Provide fire service operating cabinet and all required control features within the main car panel in accordance with Code requirements. Braille/Arabic designations shall be flush with inconspicuous mechanical mounting. Provide brushed stainless steel, no. 4 metal finish. Provide smoked colored lens and mounting studs for installation of security card readers.
 2. Provide within the main panel an integral certificate frame. Certificate Frame shall have durable Plexiglas window and be accessible from backside of locked door. Minimum window size to be 8" wide by 5.25" high. All key switches shall utilize MCC standard keying as selected by the Contracting Officer and currently in use within the facility. Cabinet shall contain the following toggle switch controls:
 - a. A light switch.
 - b. Single speed blower switch.
 - c. Inspection switch, conforming to ASME Code.
 - d. Emergency Stop switch.
 - e. Emergency Light Test Switch
 3. Engrave the car operating panels with the following:
 - a. Elevator Number over operating buttons.
 - b. Elevator Capacity.
 - c. Fire Service Instructions
- C. Car Position Indicator: Provide digital readout type with 2" high (minimum) indications over each operating panel. Position indicator illumination shall be blue. Provide voice annunciation.
- D. Hall Buttons: Provide one riser of hall pushbuttons. Station shall include flush mounted faceplate. Centerline of riser to be at 42" above the finished floor. Appendix "O" Fire signs shall be integral within the faceplate. Provide round metal disc button with blue LED illuminated halo. Incorporate fire service devices and signage in lobby stations.

Provide communication failure indicator and reset switch. Provide emergency power operation jewel. Mount a digital position indicator with blue illumination and direction of travel arrows in each hall stations. Provide brushed stainless steel, no. 4 metal finish.

- E. Car Travel Lanterns: Provide UP and DOWN lanterns mounted in both interior car return panels. Electronic chimes in each lantern shall sound once for the up direction of travel and twice for the down direction of travel. The lantern shall illuminate for corresponding direction of car travel and the chime shall sound when the elevator is at a predetermined distance from the scheduled floor stop. Faceplate material identical to hall button faceplate. Provide voice annunciation.
- F. Hoistway Access Switch: Mount within hall pushbutton station at top and bottom terminal landings. Activation of the hoistway access switch shall initiate a call to feature allowing the elevator mechanic to call the car directly from either landing. Faceplate to match hall button finish.
- G. Provide Fire Service emergency key boxes at the main Fire Recall landing. Provide brushed stainless steel, no. 4 metal finish.
- I. Voice Annunciation: Provide voice annunciation manufactured by CE Electronics, Inc. Provide a programmable unit with a female voice.

2.9 COMMUNICATION SYSTEM:

- A. Telephone System: Provide telephone integral with car operating panel. Provide automatic dial telephone station located in the car station. Activation of auto dialer shall be by a button suitably identified for the visually impaired. Speaker shall be mounted without faceplate or visible fasteners and located behind the control station. Communication shall be capable of being heard from any location within the car enclosure.
 - 1. Provide a telephone symbol minimum 2" high, and raised 1/32" with Braille indications adjacent to a separate activation button mounted on the control panel.
 - 2. Provide engraved emergency instructions above the activation button. Instructions shall read: "TO USE EMERGENCY TELEPHONE, PRESS BUTTON BELOW. DIALING WILL OCCUR AUTOMATICALLY. Identical instructions in Braille shall be provide below the engraved instructions.
 - 3. Provide a visual indication, approximately 3/4" in diameter, or a jewel that illuminates once a call has been received by the master station. Instructions under the visual indicator or within the lighted jewel shall read: "CALL HAS BEEN RECEIVED".
 - 4. Upon activation of the system, a signal shall be sent to the Security Command Center (SCC). The signal to the SCC shall provide the building name and location and the elevator number. A separate telephone line shall be provided for each cab. Occupants in the cab will be able to speak with the personnel at the SCC.
- B. Provide wiring from car to telephone terminal box in elevator machine room.
- C. Provide installation of Life Safety speaker provided by others within the elevator cab. Provide wiring from car to Life Safety junction box in machine room.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. The elevator contractor shall examine the supporting structure and the conditions under which the work shall be installed and notify the contractor of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected and are acceptable.
- B. Verify dimensions of supporting structure at the site by accurate field measurements. The work shall be accurately fabricated and fitted to the structure. Elevator contractor shall satisfy himself by review of the working drawings and field observation that the clearances and the alignments are proper for the installation of this work.
- C. Coordinate work with the work of other trades and provide items to be placed during the installation at the proper time to avoid delays in the overall work. Use contractor's benchmarks where necessary.

3.2 FIELD QUALITY CONTROL

- A. Tests:
 - 1. Perform as required by Code and as required by authorities having jurisdiction.
 - 2. Provide labor, materials, equipment and connections.
 - 3. Repair or replace defective work as required.
 - 4. Pay for restoring or replacing damaged work due to tests.
- B. Final Inspection: When all work is completed, and tested to the satisfaction of the contractor, the contractor shall notify the Contracting in writing that the elevator is ready for final inspection and acceptance test. A testing and inspection date shall be arranged. The proper operation of every part of the elevator system and compliance with contract requirements, including compliance with all applicable requirements of the Code, shall be demonstrated to the Contracting. Furnish all test instruments, weights, and materials, required at the time of final inspection.
- C. If deficiencies are found, or if the consultant/MCC deems it to be necessary the contractor shall perform the following tests at no additional charge immediately following the final inspection.
 - 1. Test Period: The elevator shall be subjected to a test for a period of one hour continuous run, with full specified load in the car. During the test run, the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor.
 - 2. Speed Load Tests: The actual speed of the elevator car shall be determined in both directions of travel with full contract load and with no load in the elevator car. Speed shall be determined by a tachometer. The actual measured speed of elevator car with full load shall be within 10% of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined between the "UP" and the "DOWN" directions shall be checked.
 - 3. Floor-to-floor times with no load in the car, balanced load and full car load shall be checked.
 - 4. Car Leveling Tests: Elevator car leveling devices shall be tested for accuracy of landing at all floors with no load in car, balanced load in car, and with full load in car, in both directions of travel. Accuracy of floor landing (plus or minus 1/4 in.) shall be determined both before and after the full-load run test.

5. Insulation Resistance Tests: The complete wiring systems of the elevator shall be free from short circuits and grounds, and the insulation resistance shall be determined by use of a "Megger." Conductors shall have an insulation resistance of not less than one megohm between each conductor and ground and between each conductor and all other conductors.
6. Final Systems Tests for Smoke Detection/Elevator Recall: After work is completed, conduct a final test of entire system.
7. Reinspection: If any equipment is found to be damaged or defective, or if the performance of the elevator does not conform with the requirements of the contract specifications or the Safety Code, no approval or acceptance of elevators shall be issued until all defects have been corrected. When the repairs and adjustments have been completed and the discrepancies corrected, the Contracting shall be notified and the elevator will be reinspected. Rejected elevators shall not be used until they have been reinspected and approved.

3.3 ADJUSTING, PAINTING AND CLEANING

- A. All equipment shall be adjusted prior to final testing and acceptance.
- B. Paint exposed work soiled or damaged during installation. Repair to match adjoining work prior to final acceptance. At a minimum all hoistway and machine room components shall be painted in the field with at least one coat of machine grade enamel. Elevator machine room walls shall be painted an off-white color. Machine room and pit floors shall be painted with epoxy type gray coating. The intent is to provide a complete final product that is neat, clean and painted.
- C. Contractor shall clean and paint the machine room walls and floor with an epoxy-based paint as selected by the Contracting Officer.
- D. Hoistway walls shall be painted white to improve effectiveness of lighting for service personnel when working in the hoistway.

3.4 INSTRUCTIONS

Upon completion of all work, the Elevator Contractor shall provide an instruction period. Instructions shall be given by competent supervisory personnel and shall apply to actual field conditions. The instructions shall cover, but shall not be limited to the following:

- A. Operation of elevators under emergency conditions.
- B. Operation and maintenance of smoke detector and elevator fire recall system.
- C. Operation of elevator communication, electronic entrance detector, hoistway access devices, etc.

END OF SECTION 14 24 00

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

1.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or ductile iron, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: Anticorrosion coated or zinc coated, with plain ends and integral waterstop collar.
- C. Galvanized-Steel Sheet Pipe Sleeves: Round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange.
- F. Molded-PE or -PP Sleeves: Removable, with nailing flange.

1.2 STACK SLEEVE FITTINGS

- A. Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral cast flashing flange, with underdeck clamp.

1.3 SLEEVE-SEAL SYSTEMS

- A. Field-assembled, modular sealing-element unit for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM rubber High-temperature silicone Nitrile (Buna N).
 - 2. Pressure Plates: Carbon steel Composite plastic Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel.

1.4 SLEEVE-SEAL FITTINGS

- A. Manufactured, sleeve-type, plastic or rubber waterstop assembly made for imbedding in concrete slab or wall.

1.5 GROUT

- A. Nonshrink, factory packaged.

1.6 SILICONE SEALANTS

- A. Silicone Sealant: Type S, Grade NS, Class 25, Use NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
- B. Silicone Sealant: Type S, Grade P, Class 25, Use NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1.7 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Exterior Concrete Walls above Grade:
 - 1. Piping Smaller Than NPS 6 Insert pipe size: Cast-iron pipe sleeves Steel pipe sleeves Sleeve-seal fittings Insert material.
 - 2. Piping NPS 6 Insert pipe size and Larger: Cast-iron pipe sleeves Steel pipe sleeves Sleeve-seal fittings Insert material.
- B. Exterior Concrete Walls below Grade:
 - 1. Piping Smaller Than NPS 6 Insert pipe size: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system Sleeve-seal fittings Insert material.
 - 2. Piping NPS 6 Insert pipe size and Larger: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system Sleeve-seal fittings Insert material.
- C. Concrete Slabs-on-Grade:
 - 1. Piping Smaller Than NPS 6 Insert pipe size: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system Sleeve-seal fittings Insert material.
 - 2. Piping NPS 6 Insert pipe size and Larger: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system Sleeve-seal fittings Insert material.

- D. Concrete Slabs above Grade:
 - 1. Piping Smaller Than NPS 6 Insert pipe size: Steel pipe sleeves PVC pipe sleeves Stack-sleeve fittings Sleeve-seal fittings Molded-PE or -PP sleeves Molded-PVC sleeves Insert material.
 - 2. Piping NPS 6 Insert pipe size and Larger: Steel pipe sleeves PVC pipe sleeves Stack-sleeve fittings Insert material.

- E. Interior Partitions:
 - 1. Piping Smaller Than NPS 6 Insert pipe size: Steel pipe sleeves PVC pipe sleeves Insert material.
 - 2. Piping NPS 6 Insert pipe size and Larger: Galvanized-steel sheet sleeves Insert material.

END OF SECTION 210517

SECTION 210518 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

1.1 SUMMARY

- A. Section includes:
1. Escutcheons.
 2. Floor plates.

1.2 PRODUCTS

- A. Escutcheons for New Piping:
1. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
 2. Chrome-Plated Piping: One-piece steel one-piece cast brass or split-plate steel with polished, chrome-plated finish.
 3. Insulated Piping: One-piece steel with polished, chrome-plated finish One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish One-piece stamped steel with exposed hinge, with polished, chrome-plated finish.
 5. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 6. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with rough-brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 7. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with rough brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
1. Chrome-Plated Piping: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 2. Insulated Piping: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 5. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 6. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 7. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
- C. Floor Plates: Split-plate, stamped steel with concealed hinge.

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT
27 SEPTEMBER 2019

END OF SECTION 210518

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

1.1 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.
- B. Minimum residual pressure at each hose-connection outlet is as follows:
 - 1. NPS 2-1/2 Hose Connections: 100 psig Insert value.

1.2 PIPING MATERIALS

- A. Black Steel Pipe: Schedule 40/Schedule 10.
- B. Black Steel Pipe Fittings:
 - 1. Uncoated, steel couplings.
 - 2. Uncoated, gray-iron threaded fittings.
 - 3. Malleable- or ductile-iron unions.
 - 4. Cast-iron flanges.
 - 5. Steel flanges and flanged fittings.
 - 6. Steel welding fittings.
 - 7. Grooved-end-pipe couplings for steel piping.

1.3 HOSE CONNECTIONS

- A. Brass or Bronze Adjustable-Valve Hose Connections:
 - 1. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
 - 2. Pattern: Angle or gate.
 - 3. Pressure-Control Device Type: Pressure reducing restricting.
 - 4. Finish: Polished chrome-plated Rough brass or bronze Rough chrome-plated.
- B. Brass or Bronze Nonadjustable-Valve Hose Connections:
 - 1. Size: NPS 1-1/2 or NPS 2-1/2, as indicated.
 - 2. Pattern: Angle or gate.
 - 3. Finish: Polished chrome-plated Rough brass or bronze Rough chrome-plated.

1.4 PRESSURE GAGES

- A. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- B. Range: Zero to 250 psig minimum Zero to 300 psig.
- C. Label on Dial Face: "WATER" or "AIR/WATER."
- D. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

END OF SECTION 211200

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SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

1.1 PERFORMANCE REQUIREMENTS

- A. Quality Standards: NFPA 13 and NFPA 70.

1.2 PIPING MATERIALS

- A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with cast-iron threaded fittings grooved-end fittings.
- B. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2 and Smaller Insert pipe size range:
 - 1. Standard-weight Schedule 40, black-steel pipe with threaded ends and uncoated, gray-iron fittings.
 - 2. Standard-weight Schedule 40, black-steel pipe with roll-grooved ends and uncoated fittings.
- C. Standard-Pressure, Wet-Pipe Sprinkler System, NPS 2-1/2 to NPS(DN 65 to DN 100)6 Insert pipe size range:
 - 1. Standard-weight or Schedule 10, black-steel pipe with threaded ends and uncoated, gray-iron fittings.
 - 2. Standard-weight or Schedule 10, black-steel pipe with roll-grooved ends and uncoated fittings.

1.3 SPRINKLER MATERIALS

- A. Sprinkler Types:
 - 1. Rooms without Ceilings: Upright sprinklers Insert type.
 - 2. Rooms with Suspended Ceilings: Concealed sprinklers Pendent as indicated.
 - 3. Wall Mounting: Sidewall sprinklers.
 - 4. Spaces Subject to Freezing: Upright sprinklers Pendent, dry sprinklers Sidewall, dry sprinklers Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated Insert type.
 - 5. Deluge-Sprinkler Systems: Sidewall open sprinklers.
 - 6. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated Insert type.
- B. Sprinkler Finishes:
 - 1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
 - 2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
 - 3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 4. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

1.4 COVER SYSTEM FOR SPRINKLER PIPING

- A. Brackets: Glass-reinforced nylon.
- B. Covers: Extruded-PVC sections.

1.5 SPECIALTY VALVES

- A. Alarm valves.
- B. Deluge valves.
- C. Automatic (ball drip) drain valves.

1.6 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch outlet fittings.
- B. Flow detection and test assemblies.
- C. Branch line testers.
- D. Sprinkler inspector's test fittings.
- E. Adjustable drop nipples.

- F. Flexible, sprinkler hose fittings.
- G. Sprinkler Escutcheons:
 - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat Chrome-plated steel, two piece, with 1-inch vertical adjustment Plastic, white finish, one piece, flat.
 - 2. Sidewall Mounting: Chrome-plated steel Plastic, white finish, one piece, flat.

1.7 ALARM DEVICES

- A. Water-motor-operated alarm.
- B. Electrically operated alarm bell.
- C. Water-flow indicators.
- D. Pressure switches.
- E. Valve supervisory switches.

1.8 MANUAL CONTROL STATIONS

- A. Hydraulic operation.

1.9 CONTROL PANELS

- A. Single-area, two-area, or single-area cross-zoned control panel with electric hydraulic-operation, manual control stations.

1.10 PRESSURE GAGES

- A. 0- to 250-psig minimum 0- to 300-psig range.

END OF SECTION 211313

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

1.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working-Pressure Rating: 175 psig.

1.2 PERFORMANCE REQUIREMENTS

- A. Quality Standards: NFPA 20 and NFPA 70.

1.3 PRODUCTS

- A. Horizontally Mounted, Single-Stage, Split-Case Fire Pumps:
 - 1. Standard: UL 448.
 - 2. Casing: Axially split case, cast iron.
 - 3. Impeller: Cast bronze.
 - 4. Wear Rings: Replaceable bronze.
 - 5. Shaft and Sleeve: Steel shaft with bronze sleeve.
 - 6. Shaft Bearings: Grease-lubricated ball bearings.
 - 7. Seals: Stuffing box.
 - 8. Mounting: Pump and driver on same base, with horizontal shafts.
 - 9. Coupling: Flexible, with metal guard.
 - 10. Inlet Flange: Class 125 Class 250.
 - 11. Outlet Flange: Class 125 Class 250 Insert class.
 - 12. Volts: 208 230 460 Insert number V.
 - 13. Phase: Three.
- B. Fire-Pump Accessories and Specialties:
 - 1. Automatic air-release valves.
 - 2. Circulation Relief Valves: Brass.
 - 3. Inlet Fitting: Eccentric tapered reducer.
 - 4. Outlet Fitting: Concentric tapered reducer.
 - 5. Hose Valve Manifold:
 - a. Body: Flush type, brass or ductile iron Exposed type, brass with polished brass rough brass polished, chrome-plated finish on exposed parts.

END OF SECTION 213113

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SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

1.1 MATERIALS

- A. Polyphase Motors: Design B, medium induction motors.
 - 1. Efficiency: Premium efficient.
 - 2. Service Factor: 1.15.
 - 3. Multispeed Motors: Variable torque, Separate winding for each speed.
 - 4. Rotor: Random-wound, squirrel cage.
 - 5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
 - 6. Temperature Rise: Match insulation rating.
 - 7. Insulation: Class F.
 - 8. Code Letter Designation:
 - a. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.
 - 9. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.
- B. Additional Requirements for Polyphase Motors:
 - 1. Motors used with reduced-voltage and multispeed controllers.
 - 2. Premium-efficient and inverter-duty motors used with variable-frequency controllers.
 - 3. Severe-duty motors.
- C. Single-Phase Motors:
 - 1. Motors Larger Than 1/20 HP: Permanent-split capacitor; split phase; capacitor start, inductor run; or capacitor start, capacitor run to suit starting torque and requirements of specific motor application.
 - 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 - 3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - 4. Motors 1/20 HP and Smaller: Shaded-pole type.
 - 5. Internal thermal protection.

END OF SECTION 220513

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SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

1.1 PRODUCTS

- A. Packless Expansion Joints:
1. Rubber Union Connector Expansion Joints:
 - a. Twin reinforced-rubber spheres with external restraining cables.
 - b. End Connections for NPS 2 and Smaller: Threaded.
 2. Flexible-Hose Packless Expansion Joints:
 - a. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint Insert type end connections.
 - b. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - c. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
 - d. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged welded end connections.
 - e. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged welded end connections.
 - f. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with end connections.
 3. Metal-Bellows Packless Expansion Joints:
 - a. Type: Circular, corrugated bellows with external tie rods.
 - b. Configuration: Single joint Single joint with base and double joint with base class(es).
 - c. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
 - 1) End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - 2) End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
 - 3) End Connections for Copper Tubing NPS 5 and Larger: Flanged.
 - d. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
 - 1) End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
 - 2) End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged Welded.
 4. Externally Pressurized Metal-Bellows Packless Expansion Joints: Totally enclosed, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
 - a. Carbon-steel housing.
 - b. Drain plugs and lifting lug for the NPS 3 and larger.
 - c. Joint Axial Movement: 4 inches 6 inches 8 inches of compression and 0.75 inch 1 inch 2 inches of extension.
 - d. Permanent locking bolts.
 - e. End Connection Configuration: Flanged; one raised, fixed and one floating flange.
 5. Rubber Packless Expansion Joints:
 - a. Material: Fabric-reinforced rubber.
 - b. Arch Type: Single or multiple arches with external control rods.
 - c. Spherical Type: Single or multiple spheres with external control rods.
 - d. Material for Fluids Containing Acids, Alkalis, or Chemicals: BR CSM EPDM Insert material.
 - e. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N CSM Insert material.
 - f. Material for Water: BR Buna-N CSM EPDM NR.
 - g. End Connections: Full-faced, integral steel flanges with steel retaining rings.
- B. Grooved-Joint Expansion Joints: Factory-assembled; made of several grooved-end pipe nipples, couplings, and grooved joints.
1. Nipples: [Galvanized,]ASTM A53/A53M, Schedule 40, Type E or S, steel pipe.
 2. Couplings: Five, flexible type. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water EPDM gasket suitable for cold and hot water, and bolts and nuts.
- C. Alignment Guides and Anchors:
1. Alignment Guides: Steel, factory fabricated.
 2. Anchor Materials:

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- a. Steel shapes, plates, bolts, nuts, and washers.
- b. Wedge-type mechanical anchor fasteners.

END OF SECTION 220516

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

1.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or ductile iron, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: Anticorrosion coated or zinc coated, with plain ends and integral waterstop collar.
- C. Galvanized-Steel Sheet Pipe Sleeves: Round tube closed with welded longitudinal joint.

1.2 STACK SLEEVE FITTINGS

- A. Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral cast flashing flange, with underdeck clamp.

1.3 SLEEVE-SEAL SYSTEMS

- A. Field-assembled, modular sealing-element unit for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM rubber High-temperature silicone Nitrile (Buna N).
 - 2. Pressure Plates: Carbon steel Composite plastic Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel.

1.4 SLEEVE-SEAL FITTINGS

- A. Manufactured, sleeve-type, plastic or rubber waterstop assembly made for imbedding in concrete slab or wall.

1.5 GROUT

- A. Nonshrink, factory packaged.

1.6 SILICONE SEALANTS

- A. Silicone Sealant: Type S, Grade NS, Class 25, Use NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
- B. Silicone Sealant: Type S, Grade P, Class 25, Use NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

1.7 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Exterior Concrete Walls above Grade:
 - 1. Piping Smaller Than NPS 6: Cast-iron pipe sleeves Steel pipe sleeves Sleeve-seal fittings.
 - 2. Piping NPS 6 and Larger: Cast-iron pipe sleeves Steel pipe sleeves Sleeve-seal fittings.
- B. Exterior Concrete Walls below Grade:
 - 1. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system.
 - 2. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system.
- C. Concrete Slabs-on-Grade:
 - 1. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system.
 - 2. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system Steel pipe sleeves with sleeve-seal system.
- D. Concrete Slabs above Grade:
 - 1. Piping Smaller Than NPS 6: Steel pipe sleeves Stack-sleeve fittings Sleeve-seal fittings.
 - 2. Piping NPS 6 and Larger: Steel pipe sleeves Stack-sleeve fittings.
- E. Interior Partitions:
 - 1. Piping Smaller Than NPS 6: Steel pipe sleeves.

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2. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

1.1 SUMMARY

- A. Section includes:
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 PRODUCTS

- A. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
 - 2. Chrome-Plated Piping: One-piece steel one-piece cast brass or split-plate steel with polished, chrome-plated finish.
 - 3. Insulated Piping: One-piece steel with polished, chrome-plated finish One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 - 4. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish One-piece stamped steel with exposed hinge, with polished, chrome-plated finish.
 - 5. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished brass finish One-piece stainless steel with polished stainless-steel finish One-piece cast brass with polished, chrome-plated finish One-piece cast brass with polished brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 - 6. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish One-piece cast brass with rough-brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish One-piece cast brass with rough brass finish One-piece stamped steel with polished, chrome-plated finish Split-plate, stamped steel with concealed hinge, with polished, chrome-plated finish Split-plate, stamped steel with exposed hinge, with polished, chrome-plated finish.
- B. Escutcheons for Existing Piping to Remain:
 - 1. Chrome-Plated Piping: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 - 2. Insulated Piping: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished chrome-plated finish.
 - 5. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed exposed hinge, with polished chrome-plated finish.
 - 6. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
 - 7. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed exposed hinge, with polished, chrome-plated finish.
- C. Floor Plates: Split-plate, stamped steel with concealed hinge.

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END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

1.1 PRODUCTS

- A. Liquid-In-Glass Thermometers:
 - 1. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Case: Cast aluminum; 9-inch size unless otherwise indicated.
 - b. Case Form: Adjustable angle unless otherwise indicated.
 - c. Tube: Glass with magnifying lens and blue or red organic liquid.
 - d. Tube Background: Nonreflective aluminum with etched scale in deg F and deg C.
 - e. Window: Glass or plastic.
 - f. Stem: Aluminum.
- B. Thermowells:
 - 1. Material for Use with Copper Tubing: CNR or CUNI.
 - 2. Material for Use with Steel Piping: CRES CSA.
 - 3. Type: Stepped shank unless straight or tapered shank is indicated.
 - 4. Heat-Transfer Medium: Mixture of graphite and glycerin.
- C. Pressure Gages:
 - 1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - a. Case: Liquid-filled type(s); cast aluminum or drawn steel; 6-inch diameter.
 - b. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - c. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - d. Dial: Nonreflective aluminum with etched scale in psi and kPa.
 - e. Window: Glass.
 - f. Ring: Metal Brass Stainless steel.
 - g. Accuracy: Grade A, plus or minus 1 percent of middle half of Grade B, plus or minus 2 percent of middle half of Grade C, plus or minus 3 percent of middle half of Grade D, plus or minus 5 percent of whole scale range.
- D. Gage Attachments:
 - 1. Snubbers: Brass; with NPS 1/4 or NPS 1/2, and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.
 - 2. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, pipe threads.
- E. Test Plugs: Test-station fitting made for insertion into piping tee fitting.
- F. Test-Plug Kits: Furnish one test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case.
- G. Sight Flow Indicators:
 - 1. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel Insert device indicator.
 - 2. Minimum Pressure Rating: 125 psig .
 - 3. Minimum Temperature Rating: 200 deg F.

END OF SECTION 220519

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SECTION 220523.12 - BALL VALVES FOR PLUMBING PIPING

1.1 LOW-PRESSURE, COMPRESSED-AIR VALVES (150 PSIG OR LESS)

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze ball valves, two-piece with full port and bronze or brass stainless steel trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel ball valves, Class 150 with full port.
 - 2. Iron ball valves, Class 150.

1.2 HIGH-PRESSURE, COMPRESSED-AIR VALVES (150 TO 200 PSIG)

- A. Pipe NPS 2 and Smaller:
 - 1. Brass ball valve.
 - 2. Bronze ball valves, two-piece with full port and bronze or brass stainless steel trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel ball valves, Class 150 with full port.
 - 2. Iron ball valves, Class 150.

1.3 DOMESTIC HOT- AND COLD-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze ball valves, two-piece with full port and bronze or brass stainless steel trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel ball valves, Class 150 with full port.
 - 2. Iron ball valves, Class 150.
- C. CPVC Pipe NPS 2 NPS 4 and Smaller: Union-ball Non-union ball valve.
- D. PVC Pipe NPS 2 NPS 4 and Smaller: Union-ball Non-union ball valve.

END OF SECTION 220523.12

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SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 .

1.2 PERFORMANCE REQUIREMENTS

- A. Pipe hangers and equipment supports designed by Contractor.
- B. Seismic-restraint hangers and supports designed by Contractor and approval obtained from authorities having jurisdiction.

1.3 SUBMITTALS

- A. Shop Drawings: Signed and sealed by a professional engineer.

1.4 QUALITY ASSURANCE

- A. AWS D1.1/D1.1M.
- B. 2015 ASME Boiler and Pressure Vessel Code, Section IX.

1.5 COMPONENTS

- A. Metal Pipe Hangers and Supports: Carbon steel stainless steel and copper.
- B. Trapeze pipe hangers.
- C. Fiberglass pipe hangers.
- D. Metal Framing Systems: MFMA manufacturer Non-MFMA manufacturer.
- E. Fiberglass strut systems.
- F. Thermal hanger-shield inserts.
- G. Fastener Systems: Powder-actuated fasteners and mechanical-expansion anchors.
- H. Pipe Stands: Compact Low type, single pipe High type, single pipe High type, multiple pipes Curb-mounted type.
- I. Pipe-positioning systems.
- J. Equipment supports.

END OF SECTION 220529

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SECTION 220533 - HEAT TRACING FOR PLUMBING PIPING

1.1 WARRANTY

- A. Materials and Workmanship: Five years.

1.2 PRODUCTS

- A. Heating-cable types apply to the following applications:
 - 1. Snow and Ice Melting on Roofs and in Gutters and Downspouts: Plastic-insulated, series-resistance Self-regulating, parallel-resistance Constant-wattage heating cables.
 - 2. Temperature Maintenance for Domestic Hot Water: Self-regulating, parallel-resistance heating cables.
- B. Plastic-Insulated, Series-Resistance Heating Cables:
 - 1. Heating Element: Single- or dual-stranded resistor wire with waterproof, nonheating leads with connectors at both ends.
 - 2. Electrical Insulating Jacket: Minimum 4.0-mil Kapton with silicone or Tefzel.
 - 3. Cable Cover: Aluminum braid and silicone or Hylar outer jacket.
- C. Self-Regulating, Parallel-Resistance Heating Cables:
 - 1. Heating Element: Pair of parallel, tinned nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core.
 - 2. Electrical Insulating Jacket: Flame-retardant polyolefin.
 - 3. Cable Cover: Tinned-copper or stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- D. Constant-Wattage Heating Cables:
 - 1. Heating Element: Pair of parallel, tinned nickel-coated, stranded copper bus wires with single-stranded resistor wire connected between bus wires.
 - 2. Electrical Insulating Jacket: Flame-retardant fluoropolymer.
 - 3. Cable Cover: Tinned-copper or stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- E. Controls:
 - 1. Pipe-Mounted Thermostat for Freeze Protection: Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - 2. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters: Microprocessor-based Automatic control with manual on, automatic, and standby/reset switch.
 - 3. Programmable Timers for Domestic Hot-Water-Temperature Maintenance: Microprocessor based with on-off-auto switch.
- F. Accessories:
 - 1. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips.
 - 2. Warning Tape: Continuously printed "Electrical Tracing."

END OF SECTION 220533

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SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1.1 PRODUCTS

- A. Equipment Labels: Metal.
- B. Warning Signs and Labels: 1/16 inch thick with fasteners.
- C. Pipe Labels: Pretensioned.
- D. Stencils: Aluminum.
- E. Valve Tags: aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness.
- F. Warning Tags: 3 by 5-1/4 inches minimum; brass grommet and wire reinforced grommet and wire or string fasteners.

END OF SECTION 220553

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SECTION 220716 - PLUMBING EQUIPMENT INSULATION

1.1 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors 75, and smoke-developed index of 150 for insulation installed outdoors, according to ASTM E 84.
- B. Mockup of each type of equipment insulation and finish.

1.2 FIELD QUALITY CONTROL

- A. Field Inspections: By Owner-engaged agency.

1.3 INDOOR EQUIPMENT INSULATION SCHEDULE

- A. Heat-Exchanger (Water-to-Water for Domestic Water-Heating Service) Insulation: mineral-fiber blanket mineral-fiber board mineral-fiber pipe and tank or mineral-fiber preformed pipe insulation, Type I.
- B. Steam-to-Hot-Water Converter Insulation: mineral-fiber blanket mineral-fiber board mineral-fiber pipe and tank or mineral-fiber preformed pipe insulation, Type I.
- C. Domestic Water Pump Insulation: mineral-fiber blanket or mineral-fiber board.
- D. Domestic Hot-Water Pump Insulation: mineral-fiber blanket or mineral-fiber board.
- E. Domestic Hot-Water Storage Tank Insulation: mineral-fiber blanket mineral-fiber board or mineral-fiber pipe and tank.
- F. Domestic Water Storage Tank Insulation: mineral-fiber blanket mineral-fiber board mineral-fiber pipe and tank.
- G. Piping System Filter-Housing Insulation: mineral-fiber blanket mineral-fiber board or mineral-fiber pipe and tank.

1.4 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Equipment, Concealed: NONE.
- B. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches: Painted aluminum.
- C. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches: Painted aluminum.

1.5 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Equipment, Concealed: Painted aluminum.
- B. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces of up to 72 Inches: Painted aluminum.
- C. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches: Painted aluminum.

END OF SECTION 220716

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SECTION 220719 - PLUMBING PIPING INSULATION

1.1 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors 75, and smoke-developed index of 150 for insulation installed outdoors, according to ASTM E 84.
- B. Mockup of each type of pipe insulation and finish.

1.2 FIELD QUALITY CONTROL

- A. Field Inspections: By Owner-engaged agency.

1.3 PIPING INSULATION SCHEDULE, GENERAL

- A. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

1.4 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water: mineral-fiber, preformed pipe insulation, Type I.
- B. Domestic Hot and Recirculated Hot Water: mineral-fiber, preformed pipe insulation, Type I.
- C. Stormwater and Overflow: mineral-fiber, preformed pipe insulation, Type I.
- D. Roof Drain and Overflow Drain Bodies: mineral-fiber, preformed pipe insulation, Type I.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities: mineral-fiber, preformed pipe insulation, Type I.
- F. Sanitary Waste Piping Where Heat Tracing Is Installed: mineral-fiber, preformed pipe insulation, Type I.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water Below 60 Deg F: mineral-fiber, preformed pipe insulation, Type I.

1.5 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Domestic Water Piping: mineral-fiber, preformed pipe insulation, Type I.
- B. Domestic Hot and Recirculated Hot Water: mineral-fiber, preformed pipe insulation, Type I.
- C. Sanitary Waste Piping Where Heat Tracing Is Installed: mineral-fiber, preformed pipe insulation, Type I.

1.6 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Insulation, for belowground piping, is specified in Division 33 piping distribution Sections.
- B. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass.

1.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Piping, Concealed: NONE.
- B. Piping, Exposed: PVC .

1.8 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Piping, Concealed: Painted aluminum .
- B. Piping, Exposed: Painted aluminum.

1.9 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

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SECTION 220800 - COMMISSIONING OF PLUMBING

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 Cx process requirements for the following plumbing systems, assemblies, and equipment:
 - 1. Domestic hot- and cold-water piping.
 - 2. Sanitary waste and vent piping.
 - 3. Storm drainage piping.
 - 4. Rainwater retention piping and equipment.
 - 5. Plumbing pumps.
 - 6. General-service compressed air piping and equipment.
 - 7. Plumbing equipment.
 - 8. Compressed-air piping and equipment for laboratory and healthcare facilities.
 - 9. Vacuum piping and equipment for laboratory and healthcare facilities.
 - 10. Chemical waste systems for laboratory and healthcare facilities.
 - 11. Processed water systems for laboratory and healthcare facilities.
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.
 - 2. For construction checklists, comply with requirements in various Division 22 Sections specifying plumbing systems, system components, equipment, and products.

1.3 DEFINITIONS

- A. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- B. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- C. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For plumbing testing technician.
- B. Construction Checklists: Draft construction checklists will be created by CxA for Contractor review.
- C. Construction Checklists: Material, installation, and performance test checklists for systems, assemblies, subsystems, equipment, and components to be part of the Cx process and according to requirements in Section 019113 "General Commissioning Requirements."
 - 1. Facility water distribution piping, including the following:
 - a. Domestic water piping, fittings, and specialties outside the building.
 - b. Pumps, motors, accessories, and controls.
 - c. Outdoor water-storage tanks.
 - d. Sleeves and sleeve seals.
 - e. Meters and gages.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Heat tracing.
 - i. Vibration isolation and seismic restraints.
 - 2. Domestic water piping, including the following:
 - a. Domestic cold- and hot-water piping, fittings, and specialties inside the building.
 - b. Pumps, motors, accessories, and controls.

- c. Sleeves and sleeve seals.
 - d. Indoor water-storage tanks.
 - e. Meters and gages.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Heat tracing.
 - i. Vibration isolation and seismic restraints.
3. Sanitary waste and vent piping, including the following:
- a. Gravity and forced-main sewerage piping, fittings, and specialties.
 - b. Sanitary waste interceptors.
 - c. Pumps, motors, accessories, and controls.
 - d. Drains.
 - e. Sleeves and sleeve seals.
 - f. Meters and gages.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Heat tracing.
 - j. Vibration isolation and seismic restraints.
4. Storm-water piping, including the following:
- a. Drainage piping, fittings, and specialties.
 - b. Pumps, motors, accessories, and controls.
 - c. Drains and collection basins.
 - d. Rainwater collection and storage equipment.
 - e. Sleeves and sleeve seals.
 - f. Meters and gages.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Heat tracing.
 - j. Vibration isolation and seismic restraints.
5. Plumbing fixtures, including the following:
- a. Water closets, supports and connections, supplies, and flush valves.
 - b. Urinals, supports and connections, supplies, and flush valves.
 - c. Lavatories, supports, supplies, drain connections, and faucets.
 - d. Sinks, supports, supplies, drain connections, and faucets.
 - e. Tubs, drain connections, and faucets.
 - f. Showers, supplies, drain connections, and faucets.
 - g. Wash fountains, supplies, drain connections, and faucets.
 - h. Emergency plumbing fixtures, supplies, drain connections, and controls.
 - i. Drinking fountains, supplies, and drainage connections.
6. General-service compressed-air piping, including the following:
- a. Piping, fittings, and specialties inside the building.
 - b. Compressors, motors, accessories, and controls.
 - c. Compressed-air outlets and connections.
 - d. Sleeves and sleeve seals.
 - e. Meters and gages.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Vibration isolation and seismic restraints.
7. Compressed-air piping for laboratory and healthcare facilities, including the following:
- a. Piping, fittings, and specialties inside the building.
 - b. Compressors, motors, accessories, and controls.
 - c. Medical gas alarms.
 - d. Compressed-air outlets and connections.
 - e. Sleeves and sleeve seals.
 - f. Meters and gages.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Vibration isolation and seismic restraints.
8. Vacuum piping for laboratory and healthcare facilities, including the following:

- a. Piping, fittings, and specialties inside the building.
 - b. Vacuum pumps, motors, accessories, and controls.
 - c. Medical gas alarms.
 - d. Vacuum terminal units and connections.
 - e. Sleeves and sleeve seals.
 - f. Meters and gages.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Vibration isolation and seismic restraints.
9. Gas piping for laboratory and healthcare facilities, including the following:
- a. Compressed air, vacuum piping, fittings, and specialties inside the building.
 - b. Storage tanks, manifolds, mounting devices, and accessories.
 - c. Medical gas alarms.
 - d. Medical gas terminal units and connections.
 - e. Sleeves and sleeve seals.
 - f. Meters and gages.
 - g. General-duty and specialty valves.
 - h. Hangers and supports.
 - i. Vibration isolation and seismic restraints.
10. Processed water piping for laboratory and healthcare facilities, including the following:
- a. Water piping, fittings, and specialties inside the building.
 - b. Water purification equipment, accessories, and controls.
 - c. Pumps, motors, accessories, and controls.
 - d. Sleeves and sleeve seals.
 - e. Meters and gages.
 - f. General-duty and specialty valves.
 - g. Hangers and supports.
 - h. Heat tracing.
 - i. Vibration isolation and seismic restraints.
- D. Test equipment and instrumentation list, identifying the following:
1. Equipment/instrument identification number.
 2. Planned Cx application or use.
 3. Manufacturer, make, model, and serial number.
 4. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 5. Equipment manufacturers' proprietary instrumentation and tools. For each instrument or tool, identify the following:
 - a. Instrument or tool identification number.
 - b. Equipment schedule designation of equipment for which the instrument or tool is required.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.

1.5 QUALITY ASSURANCE

- A. Plumbing Testing Technician Qualifications: Technicians to perform plumbing construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level with knowledge of plumbing system, electrical concepts, and building operations.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Medical Gas Piping Systems Testing Technician Qualifications: Technicians to perform medical compressed-air, vacuum, and medical gas piping for laboratory and healthcare facilities system construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:

1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in mechanical systems, plumbing systems, or similar field. Degree may be offset by three years' experience in servicing plumbing systems in the gas piping for laboratory and healthcare facilities plumbing systems industry. Generally, required knowledge includes gas piping for laboratory and healthcare facilities systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of plumbing system equipment, assemblies, and systems.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- C. Testing Equipment and Instrumentation Quality and Calibration:
1. Capable of testing and measuring performance within the specified acceptance criteria.
 2. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 3. Be maintained in good repair and operating condition throughout duration of use on Project.
 4. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- D. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, shall comply with the following:
 - a. Be calibrated by manufacturer with current calibration tags permanently affixed.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Plumbing system proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for plumbing systems, assemblies, subsystems, equipment, and components.
1. Domestic hot- and cold-water piping.
 2. Sanitary waste and vent piping.
 3. Storm drainage piping.
 4. Rainwater retention piping and equipment.
 5. Plumbing pumps.
 6. General-service compressed air piping and equipment.
 7. Plumbing equipment, including the following:
 - a. Water softeners.
 - b. Water storage tanks.
 - c. Water filtration equipment.
 - d. Domestic water heating equipment.
 - e. Plumbing fixtures.
 - f. Water coolers.
 8. Compressed-air piping and equipment for laboratory and healthcare facilities.
 9. Vacuum piping and equipment for laboratory and healthcare facilities.
 10. Chemical waste systems for laboratory and healthcare facilities.
 11. Processed water systems for laboratory and healthcare facilities.

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft construction checklist review comments within 10 days of receipt.

- C. When review comments have been resolved, the CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 Cx TESTING PREPARATION

- A. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved submittals.
- B. Certify that plumbing systems instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

3.4 Cx TEST CONDITIONS

- A. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- B. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to Architect. After deficiencies are resolved, reschedule tests.
- C. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.5 Cx TESTS COMMON TO PLUMBING

- A. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions, to verify compliance with acceptance criteria.
- B. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, responses to abnormal or emergency conditions, and response according to acceptance criteria.
- C. Coordinate schedule with, and perform Cx activities at the direction of, CxA.
- D. Comply with construction checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Division 22 Sections specifying plumbing systems and equipment.
- E. Provide technicians, instrumentation, tools, and equipment to perform and document the following:
 - 1. Construction checklist verification tests.
 - 2. Construction checklist verification test demonstrations.
 - 3. Cx tests.
 - 4. Cx test demonstrations.
- F. Vibration Isolation in Plumbing Systems:
 - 1. Prerequisites: Acceptance of results of construction checklists for vibration and seismic control devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."
 - 2. Components to Be Tested:
 - a. Vibration isolation and seismic control devices in plumbing systems.
 - b. Structural systems.
 - 3. Test Purpose: Evaluate effectiveness of vibration isolation and seismic control devices.

4. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness while the isolated equipment operates.
 5. Test Conditions: Measure vibration of the facility structure at three locations designated by Owner's witness at the following operating conditions:
 - a. Maximum speed.
 - b. Minimum speed.
 - c. Critical speed.
 6. Acceptance Criteria: Structure-borne vibration not to exceed specified performance.
- G. Supervision of Alarms in Plumbing Systems:
1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the Sections listed below:
 - a. Section 221113 "Facility Water Distribution Piping."
 - b. Section 221216 "Facility Elevated, Potable-Water Storage Tanks."
 - c. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities."
 - d. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities."
 - e. Section 226400 "Medical Gas Alarms."
 2. Scope:
 - a. Supervised or Monitored plumbing system alarms.
 3. Purpose:
 - a. Verify reporting of supervised or monitored plumbing alarm at building management system.
 4. Conditions of the Test:
 - a. Alarm monitoring systems operating in normal, automatic mode.
 - b. Activate supervised or monitored plumbing alarms, one at a time.
 5. Acceptance Criteria:
 - a. Activation of supervised or monitored plumbing alarm generates alarm at building management system control panel.
- H. Plumbing Meter Reporting:
1. Prerequisites: Acceptance of results of construction checklists for plumbing systems specified in the Sections listed below:
 - a. Section 221113 "Facility Water Distribution Piping."
 - b. Section 221119 "Domestic Water Piping Specialties."
 - c. Section 223100 "Domestic Water Softeners."
 2. Scope:
 - a. Supervised or Monitored plumbing system water meters.
 3. Purpose:
 - a. Verify accuracy of reporting of supervised or monitored plumbing system water meters at building management system.
 4. Conditions of the Test:
 - a. Plumbing system water meter recording systems operating in normal, automatic mode.
 - b. Compare cumulative consumption data at plumbing system water meter recording systems with independent, calibrated flow-measuring instrumentation under the following conditions:
 - 1) Low Flow: 1 percent of maximum design flow rate for a period of four hours.
 - 2) High Flow: 80 percent of maximum design flow rate for a period of 20 minutes.
 - c. Activate supervised or monitored plumbing alarms, one at a time.
 5. Acceptance Criteria:
 - a. Cumulative flow reported for low-flow condition is within 5 percent flow recorded by calibrated flow-measuring instrumentation.
 - b. Cumulative flow reported for high-flow condition is within 1 percent flow recorded by calibrated flow-measuring instrumentation.
- I. Heat Tracing in Plumbing Systems:
1. Prerequisites: Acceptance of results of construction checklists for heat tracing specified in heat-tracing systems. Comply with requirements listed in Section 220533 "Heat Tracing for Plumbing Piping."
 2. Equipment and Systems to Be Tested:
 - a. Self-regulating, parallel-resistance heating cables.
 - b. Heater trace circuit controller.
 3. Test Purpose:

- a. Evaluate response to ambient temperature below freeze-protection set point.
- b. Evaluate heating cable fault alarm.
4. Test Conditions:
 - a. Subject temperature sensor to temperature approximately 3 deg F above freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is energized.
 - b. Subject temperature sensor to temperature approximately 3 deg F below freeze-protection set point (initial set point 41 deg F). Monitor sensed temperature with a calibration-grade thermometer. Gradually change set point or sensed temperature until freeze-protection circuit is de-energized.
 - c. Simulate an electrical fault on the heating cable.
5. Acceptance Criteria:
 - a. Freeze-protection circuit is energized at set-point temperature minus 2 deg F.
 - b. Freeze-protection circuit is de-energized at set-point temperature plus 2 deg F.
 - c. Heater trace circuit controller initiates an alarm of cable fault. Alarm is correctly reported at the fire-alarm control panel.

3.6 Cx TESTS FOR COMPRESSED AIR SYSTEMS

- A. Air Compressor Run Time:
 1. Prerequisites:
 - a. Acceptance of results of construction checklists specified in the following:
 - 1) Section 221519 "General-Service Packaged Air Compressors and Receivers."
 - 2) Section 226119 "Compressed-Air Equipment for Laboratory and Healthcare Facilities."
 2. Scope:
 - a. Air compressors in plumbing systems.
 - b. Associated compressed air piping, valves, and appurtenances.
 - c. Associated air pressure controllers.
 3. Purpose: Evaluate air compressor run time and number of compressor starts.
 4. Conditions of the Test:
 - a. Keep compressed air openings closed during test.
 - b. For systems with multiple compressors, lock out compressor motors on all but one compressor. Repeat test for each compressor in turn.
 - c. Record number of air compressor motor starts during a 14-day period.
 - d. Record air compressor motor run time during the same 14-day period.
 5. Acceptance Criteria:
 - a. Number of compressor motor starts during test period shall not exceed 20.
 - b. Compressor motor run time during test period shall not exceed 60 minutes.

3.7 Cx TESTS FOR VACUUM SYSTEMS

- A. Vacuum Pump Run Time:
 1. Prerequisites:
 - a. Acceptance of results of construction checklists for vacuum equipment for laboratory and healthcare facilities.
 2. Scope:
 - a. Vacuum pumps in plumbing systems.
 - b. Associated vacuum piping, valves, and appurtenances.
 - c. Associated vacuum pressure controllers.
 3. Purpose:
 - a. Evaluate vacuum pump run time and number of vacuum pump starts.
 4. Conditions of the Test:
 - a. Keep vacuum piping openings closed during test.
 - b. For systems with multiple vacuum pumps, lock out vacuum pump motors on all but one pump. Repeat test for each vacuum pump in turn.
 - c. Record number of vacuum pump motor starts during a 14-day period.
 - d. Record vacuum pump motor run time during the same 14-day period.
 5. Acceptance Criteria:

- a. Number of vacuum pump motor starts during test period shall not exceed 20.
- b. Vacuum pump motor run time during test period shall not exceed 60 minutes.

3.8 Cx TESTS FOR PROCESSED WATER SYSTEMS

- A. Air Compressor Run Time:
 1. Prerequisites: Acceptance of results of construction checklists specified for processed-water systems. Comply with requirements in Section 226700 "Processed Water Systems for Laboratory and Healthcare Facilities."
 2. Scope:
 - a. Processed water equipment in plumbing systems.
 - b. Associated processed water piping, valves, and appurtenances.
 - c. Processed water point-of-use fixtures.
 3. Purpose: Evaluate processed water quality at points-of-use.
 4. Conditions of the Test:
 - a. Operate water processing equipment and circulation pumps in normal automatic mode for seven days prior to the test.
 - b. Collect process water samples from points-of-use.
 - c. Collect and handle water samples according to analytical laboratory recommendations.
 - d. Document that the following parameters meet minimum standards required for the specified grade of process water, as applicable:
 - 1) Resistivity.
 - 2) pH.
 - 3) Total organic carbon (TOC).
 - 4) Sodium.
 - 5) Chloride.
 - 6) Total silica.
 - 7) Microbial.
 - 8) Endotoxin.
 - 9) Bacteria.
 5. Acceptance Criteria:
 - a. Measured process water parameters shall meet the following criteria:
 - 1) Resistivity: 10 megohms.
 - 2) pH: 6 units.
 - 3) TOC: 500 ppb.
 - 4) Sodium: 5 ug/L.
 - 5) Chloride: 5 ug/L.
 - 6) Total Silica: 3 ug/L.
 - 7) Microbial: 10 CFU/mL.
 - 8) Endotoxin: 0.01 EU/mL.
 - 9) Bacteria: 10 CFU/100 mL.

END OF SECTION 220800

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

1.1 SUMMARY

- A. Water service Fire-service mains Combined water service and fire-service mains outside the building.

1.2 SUBMITTALS

- A. Coordination Drawings.

1.3 QUALITY ASSURANCE

- A. Quality Standard for Electrical Components, Devices, and Accessories: NFPA 70.
- B. Quality Standard for Materials, Installations, Tests, Flushing, and Valve and Hydrant Supervision for Fire-Service-Main Piping: NFPA 24.
- C. Quality Standard for Plastic Potable-Water-Service Piping: NSF 14. Include marking "NSF-pw" on piping.
- D. Quality Standard for Water-Service Piping and Specialties for Domestic Water: NSF 61 Annex G.
- E. Quality Standard for Fire-Service-Main Products: FMG's "Approval Guide." UL's "Fire Protection Equipment Directory."

1.4 MATERIALS

- A. Underground Combined Water-Service and Fire-Service-Main Piping:
 - 1. Ductile-iron, mechanical-joint pipe and fittings.
 - 2. Ductile-iron, grooved-end pipe and ductile-iron-pipe appurtenances.
 - 3. PVC, AWWA Class 200 pipe listed for fire-protection service.
 - 4. Fiberglass, AWWA, FMG-approved RTRP, Class 200 and RTRF.
- B. Special Pipe Fittings: Ductile-iron rigid expansion joints flexible expansion joints deflection fittings.
- C. Piping Specialties:
 - 1. Transition fittings.
 - 2. Tubular-sleeve pipe couplings.
 - 3. Split-sleeve pipe couplings.
 - 4. Flexible connectors.
 - 5. Dielectric fittings.
- D. Corrosion-Protection Piping Encasement: Required.

1.5 MANUFACTURED UNITS

- A. Gate Valves:
 - 1. Cast Iron: OS&Y, rising stem, C509, 200 psig.
 - 2. UL/FMG, Cast Iron: OS&Y, rising stem.
 - 3. Bronze: UL/FMG, OS&Y, rising stem.
- B. Check Valves: AWWA UL/FMG, 250 psig.
- C. Butterfly Valves: AWWA UL/FMG.
- D. Water Meters: Disc Turbine Compound Detector type with remote registration.
- E. Pressure-Reducing Valves: Water regulators control valves.
- F. Relief Valves: Air-release Air/vacuum Combination air valves.
- G. Backflow Preventers:
 - 1. Reduced-pressure-principle backflow preventers.
 - 2. Double-check, backflow-prevention assemblies.
 - 3. Reduced-pressure-detector, fire-protection backflow preventer assemblies.
 - 4. Double-check, detector-assembly backflow preventers.
 - 5. Backflow preventer test kits.

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

END OF SECTION 221113

SECTION 221116 - DOMESTIC WATER PIPING

1.1 UNDER-BUILDING SLAB, COMBINED DOMESTIC WATER, BUILDING-SERVICE, AND FIRE-SERVICE-MAIN PIPING

- A. Pipe NPS 6 to NPS 12:
 - 1. Mechanical-joint, ductile-iron pipe; standard- or compact-pattern, mechanical-joint fittings; and mechanical joints.
 - 2. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

1.2 UNDER-BUILDING-SLAB, DOMESTIC WATER PIPING

- A. Pipe NPS 2 and Smaller:
 - 1. Hard or soft copper tube; wrought-copper, solder-joint fittings joints.

1.3 ABOVEGROUND DOMESTIC WATER PIPING

- A. Pipe NPS 2 and Smaller:
 - 1. Hard copper tube; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- B. Pipe NPS 2-1/2 to NPS 4:
 - 1. Hard copper tube; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube; grooved-joint, copper-tube appurtenances; and grooved joints.
- C. Pipe NPS 5 to NPS 8:
 - 1. Hard copper tube; cast- or wrought-copper, solder-joint fittings; and soldered joints.
 - 2. Hard copper tube; grooved-joint, copper-tube appurtenances; and grooved joints.

1.4 ABOVEGROUND, COMBINED DOMESTIC-WATER-SERVICE AND FIRE-SERVICE-MAIN PIPING

- A. Pipe NPS 6 to NPS 12:
 - 1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.

1.5 MANUFACTURED UNITS

- A. Hot-Water Circulation Piping, Balancing Duty: Calibrated Memory-stop balancing valves.
- B. Flexible Connectors: Bronze, Stainless-steel hose.

1.6 PRODUCTS

- A. Wall Penetrations below Grade: Sleeve and sleeve seal Wall penetration system.

END OF SECTION 221116

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SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

1.1 QUALITY ASSURANCE

- A. Quality Standards: NSF 14, NSF 61, and NSF 372.

1.2 PRODUCTS

- A. Vacuum Breakers:
1. Pipe-Applied, Atmospheric-Type Vacuum Breakers: Rough-bronze Chrome-plated finish.
 2. Hose-Connection Vacuum Breakers: Chrome- or nickel-plated Rough-bronze finish.
 3. Pressure vacuum breakers.
 4. Laboratory-faucet vacuum breakers.
 5. Spill-resistant vacuum breakers.
- B. Backflow Preventers:
1. Reduced-Pressure-Principle Backflow Preventers:
 - a. Body: Bronze for NPS 2 and smaller; cast iron with interior lining steel with interior lining stainless steel for NPS 2-1/2 and larger.
 - b. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - c. Configuration: Horizontal, straight through Vertical inlet, horizontal center section, and vertical outlet Vertical.
 2. Double-Check Backflow-Prevention Assemblies:
 - a. Body: Bronze for NPS 2 and smaller; cast iron with interior lining steel with interior lining stainless steel for NPS 2-1/2 and larger.
 - b. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 - c. Configuration: Horizontal, straight through.
 3. Beverage-dispensing-equipment backflow preventers.
 4. Dual-check-valve backflow preventers.
 5. Hose-connection backflow preventers.
 6. Backflow-preventer test kits.
- C. Water Pressure-Reducing Valves:
1. Water Regulators:
 - a. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior for NPS 2-1/2 and NPS 3.
 - b. Valves for Booster Heater Water Supply: Include integral bypass.
 - c. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.
 2. Water Control Valves:
 - a. Main Valve Body: Angle Globe-valve design.
 - b. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- D. Automatic Water Shutoff Valves:
1. Shutoff Control Ball Valve:
 - a. Size: NPS 2 and smaller.
 - b. Control Valve: Two-piece, full-port brass ball valve, MSS SP-110.
 - c. End Connections: Threaded, female.
 - d. CWP Rating: 600 psig.
 2. Shutoff Control Butterfly Valve:
 - a. Size: NPS 2-1/2 to NPS 4.
 - b. Compliance: MSS SP-67.
 - c. Full-port, epoxy-coated, ductile-iron lug body.
 - d. Face-to-Face Flange: API 609.
 3. Clothes Washer Shutoff Control Valve: Two-way, four-port, low-zinc bronze alloy valve.
 - a. End Connections: Male hose connections, NPS 3/4.
 - b. Pressure Rating: ANSI 250, 400 psi at 32 to 150 deg F
 - c. Actuator: Two position, drive closed, spring open.
 4. Water Main Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or closed/closed.

5. Domestic Water Heater Shutoff Valve Actuator: Motor operated, with or without gears, electric and electronic. Capable of closing valve against inlet pressure. Direct mount, two way; fails open/open or close/close.
 6. Wireless Leak Detection Receiver System:
 - a. Onboard Battery Backup: 48 hours of protection. Valve to close prior to backup failure.
 - b. LED Indicators: Wireless signal strength, communication loss, water fault, low temperature fault, and low battery.
 - c. Output Contacts: Interface with home security or building automation system, cellular text notification service, or auto dialer accessories.
 - d. Power Supply: 120 V ac 9-V dc battery.
 7. Wired Leak Detection System:
 - a. Power Supply: Class II transformer with cord and plug, 120 V ac, UL listed.
 - b. Control Panel: LED power and LED valves indicator.
 - c. Alarms: Audible alarm, with external output.
 - d. Wired Sensors: Local water sensors.
- E. Balancing Valves:
1. Copper-Alloy Calibrated Balancing Valves: Ball Y-pattern globe valve.
 2. Cast-iron calibrated balancing valves.
 3. Accessories: Meter kit.
 4. Memory-stop balancing valves.
- F. Temperature-Actuated Water Mixing Valves:
1. Water-Temperature Limiting Devices:
 - a. Connections: Threaded union inlets and outlet.
 - b. Finish: Chrome plated Rough bronze.
 2. Primary, Thermostatic, Water Mixing Valves:
 - a. Type: Exposed mounted Cabinet type.
 - b. Connections: Threaded[union] inlets and outlet.
 - c. Finish: Chrome plated Polished, chrome plated Rough bronze.
 - d. Piping: Chrome plated Copper.
 - e. Cabinet: Recessed Surface mounted.
 3. Manifold, Thermostatic, Water-Mixing-Valve Assemblies:
 - a. Description: Cabinet-type Exposed-mounted assembly in two -valve parallel arrangement.
 - b. Cabinet: Recessed Surface mounted.
 - c. Finish: Chrome plated Polished, chrome plated Rough bronze.
 - d. Piping: Chrome plated Copper.
 4. Photographic-process, thermostatic, water-mixing-valve assemblies.
 5. Individual-fixture, water tempering valves.
 6. Primary water tempering valves.
- G. Strainers for Domestic Water Piping:
1. Body: Bronze for NPS 2 and smaller; cast iron with interior lining and epoxy coating for NPS 2-1/2 and larger.
 2. Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
 3. Screen: Stainless steel with round perforations unless otherwise indicated.
 4. Drain: Pipe plug Factory-installed, hose-end drain valve.
- H. Outlet Boxes:
1. Clothes Washer Outlet Boxes:
 - a. Material and Finish: Enameled-steel or epoxy-painted-steel Enameled-steel, epoxy-painted-steel, or plastic Plastic Stainless-steel box and faceplate.
 - b. Inlet Hoses: Two, 60 inches long.
 - c. Drain Hose: One, 48 inches long.
 2. Icemaker Outlet Boxes: Enameled-steel or epoxy-painted-steel Enameled-steel or epoxy-painted-steel or plastic Plastic Stainless-steel box and faceplate.
- I. Hose Bibbs:
1. Vacuum Breaker: Integral or field installation.
 2. Finish for Service Areas: Rough bronze Chrome or nickel plated.

3. Operation for Service Areas: Wheel handle Operating key.
 4. Operation for Finished Rooms: Wheel handle Operating key.
 5. Wall flange with each chrome- or nickel-plated hose bibb.
- J. Wall Hydrants:
1. Nonfreeze Wall Hydrants:
 - a. Outlet: Exposed.
 - b. Finish: Polished nickel bronze Chrome plated.
 2. Nonfreeze, Hot- and Cold-Water Wall Hydrants:
 - a. Outlet: Concealed.
 - b. Finish: Polished nickel bronze Chrome plated.
 3. Moderate-Climate Wall Hydrants:
 - a. Outlet: Concealed Exposed.
 - b. Finish: Polished nickel bronze Chrome plated.
 4. Vacuum Breaker Wall Hydrants: Loose key Loose key or wheel handle Wheel handle.
- K. Drain Valves: Ball-valve Gate-valve Stop-and-waste type.
- L. Water Hammer Arresters: Metal bellows Copper tube with piston.
- M. Air Vents: Bolted Welded construction.
- N. Trap-Seal Primer Valves: Supply Drainage type.

1.3 MANUFACTURED UNITS

- A. Trap-Seal Primer Systems:
1. Cabinet: Recessed- Surface-mounted steel box with stainless-steel cover.
- B. Water Meters: Displacement type Turbine type Compound type with remote registration system.

END OF SECTION 221119

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MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

SECTION 221123 – DOMESTIC WATER PUMPS

PART 1 - GENERAL (Not Applicable in DD)

PART 2 - PRODUCTS (Not Applicable in DD)

PART 3 - EXECUTION (Not Applicable in DD)

END OF SECTION 221123

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SECTION 221123.13 - DOMESTIC-WATER PACKAGED BOOSTER PUMPS

1.1 QUALITY ASSURANCE

- A. Quality Standards for Packaged Booster Pumps: UL 508, UL 508A, UL 778, and UL 1995.
- B. Drinking Water System Components: NSF 61 and NSF 372.
- C. Booster pumps listed and labeled as packaged pumping systems.

1.2 MANUFACTURED UNITS

- A. Multiplex, Variable-Speed Booster Pumps:
 - 1. Pumps:
 - a. Type: End suction as defined in HI 1.1-1.2 and HI 1.3 for end suction, close coupled, single stage, overhung impeller, centrifugal.
 - b. Casing: Radially split; bronze.
 - c. Impeller: Closed, ASTM B584 cast bronze statically and dynamically balanced and keyed to shaft.
 - d. Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve and deflector.
 - e. Seal: Mechanical.
 - f. Orientation: Mounted vertically.
 - 2. Motors: Single speed, with grease-lubricated, ball-bearings.
 - 3. Piping: Stainless-steel pipe and fittings.
 - 4. Control Logic: Solid-state system with transducers, programmable microprocessor, VFC, and other devices in controller. Install VFC for pump motors larger than 25 hp in separate panel; same type as motor control panel enclosure.
 - 5. Motor Controller: NEMA ICS 2, variable-frequency, solid-state type.
 - a. Control Voltage: 208V, with integral control-power transformer.
 - 6. Enclosure: NEMA 250, Type 1.
 - 7. Motor Overload Protection: Overload relay in each phase.
 - 8. Starting Devices: Hand-off-automatic selector switch for each pump in cover of control panel, plus pilot device for automatic control.
 - a. Duplex, Automatic, Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
 - 9. Pump Operation and Sequencing: Pressure-sensing method pressure-sensing method for lead pump and flow-sensing method for lag pumps.
 - a. Time Delay: Controls pump on-off operation; adjustable from 1 to 300 seconds.
 - 10. VFC: Voltage-source, pulse-width, modulating-frequency converter for each pump.
 - 11. Manual Bypass: Magnetic contactor arranged to transfer to constant-speed operation upon VFC failure.
 - 12. Instrumentation: Suction and discharge pressure gauges.
 - 13. Lights: Running light for each pump.
 - 14. Alarm Signal Device: Sounds alarm when backup pumps are operating.
 - a. Time Delay: Controls alarm operation; adjustable from 1 to 300 seconds, with automatic reset.
 - 15. Thermal-bleed cutoff.
 - 16. Low-suction-pressure cutout.
 - 17. High-suction-pressure cutout.
 - 18. Low-discharge-pressure cutout.
 - 19. High-discharge-pressure cutout.
 - 20. Building Automation System Interface: Auxiliary contacts for BACnet building automation system. Include on-off status of each pump and alarm status.
 - 21. Base: Structural steel.

END OF SECTION 221123.13

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SECTION 221316 - SANITARY WASTE AND VENT PIPING

1.1 MATERIALS

- A. Type DWV copper tube with solder-joint drainage fittings.
- B. Hard copper tube with copper pressure fittings.
- C. Solid-wall PVC pipe with PVC socket fittings.
- D. Shielded, nonpressure Pressure transition couplings.
- E. Union, Flange, Flange insulating kit, Nipple dielectric fittings.
- F. PE-film encasement for underground metal piping.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

1.1 QUALITY ASSURANCE

- A. Quality Standard for Plastic Piping: NSF 14.

1.2 PRODUCTS

- A. Backwater Valves: Horizontal, cast iron, Drain outlet, Horizontal, plastic.
- B. Cleanouts: Stainless steel exposed Stainless steel exposed floor Cast iron, wall.
- C. Air-Admittance Valves: Fixture air-admittance valves Wall box for air-admittance valves.
- D. Miscellaneous Sanitary Drainage Piping Specialties:
 - 1. Open drains, shop or field fabricated from Service Class, hub-and-spigot, cast-iron, soil-pipe fittings.
 - 2. Cast-iron or bronze deep-seal traps.
 - 3. Floor-drain, trap-seal primer fittings.
 - 4. Air-gap fittings.
 - 5. Sleeve flashing devices.
 - 6. Stack flashing fittings.
 - 7. Cast-iron body vent caps.
 - 8. Frost-resistant vent terminals.
 - 9. Expansion joints.

END OF SECTION 221319

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SECTION 221413 - FACILITY STORM DRAINAGE PIPING

1.1 MATERIALS

- A. Hub-and-spigot, Service class, cast-iron soil pipe and fittings.
- B. Hubless, cast-iron soil pipe and heavy-duty, cast-iron, hubless piping couplings.
- C. Copper Type DWV tube with solder-joint drainage fittings.
- D. Hard copper tube with copper pressure fittings.
- E. Shielded, nonpressure, Pressure transition couplings.
- F. Union, Flange, Flange insulating kit, Nipple dielectric fittings.
- G. High-density, crosslaminated PE-film, Linear low-density PE film encasement for underground metal piping.

END OF SECTION 221413

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SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

1.1 PRODUCTS

- A. Metal Roof Drains:
 - 1. Cast-Iron Roof Drains:
 - a. Sump: Large, Medium.
 - b. Combination Flashing Ring and Gravel Stop: Required.
 - c. Flow-Control Weirs: Required.
 - d. Outlet: Bottom Side.
 - e. Outlet Type: No hub Inside caulk Threaded.
 - f. Extension Collars: Required.
 - g. Underdeck Clamp: Required.
 - h. Expansion Joint: Required.
 - i. Sump Receiver Plate: Required.
 - j. Dome Material: Aluminum Cast iron.
 - k. Perforated Gravel Guard: Stainless steel.
 - l. Vandal-Proof Dome: Required.
 - m. Water Dam: 2 to 4 inches high.
- B. Miscellaneous Storm Drainage Piping Specialties: Downspout adaptors, Downspout boots, Conductor nozzles.
- C. Cleanouts: Cast-iron floor cleanouts, Test tees, Cast-iron wall cleanouts.
- D. Backwater Valves: Cast iron, horizontal Cast iron; drain outlet.
- E. Trench Drains:
 - 1. Body Material: Cast iron.
 - 2. Flange: Anchor Seepage.
 - 3. Outlet: Bottom or End.
 - 4. Outlet Type: Inside caulk.
 - 5. Grate Material: Ductile iron cast iron or stainless steel.
 - 6. Grate Finish: Painted Not required.
 - 7. Top-Loading Classification: Heavy Medium Duty.

END OF SECTION 221423

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SECTION 221429 - SUMP PUMPS

1.1 PRODUCTS

- A. Submersible, Fixed-Position, Double-Seal Sump Pumps:
 - 1. Pump Casing: Cast iron.
 - 2. Impeller: Cast iron, design.
 - 3. Pump and Motor Shaft: Stainless steel.
 - 4. Seals: Mechanical.
 - 5. Moisture-sensing probe.
 - 6. Motor: Hermetically sealed, capacitor-start type.
 - a. Motor Housing Fluid: Air.
 - 7. Controls: Pedestal-mounted float switch with float rods and rod buttons.
 - 8. Controls: Wall-mounted, mechanical-float type.
 - 9. High-water alarm.
 - 10. Control-Interface Features:
 - a. Remote alarm contacts.
 - b. Building Automation System Interface:
 - 1) On-off status of pump.
 - 2) Alarm status.
- B. Sump-Pump Basins:
 - 1. Material: Fiberglass.
 - 2. Reinforcement: Mounting plates for pumps, fittings, guide-rail supports if used, and accessories.
 - 3. Anchor flange.
- C. Basin Covers:
 - 1. Inlet Type: Flanged Hubbed Threaded outside.
 - 2. Sidewall Outlet Type: Hubbed inside Hubbed outside.
 - 3. Cover Material: Steel with bituminous coating.

END OF SECTION 221429

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SECTION 223400 - FUEL-FIRED, DOMESTIC-WATER HEATERS

1.1 QUALITY ASSURANCE

- A. Performance Efficiency: ASHRAE 189.1 and ASHRAE/IES 90.1 ASHRAE 90.2.
- B. ASME Compliance: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- C. NSF Compliance: NSF 61 and NSF 372.

1.2 WARRANTY

- A. Commercial, Gas-Fired, Domestic-Water Heaters:
 - 1. Storage Tank: 15 years.
 - 2. Controls and Other Components: One year(s).
- B. Expansion Tanks: Five years.

1.3 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS

- A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:
 - 1. Combustion Efficiency: 95 percent.
 - 2. Tank: ASME-code steel.
 - 3. Pressure Rating: 150 psig.
 - 4. Lining: Stainless Steel.
- B. Capacity and Characteristics:
 - 1. Capacity: See Plumbing Drawings.
 - 2. Recovery: temperature rise: See Plumbing Drawings.
 - 3. Temperature Setting: See Plumbing Drawings.

1.4 DOMESTIC-WATER HEATER ACCESSORIES

- A. Domestic-Water Expansion Tanks: Steel tank with welded joints and butyl-rubber diaphragm; 100-psig pressure rating.
- B. Drain Pans: Corrosion-resistant metal with raised edge.
- C. Piping-type heat traps.
- D. Manifold kits.
- E. Gas shutoff valves.
- F. Gas pressure regulators.
- G. Automatic gas valves.
- H. Combination temperature-and-pressure relief valves.
- I. Pressure relief valves.
- J. Vacuum relief valves.
- K. Domestic-water heater stands.
- L. Domestic-water heater mounting brackets.

END OF SECTION 223400

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SECTION 224213.13 - COMMERCIAL WATER CLOSETS

1.1 WALL-MOUNTED WATER CLOSETS

- A. Water Closets : Wall mounted, top spud, back spud , accessible.
 - 1. Material: Vitreous china.
 - 2. Type: Siphon jet.
 - 3. Style: Flushometer valve.
 - 4. Water Consumption: 1.6 gal/1.1 gal. dual flush, 1.28 gal per flush
 - 5. Support: carrier.

1.2 FLUSHOMETER VALVES

- A. Battery-Powered, Solenoid-Actuator, Piston Flushometer Valves :
 - 1. Style: Exposed Concealed.
 - 2. Consumption: 1.28 gal. or 1.6 gal/1.1. per flush.

1.3 TOILET SEATS

- A. Toilet Seats :
 - 1. Type: Commercial (Heavy duty).
 - 2. Shape: Elongated rim, open front.
 - 3. Hinge: Self-sustaining, check.
 - 4. Seat Cover: Not required.

END OF SECTION 224213.13

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SECTION 224213.16 - COMMERCIAL URINALS

1.1 WALL-HUNG URINALS

- A. Urinals : Wall hung, back outlet, siphon jet.
 - 1. Material: Vitreous china.
 - 2. Type: Siphon jet with extended shields.
 - 3. Water Consumption: Low.

1.2 FLUSHOMETER VALVES

- A. Hard-Wired, Solenoid-Actuator, Siphon-jet Flushometer Valves :
 - 1. Style: Exposed Concealed.
 - 2. Consumption: Insert value 0.125 per flush.

END OF SECTION 224213.16

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SECTION 224216.13 - COMMERCIAL LAVATORIES

1.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory:
 - 1. Type: For wall hanging.
 - 2. Nominal Size: See drawing.
 - 3. Faucet-Hole Location: Top.

1.2 MANUALLY OPERATED FAUCETS

- A. Lavatory Faucets : Manual-type, single-control mixing single-control nonmixing two-handle mixing, commercial general-duty, solid-brass valve.
 - 1. Maximum Flow Rate: 0.5 gpm.
 - 2. Valve Handle(s): Wrist blade, min 4 inches.
 - 3. Spout: Rigid Swing Rigid, gooseneck Swivel, gooseneck type.
 - 4. Drain: 1-1/2".

END OF SECTION 224216.13

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SECTION 224216.16 - COMMERCIAL SINKS

1.1 SERVICE SINKS

- A. Service Sinks : Enameled, cast iron, floor mounted.
 - 1. Style: With front apron and raised back.
 - 2. Nominal Size: 24 by 24 inches.
 - 3. Drain: Grid with NPS 3 outlet.
 - 4. Faucet: See Plumbing drawing.

1.2 SINKS

- A. Sinks: See Plumbing drawings

END OF SECTION 224216.16

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SECTION 224223 - COMMERCIAL SHOWERS

1.1 SHOWER FAUCETS

- A. Shower Faucets : Single-handle, pressure-balance mixing valve with hot- and cold-water indicators; check stops; and shower head.
 - 1. Body Material: Polished chrome plate, solid brass.
 - 2. Maximum Flow Rate: See Plumbing Drawings.
 - 3. Mounting: Concealed.
 - 4. Operation: Single-handle, control.
 - 5. Antiscald Device: Integral with mixing valve.
 - 6. Shower Head: Ball joint and head integral with mounting flange.
 - 7. Shower-Arm, Flow-Control Fitting: See Plumbing Drawings.

1.2 SHOWER BASINS

- A. Shower Basins : Precast terrazzo.
 - 1. Type: Standard residential, Handicapped/wheelchair.
 - 2. Nominal Size and Shape: See Plumbing Drawings.

END OF SECTION 224223

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SECTION 224500 - EMERGENCY PLUMBING FIXTURES

1.1 QUALITY ASSURANCE

- A. Quality Standard: ANSI Z358.1, NSF 61, and NSF 372.

1.2 MANUFACTURED UNITS

- A. Emergency Showers: Freestanding, plumbed.
- B. Eye/Face Wash Equipment: Standard, wall mounted, plumbed Accessible, wall mounted, plumbed Sink, fixed position, plumbed.
- C. Water-Tempering Equipment: Hot and cold water.

END OF SECTION 224500

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SECTION 224716 - PRESSURE WATER COOLERS

1.1 PRODUCTS

- A. Pressure Water Coolers With Bottle Filing, Without Bottle Filling,: Recessed.
 - 1. Cabinet: All stainless steel.
 - 2. Bubbler: One, with adjustable stream regulator, located on deck.
 - 3. Control: Push button Push bar.
 - 4. Drain: Grid.
 - 5. Filter.
 - 6. Cooling System: Electric, with precooler, hermetically sealed compressor, and adjustable thermostat.
 - 7. Capacities and Characteristics:
 - a. Cooled Water: 8 gph 12 gph.
 - b. Cooled-Water Storage: .
 - 8. Ventilation Grille: Stainless steel, located above below water cooler.
 - 9. Support: Mounting frame.

END OF SECTION 224716

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SECTION 226113 - COMPRESSED-AIR PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 QUALITY ASSURANCE

- A. Installer's Qualifications:
 - 1. Medical Air Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 and NFPA 99 for medical-gas-system installers.
 - 2. Shape-Memory-Metal Coupling Joints: Manufacturer authorized, trained, and approved in accordance with ASSE Standard #6060 and NFPA 99.

1.2 PRODUCTS

- A. System Description:
 - 1. Instrument air operating at 175 psig.
 - 2. Medical laboratory air operating at 100 psig.
 - 3. Laboratory air operating at 50 psig 100 psig 125 psig.
- B. Piping:
 - 1. Copper Medical Gas Tube: Type L, seamless, drawn temper.
 - 2. Wrought-copper fittings.
 - 3. Copper unions.
 - 4. Cast-copper-alloy flanges.
 - 5. Shape-memory-metal couplings.
- C. Pressure-seal fittings.
- D. Flexible pipe connectors.
- E. Valves:
 - 1. Zone-Valve Boxes: Steel with stainless steel cover.
 - 2. Ball Valves: Three-piece body, brass or bronze.
 - 3. Check Valves: In-line pattern, bronze.
 - 4. Emergency oxygen connections.
 - 5. Safety Valves: Bronze body, ASME construction.
 - 6. Pressure Regulators: Bronze body and trim.
- F. Compressed-Air Service Connections:
 - 1. Quick-coupler pressure service connections.
 - 2. D.I.S.S. pressure service connections.
 - 3. Cover Plates: One piece, stainless steel.
- G. Compressed-air pressure control panels.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 226113

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SECTION 226119 - COMPRESSED-AIR EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design compressed-air equipment mounting.
- B. Seismic Performance: Compressed-air equipment shall withstand the effects of earthquake motions.

1.3 MANUFACTURED UNITS

- A. Quality Standards:
 - 1. Medical Compressed-Air Equipment and Accessories: NFPA 99.
 - 2. Receiver Tanks: ASME Boiler and Pressure Vessel Code.
- B. Control Panels: Automatic control station with load control and protection functions.
 - 1. Automatic control switches to alternate lead-lag air compressors for duplex and sequence lead-lag air compressors for multiplex air compressors.
- C. Mounting Frame: Resist movement during a seismic event.
- D. Scroll Air Compressors:
 - 1. Compressed-Air Service: Nonmedical laboratory air.
 - 2. Air Compressor(s): Two.
 - 3. Receiver: Vertical steel tank.
- E. Inlet-Air Filters: Combination filter-silencer for each or multiple air compressor(s).
- F. Compressed-Air Dryers: Refrigerant or Desiccant type.
- G. Compressed-Air Purification Systems: Coalescing, particulate, and activated-charcoal filters; compressed-air dryer; catalytic converter; gages and thermometers; and controls.
- H. Compressed-Air Filter Assemblies: Particulate, odor and taste, and coalescing filters.

1.4 INSTALLATION

- A. Vibration Isolation: Equipment installed with spring or restrained-spring isolators.

END OF SECTION 226119

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SECTION 226213 - VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 QUALITY ASSURANCE

- A. Installers Qualifications:
 - 1. Medical Vacuum Piping Systems for Healthcare Facilities: In accordance with ASSE Standard #6010 and NFPA 99.
 - 2. Shape-Memory-Coupling Joint: An authorized representative who is trained and approved by manufacturer in accordance with ASSE Standard #6040 and NFPA 99.
- B. Testing Agency Qualifications: Independent testing agency that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to the authorities having jurisdiction.
 - 1. Qualify testing personnel in accordance with ASSE Standard #6020 and NFPA 99 for medical-gas-system inspectors and AASSE Standard #6030 and NFPA 99 for medical-gas-system verifiers.

1.2 PRODUCTS

- A. System Description:
 - 1. Laboratory vacuum operating at 12 in. Hg 20 in. Hg 24 in. Hg 29 in. Hg.
- B. Piping:
 - 1. Laboratory Vacuum Piping: One of the following for each size range As follows:
 - a. NPS 4 and Smaller: Copper medical gas tube, wrought-copper fittings, and brazed joints.
 - b. NPS 5 to NPS 8: Copper medical gas tube, wrought-copper fittings, and brazed joints.
 - c. All Sizes: Extruded-tee fittings and brazed joints may be used instead of standard tee fittings.
- C. Flexible pipe connectors.
- D. Valves:
 - 1. Zone-Valve Boxes: Steel with stainless steel cover.
 - 2. Ball Valves: Three-piece body, brass or bronze.
 - 3. Check Valves: In-line pattern, bronze.
- E. Vacuum Service Connections:
 - 1. Quick-coupler suction service connections.
 - 2. D.I.S.S. suction service connections.
 - 3. Bottle brackets.
 - 4. Cover Plates: One piece, aluminum or stainless steel.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 226213

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SECTION 226219 - VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Vacuum equipment mounting.
- B. Seismic Performance: Vacuum equipment shall withstand the effects of earthquake motions.

1.3 MANUFACTURED UNITS

- A. Medical Vacuum Equipment and Accessories: NFPA 99.
- B. Medical Vacuum Equipment: UL 544.
- C. Control Panel: Automatic control station with load control and protection functions.
 - 1. Automatic control switches to alternate lead-lag vacuum pumps for duplex and sequence lead-lag vacuum pumps for multiplex vacuum pumps.
- D. Receiver Tanks: ASME Boiler and Pressure Vessel Code.
- E. Mounting Frames: Resist movement during a seismic event when base is anchored to building structure.
- F. Single-Stage, Rotary, Dry-Claw Vacuum Pumps:
 - 1. Vacuum Service: Nonmedical laboratory vacuum.
 - 2. Vacuum Pump(s): Two.
 - 3. Mounting: Freestanding or Tank mounted.
 - 4. Receiver: Vertical steel tank.

1.4 INSTALLATION

- A. Vibration Isolation: Equipment installed with concrete equipment base on elastomeric pads , elastomeric mounts, restrained-spring isolators.

END OF SECTION 226219

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SECTION 226600 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 PRODUCTS

- A. Single-Wall Pipe and Fittings:
 - 1. PP drainage piping.
- B. Double-Containment Pipe and Fittings:
 - 1. PP drainage piping.
- C. Field-fabrication containment piping for new carrier piping.
 - 1. Material: PP pipe and fittings.
- D. Piping Specialties:
 - 1. PP corrosion-resistant traps.
 - 2. PP floor drains.
 - 3. Stainless steel cleanouts.
 - 4. PP sink outlets.
- E. Neutralization Tanks:
 - 1. Tank: Plastic or Ceramic.
 - 2. Dolomitic Limestone.
 - 3. Collection Tanks: Ceramic, Steel with protective coating.
- F. Neutralization Systems:
 - 1. Tanks: Plastic, Ceramic.
 - 2. Dolomitic Limestone.
- G. Manholes: Single, Double-wall PE.
- H. Leak-detection systems.

END OF SECTION 226600

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SECTION 226700 - PROCESSED WATER SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

1.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure Ratings:
 - 1. Reverse-Osmosis-Water Piping: 100 psig unless otherwise indicated.
- B. Seismic Performance: Water piping shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.2 MATERIALS

- A. Reverse-Osmosis-Water Piping:
 - 1. PP pipe and fittings and heat-fusion joints.
 - 2. PVDF pipe and fittings and heat-fusion joints.
- B. Transition fittings.

1.3 VALVES

- A. PP Valves: Ball, butterfly, ball check, swing check and diaphragm.
- B. PVDF Valves: Ball, butterfly, ball check, swing check and diaphragm.

END OF SECTION 226700

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SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

1.1 MATERIALS

- A. Polyphase Motors: Design B, medium induction motors.
 - 1. Efficiency: Premium efficient.
 - 2. Service Factor: 1.15.
 - 3. Multispeed Motors: Variable torque.
 - a. For motors with speed ratio other than 2:1, separate winding for each speed.
 - 4. Rotor: Random-wound, squirrel cage.
 - 5. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
 - 6. Temperature Rise: Match insulation rating.
 - 7. Insulation: Class F Insert class.
 - 8. Code Letter Designation:
 - a. Motors 15 Insert number HP and Larger: NEMA starting Code F or Code G.
 - b. Motors Smaller Than 15 Insert number HP: Manufacturer's standard starting characteristic.
 - 9. Enclosure Material: Cast iron for motor frame sizes 324T Insert number and larger; rolled steel for motor frame sizes smaller than 324T Insert number.
- B. Additional Requirements for Polyphase Motors:
 - 1. Motors used with reduced-voltage and multispeed controllers.
 - 2. Premium-efficient and inverter-duty motors used with variable-frequency controllers.
 - 3. Severe-duty motors.
- C. Single-Phase Motors:
 - 1. Motors Larger Than 1/20 HP: Permanent-split capacitor; split phase; capacitor start, inductor run; or capacitor start, capacitor run to suit starting torque and requirements of specific motor application.
 - 2. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
 - 3. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
 - 4. Motors 1/20 HP and Smaller: Shaded-pole type.
 - 5. Internal thermal protection.

END OF SECTION 230513

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SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

1.1 PRODUCTS

- A. Packless Expansion Joints
 - 1. Metal, Compensator Packless Expansion Joints:
 - a. Configuration for Copper Tubing: Multi-ply, phosphor-bronze bellows with copper pipe ends.
 - 1) End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
 - b. Configuration for Steel Piping: Multi-ply, stainless-steel bellows; steel-pipe ends; and carbon-steel shroud.
 - 1) End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged .
 - 2. Flexible-Hose Packless Expansion Joints:
 - a. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint or threaded end connections.
 - b. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
 - c. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged end connections.
- B. Grooved-Joint Expansion Joints: Factory-assembled; made of several grooved-end pipe nipples, couplings, and grooved joints.
 - 1. Nipples: Galvanized, ASTM A53/A53M, Schedule 40, Type E or S, steel pipe.
 - 2. Couplings: Flexible type. Include ferrous housing sections, EPDM gasket suitable for cold and hot water, and bolts and nuts.
- C. Alignment Guides and Anchors:
 - 1. Alignment Guides: Steel, factory fabricated.
 - 2. Anchor Materials:
 - a. Steel shapes, plates, bolts, nuts, and washers.
 - b. Wedge-type mechanical anchor fasteners.

END OF SECTION 230516

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SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

1.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast iron or ductile iron, with plain ends and integral waterstop collar.
- B. Galvanized-Steel Sheet Pipe Sleeves: Round tube closed with welded longitudinal joint.

1.2 STACK SLEEVE FITTINGS

- A. Manufactured, Dura-coated or Duco-coated Galvanized cast-iron sleeve, with integral cast flashing flange and underdeck clamp.

1.3 SLEEVE-SEAL SYSTEMS

- A. Field-assembled, modular sealing-element unit for filling annular space between piping and sleeve.
 - 1. Sealing Elements: EPDM rubber High-temperature-silicone Nitrile (Buna N).
 - 2. Pressure Plates: Carbon steel Composite plastic Stainless steel.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating Stainless steel.

1.4 SLEEVE-SEAL FITTINGS

- A. Manufactured plastic, sleeve-type, plastic or rubber waterstop assembly, made for imbedding in concrete slab or wall.

1.5 GROUT

- A. Nonshrink, factory packaged.

1.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant.
- B. Silicone, S, P, 25, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

1.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.

1.8 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Exterior Concrete Walls above Grade:
 - 1. Piping Smaller Than NPS 6: Cast-iron wall sleeves Insert material.
 - 2. Piping NPS 6 and Larger: Cast-iron wall sleeves Galvanized-steel-pipe sleeves Insert material.
- B. Exterior Concrete Walls below Grade:

1. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 2. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
- C. Concrete Slabs-on-Grade:
1. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.
 2. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
- D. Concrete Slabs above Grade:
1. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
 2. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

END OF SECTION 230517

SECTION 230518 - ESCUTCHEONS FOR HVAC PIPING

1.1 SUMMARY

- A. Section includes:
 - 1. Escutcheons.

1.2 PRODUCTS

- A. Escutcheons for New Piping:
 - 1. Piping with Fitting or Sleeve Protruding from Wall: One-piece deep pattern.
 - 2. Insulated Piping: Split-plate stamped steel, concealed hinge, with polished, chrome-plated finish.
 - 3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate stamped steel, concealed hinge, with polished, chrome-plated finish.
 - 4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate stamped steel, concealed hinge, with polished, chrome-plated finish.
- B. Floor Plates: Split-plate stamped steel with concealed hinge.

END OF SECTION 230518

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SECTION 230519 - METERS AND GAGES FOR HVAC PIPING

1.1 PRODUCTS

- A. Liquid-in-Glass Thermometers:
 - 1. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
 - a. Case: Cast aluminum ;6-inch size.
 - b. Case Form: Straight.
 - c. Tube: Glass with magnifying lens and blue or red organic liquid.
 - d. Tube Background: Nonreflective aluminum with etched scale in deg F .
 - 2. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
 - a. Case: Cast aluminum ; 9-inch size unless otherwise indicated.
 - b. Case Form: Adjustable angle unless otherwise indicated.
 - c. Tube: Glass with magnifying lens and blue or red organic liquid.
 - d. Tube Background: Nonreflective aluminum with etched scale in deg F .
 - e. Window: Glass .
 - f. Stem: Aluminum .
- B. Duct-Thermometer Mounting Brackets: Flanged bracket, for attachment to air duct.
- C. Thermowells:
 - 1. Material for Use with Copper Tubing: CNR or CUNI .
 - 2. Material for Use with Steel Piping: CRES CSA .
 - 3. Type: Stepped shank unless straight or tapered shank is indicated.
 - 4. Heat-Transfer Medium: Mixture of graphite and glycerin Insert material.
- D. Pressure Gages:
 - 1. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
 - a. Case: Liquid-filled type(s); ; 4-1/2-inch diameter.
 - b. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
 - c. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2 , ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
 - d. Dial: Nonreflective aluminum with etched scale in psi .
 - e. Window: Glass .
 - f. Ring: Stainless steel.
 - g. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.
- E. Gage Attachments:
 - 1. Snubbers: Brass; with NPS 1/4 or NPS 1/2 , and porous-metal-type surge-dampening device.Include extension for use on insulated piping.
 - 2. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2 pipe threads.
- F. Test Plugs: Test-station fitting made for insertion in piping tee fitting.
- G. Test-Plug Kits: Furnish one Insert number test-plug kit(s) containing one two thermometer(s), one pressure gage and adapter, and carrying case.
- H. Flowmeters:
 - 1. Venturi Flowmeters:
 - a. Sensor:
 - 1) Minimum Pressure Rating: 250 psig .
 - 2) Minimum Temperature Rating: 250 deg F .
 - b. Permanent Indicators:
 - 1) Scale: Gallons per minute .
 - c. Portable Indicators:
 - 1) Scale: Gallons per minute .
 - 2) Display: Shows rate of flow, with register to indicate total volume in gallons .
- I. Thermal-Energy Meters:
 - 1. Ultrasonic, Thermal-Energy Meters:
 - a. Indicator: Solid-state, integrating-type meter with integral battery pack.

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MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

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LEGGETT BUILDING
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- b. Display: Visually indicates total fluid volume in gallons and thermal-energy flow in kilowatts per hour or British thermal units .

END OF SECTION 230519

SECTION 230523.12 - BALL VALVES FOR HVAC PIPING

1.1 CHILLED-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Ball Valves: Bronze, two piece, with stainless-steel trim, and full port.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Ball Valves: Class 125.
 - 2. Steel Ball Valves: Class 150.

1.2 CONDENSER-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze, two piece with stainless-steel trim, and full port.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Ball Valves: Class 125.
 - 2. Steel Ball Valves: Class 150.

1.3 HEATING-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze, one three piece with brass bronze trim, and full port.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron Ball Valves: Class 125.
 - 2. Steel Ball Valves: Class 150.

END OF SECTION 230523.12

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SECTION 230523.13 - BUTTERFLY VALVES FOR HVAC PIPING

1.1 CHILLED-WATER VALVES

- A. Pipe NPS 2-1/2 and Larger :
 - 1. High-Performance Butterfly Valves: Single flange, Class 150.

1.2 CONDENSER-WATER VALVES

- A. Pipe NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Single flange, Class 150.

1.3 HEATING-WATER VALVES

- A. Pipe NPS 2-1/2 and Larger:
 - 1. High-Performance Butterfly Valves: Single flange, Class 150.

END OF SECTION 230523.13

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SECTION 230523.14 - CHECK VALVES FOR HVAC PIPING

1.1 CHILLED-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves with metal seats, Class 125.
 - 2. Iron, globe, center-guided check valves with metal seat, Class 125 .

1.2 CONDENSER-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves with metal seats, Class 125.
 - 2. Iron, globe, center-guided check valves with metal seat, Class 125.

1.3 HEATING-WATER VALVES

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze swing check valves with bronze disc, Class 125.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Iron swing check valves with metal seats, Class 125.
 - 2. Iron, globe, center-guided check valves with metal seat, Class 125.

END OF SECTION 230523.14

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

1.1 PERFORMANCE REQUIREMENTS

- A. Pipe hangers and equipment supports designed by Contractor.

1.2 SUBMITTALS

- A. Shop Drawings: Signed and sealed by a professional engineer.

1.3 QUALITY ASSURANCE

- A. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. ASME Boiler and Pressure Vessel Code, Section IX.

1.4 COMPONENTS

- A. Metal Pipe Hangers and Supports: Carbon steel and copper.
- B. Trapeze pipe hangers.
- C. Metal Framing Systems:
 - 1. Manufacturer: MFMA.
 - 2. Material: Carbon steel.
 - 3. Coating: None.
- D. Thermal-Hanger Shield Inserts:
 - 1. For Cold Piping: Cellular glass.
 - 2. For Hot Piping: Polyisocyanurate.
- E. Fastener Systems: Powder-actuated fasteners and mechanical-expansion anchors.
- F. Pipe Stands: Curb-mounted type.
- G. Equipment supports.

END OF SECTION 230529

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SECTION 230533 - HEAT TRACING FOR HVAC PIPING

1.1 WARRANTY

- A. Materials and Workmanship: Three Five Insert number years.

1.2 PRODUCTS

- A. Self-Regulating, Parallel-Resistance Heating Cables:
 - 1. Heating Element: Pair of parallel, nickel-coated, stranded copper bus wires embedded in crosslinked conductive polymer core.
 - 2. Electrical Insulating Jacket: Flame-retardant polyolefin.
 - 3. Cable Cover: Tinned-copper or stainless-steel braid and polyolefin outer jacket with ultraviolet inhibitor.
- B. Controls: Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature. Provide remote, wall-mounted heat trace system control unit capable of monitoring and control of up to 8 independent circuits.
- C. Accessories:
 - 1. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips.
 - 2. Warning Tape: Continuously printed "Electrical Tracing."

END OF SECTION 230533

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SECTION 230548.13 - VIBRATION CONTROLS FOR HVAC

1.1 COMPONENTS

- A. Vibration Isolators:
 - 1. Elastomeric Isolation Pads: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area. Material to be oil and water resistant with elastomeric properties.
 - a. Surface Pattern: Smooth pattern.
 - b. Infused nonwoven cotton or synthetic fibers.
 - c. Load-bearing metal plates adhered to pads.
 - 2. Double-Deflection, Elastomeric Isolation Mounts: Molded, oil-resistant rubber, neoprene, or other elastomeric material.
 - 3. Housed-Restrained-Spring Isolators: Freestanding, steel, open-spring isolators with vertical-limit stop restraint in two-part telescoping housing.
 - 4. Pipe-Riser Resilient Support: All-directional, acoustical pipe anchor.
 - 5. Resilient pipe guides.
 - 6. Elastomeric hangers.
 - 7. Spring Hangers: Combination coil-spring and elastomeric-insert hangers with spring and insert in compression and with vertical-limit stop.
- B. Vibration Isolation Equipment Bases:
 - 1. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.
 - 2. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

END OF SECTION 230548.13

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

1.1 QUALITY ASSURANCE

- A. Quality Standard for Piping Identification: ASME A13.1.

1.2 PRODUCTS

- A. Equipment Labels: Plastic.
- B. Warning Signs and Labels: 1/8 inch thick with fasteners.
- C. Pipe Labels: Self-adhesive.
- D. Duct Labels: 1/8 inch thick with adhesive.
- E. Valve Tags: Brass, 0.032-inch minimum thickness.
- F. Warning Tags: 3 by 5-1/4 inches minimum ; brass grommet and wire fasteners.

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

1.1 SUMMARY

- A. TAB for the following:
 - 1. Balancing Air Systems:
 - a. Variable-air-volume systems.
 - b. Multizone systems.
 - 2. Balancing Hydronic Piping Systems:
 - a. Variable-flow hydronic systems.
 - 3. TAB Equipment:
 - a. Heat exchangers.
 - b. Motors.
 - c. Chillers.
 - d. Cooling towers.
 - e. Condensing units.
 - f. Boilers.
 - g. Heat-transfer coils.
 - 4. TAB existing systems and equipment.
 - 5. Sound tests.
 - 6. Vibration tests.
 - 7. Duct leakage tests.
 - 8. Control system verification.

1.2 QUALITY ASSURANCE

- A. TAB Agent Qualifications: AABC or TABB certified.

1.3 EXECUTION

- A. Tolerances: Plus or minus 5 percent of design values.
- B. Inspections: Random checks by TAB firm to verify final TAB report.
- C. Additional Tests: Random tests within 90 days of completing TAB to verify balance conditions and seasonal tests.

END OF SECTION 230593

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SECTION 230713 - DUCT INSULATION

1.1 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors; according to ASTM E 84.
- B. Mockup of each type of duct insulation and finish.

1.2 FIELD QUALITY CONTROL

- A. Field Inspections: By Owner-engaged Contractor-engaged agency.

1.3 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
 - 1. Indoor, concealed supply and outdoor air.
 - 2. Indoor, exposed supply and outdoor air.
 - 3. Indoor, concealed return located in unconditioned space.
 - 4. Indoor, exposed return located in unconditioned space.
 - 5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
 - 6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
 - 7. Indoor, concealed oven and warewash exhaust.
 - 8. Indoor, exposed oven and warewash exhaust.
 - 9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
 - 10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
 - 11. Outdoor, concealed supply and return.
 - 12. Outdoor, exposed supply and return.
- B. Items Not Insulated:
 - 1. Fibrous-glass ducts.
 - 2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
 - 3. Factory-insulated flexible ducts.
 - 4. Factory-insulated plenums and casings.
 - 5. Flexible connectors.
 - 6. Vibration-control devices.
 - 7. Factory-insulated access panels and doors.

1.4 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed, Round and Flat-Oval, Supply-Air Duct Insulation: mineral-fiber blanket .
- B. Concealed, Rectangular, Supply-Air Duct Insulation: mineral-fiber blanket .
- C. Exposed, Round and Flat-Oval, Supply-Air Duct Insulation: mineral-fiber blanket mineral-fiber pipe and tank .
- D. Exposed, Rectangular, Supply-Air Duct Insulation: mineral-fiber board .
- E. Exposed, Outdoor-Air Plenum Insulation: mineral-fiber board.

END OF SECTION 230713

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SECTION 230716 - HVAC EQUIPMENT INSULATION

1.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors; in accordance with ASTM E84.
- B. Mockup of each type of equipment insulation and finish.

1.2 EQUIPMENT INSULATION SCHEDULE

- A. Chillers: flexible elastomeric .
- B. Chilled-Water Pump Insulation: Cellular glass.
- C. Condenser-Water Pump Insulation: Cellular glass.
- D. Heating-Hot-Water Pump Insulation: Calcium silicate.
- E. Heat-Recovery Pump Insulation: Cellular glass.
- F. Chilled-Water Expansion/Compression Tank Insulation: flexible elastomeric mineral-fiber pipe and tank.
- G. Condenser-Water Expansion/Compression Tank Insulation: flexible elastomeric mineral-fiber pipe and tank .
- H. Heating-Hot-Water Expansion/Compression Tank Insulation: mineral-fiber pipe and tank.
- I. Heat-Recovery Expansion/Compression Tank Insulation: mineral-fiber pipe and tank.
- J. Chilled-Water Air-Separator Insulation: flexible elastomeric mineral-fiber pipe and tank.
- K. Condenser-Water Air-Separator Insulation: flexible elastomeric mineral-fiber pipe and tank.
- L. Heating-Hot-Water Air-Separator Insulation: mineral-fiber pipe and tank.
- M. Heat-Recovery Air-Separator Insulation: flexible elastomeric mineral-fiber pipe and tank.
- N. Thermal Storage Tank (Brine, Water, Ice) Insulation: mineral-fiber pipe and tank.
- O. Piping System Filter-Housing Insulation: mineral-fiber pipe and tank.

1.3 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches: PVC.
- B. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches: None.

1.4 FIELD QUALITY CONTROL

- A. Field Inspections: By Contractor-engaged agency.

END OF SECTION 230716

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SECTION 230719 - HVAC PIPING INSULATION

1.1 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: Flame-spread index of 25, and smoke-developed index of 50 for insulation installed indoors, according to ASTM E 84.
- B. Mockup of each type of pipe insulation and finish.

1.2 FIELD QUALITY CONTROL

- A. Field Inspections: By Contractor-engaged agency.

1.3 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water below 60 Deg F: flexible elastomeric or mineral-fiber, preformed pipe insulation, Type I .
- B. Chilled Water and Brine, Above 40 Deg F: Cellular glass.
- C. Condenser-Water Supply and Return: Cellular glass.
- D. Heating-Hot-Water Supply and Return, 200 Deg F and Below: Cellular glass .
- E. Refrigerant Suction and Hot-Gas Piping: mineral-fiber, preformed pipe, Type I.
- F. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric.
- G. Heat-Recovery Piping: Cellular glass .

1.4 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water and Brine: Cellular glass.
- B. Condenser-Water Supply and Return: Cellular glass.
- C. Steam and Steam Condensate, 350 Deg F and Below: Calcium silicate cellular glass or.
- D. Refrigerant Suction and Hot-Gas Piping: flexible elastomeric.
- E. Refrigerant Suction and Hot-Gas Flexible Tubing: Flexible elastomeric.

1.5 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Insulation, for belowground piping, is specified in piping distribution Sections.

1.6 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Piping, Exposed: PVC .

1.7 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Piping, Exposed: Aluminum.

1.8 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 230719

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SECTION 230800 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes Cx process requirements for the following HVAC systems, assemblies, and equipment:
 - 1. Energy supply systems.
 - 2. Heat generation systems.
 - 3. Cooling generation systems.
 - 4. Central-station air-handling systems.
 - 5. Air and hydronic distribution systems.
 - 6. Heating and cooling terminal and unitary equipment.
 - 7. HVAC controls.
 - 8. TAB verification.

1.2 QUALITY ASSURANCE

- A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level with knowledge of BAS, HVAC, electrical concepts, and building operations.
 - 2. Minimum three years experience installing, servicing, and operating systems manufactured by approved manufacturer.
 - 3. International Society of Automation (ISA)-Certified Control Systems Technician (CCST) Level I.
- B. HVAC Testing Technician Qualifications: Technicians to perform HVAC construction checklist verification tests, construction checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
 - 1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC equipment, assemblies, and systems.
 - 2. Minimum three years experience installing, servicing, and operating systems manufactured by approved manufacturer.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for following HVAC systems, assemblies, subsystems, equipment, and components:
 - 1. Energy supply systems, including the following:
 - a. Fuel gas supply.
 - b. Central-plant chilled water supply.
 - c. Central-plant hot-water supply.
 - d. Solar-energy supply.
 - 2. Heat generation systems, including the following:
 - a. Boilers.
 - b. Auxiliary equipment.
 - 3. Cooling generation systems, including the following:
 - a. Water chillers.
 - b. Cooling towers.
 - c. Direct-expansion refrigeration systems.
 - 4. Central-station air-handling systems.

5. Air, steam, and hydronic distribution systems, including the following:
 - a. Supply, return, outdoor-air, and exhaust-air distribution systems.
 - b. Hydronic systems.
 - c. Energy recovery systems.
6. Heating and cooling terminal and unitary equipment, including the following:
 - a. Unit heaters.
 - b. Fan-coil units.
 - c. Electric heating.
 - d. Unitary heating and cooling equipment.
7. Controls and instrumentation.
8. TAB verification.

END OF SECTION 230800

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

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 control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.
- B. Direct-Digital Control (DDC) system description
 - 1. The Controls Contractor shall supply and install a complete Direct Digital Control (DDC) Building Automation System (BAS) as required to accomplish the Sequences of Control for heating, ventilating, air-conditioning and other building-level equipment and systems as described herein.
- C. Work included
 - 1. Furnish all labor, materials, equipment and service necessary for a complete and operational DDC BAS pursuant with this specification and as shown on the associated contract drawings.
 - 2. Coordinate interface requirements for integration into BAS of following building-level equipment and systems:
 - a. Computer/Server Room Air Conditioning Units
 - b. Utility Metering (public utility-provided and smart meters)
 - c. Electrical Sub-Metering
 - d. Occupancy, Lighting controls
 - e. Plumbing Sub-Metering
 - f. Variable Speed Drives
 - 3. All labor, material, equipment and service not specifically referred to in this specification or on associated drawings that are required to fulfill the functional intent of this specification shall be provided by the controls contractor at no additional cost to the Owner.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. I/O: Input/output.
- C. MS/TP: Master slave/token passing.
- D. PC: Personal computer.
- E. PID: Proportional plus integral plus derivative.
- F. RTD: Resistance temperature detector.

1.4 DDC SYSTEM REQUIREMENTS

- A. DDC Systems installed under this specification shall strictly adhere to the following characteristics:
 - 1. Building Automation System (BAS) Direct Digital Controls (DDC) shall consist of native BACnet, microprocessor-based, peer-to-peer, networked, distributed devices utilizing the BACnet communication protocol in an open, interoperable system. The BAS also includes operator interface devices, programming and configuration software applications, DDC input/output devices, non-DDC automatic temperature controls, enclosures and interconnecting conduit and wire.
 - a. The BACnet operating stack must be embedded directly in every Device at the board level, and in all operator interface software packages.
 - b. No Gateways, Communication Bridges, Protocol Translators or any other device that translates any proprietary or other communication protocol to the BACnet communication protocol shall be permitted as a part of the BAS installation pursuant with this specification section. Gateways may only be used as required for communication to existing systems or systems installed pursuant with other specification sections.
 - c. DDC controllers that are not BACnet compliant shall not be acceptable under this specification and are strictly prohibited.

2. The BAS shall be modular in nature and comprised of a network of stand-alone DDC devices. The System shall be designed and implemented in such a way that it may be expanded in both capacity and functionality through the addition of DDC Devices, sensors, actuators, etc.
3. All BAS controllers shall be tested, certified, clearly stamped and listed by the BACnet Testing Laboratories (BTL).
4. Program database, data acquisition, and all control sequence logic shall reside in each DDC Device. The Building Level Communication Network (BLCN) shall not be dependent upon connection to a Server or Master Controller for performance of the Sequence of Control as outlined in this specification. Each individual Device shall, to the greatest possible extent, perform its programmed sequence without reliance on the BLCN.
5. All BAS DDC Devices at all levels shall be fully custom-programmable in the field using the standard Operators Workstation Software. Configurable, canned program application specific controllers will be permitted; all related changes and modifications required to implement the project specific sequences of operation shall be done at no additional cost to the owner.
6. All BAS DDC Devices shall be capable of updating firmware using software via internet without replacing any hardware, microprocessors or chips.
7. The BAS shall be capable of sending system alarms and Event Notifications to pagers, and email services.
8. Actuation of control devices shall be electronic.
9. DDC Automatic Temperature Control (ATC) System shall prevent all controlled equipment from simultaneously restarting after a power outage. The order in which equipment (or groups of equipment) is started; along with the time delay between starts shall be user-selectable.
10. All binary output points shall be protected from short cycling via output configuration and/or programming. This feature shall allow minimum on time and off-time to be configurable.
11. The DDC System Manufacturer product line selected shall be the most current and complete offering from the manufacturer and shall currently be actively manufactured and supported at the time that this project is bid.
12. This project shall not be used as a test site. First release and test version hardware, software and firmware shall not be implemented on this project under any circumstances.
13. DDC System devices and spare components or equivalent shall be readily available for a minimum of five (5) years after the completion and final acceptance of this project.

1.5 BASIC SYSTEM ARCHITECTURE

- A. The DDC BAS as provided and installed under this specification shall be a complete system from a single manufacturer designed for use on intranets and the internet.
- B. The primary BAS components shall include but not be limited to:
 1. BACnet Advanced Operator Workstation Software (B-AWS)
 2. Remote BACnet Advanced Operator Workstation Software (Remote B-AWS)
 3. Portable Operator Workstation Software (Portable B-OWS)
 4. Building Level Controllers (B-BC)
 5. Advanced Application Controllers (B-AAC)
 6. Application Specific Controllers (B-ASC)
- C. Enterprise Level Communication Network (ELCN) shall consist of high-speed BACnet/IP Local Area Network (LAN) to host Operators Workstations (B-OWS), Building Level Controllers (B-BC), Building Level Communication Networks (BLCN) and Web-Enabled remote connectivity.
- D. Building Level Communication Network (BLCN) shall consist of a BACnet MS/TP Network to host Advanced Application Controllers (B-AAC) and Application Specific Controllers (B-ASC).
- E. B-BC's shall automatically route BACnet communications to all configured available BACnet networks.
- F. B-AWS shall be fully IT-compatible devices that communicate directly on a TCP/IP Local Area Network (LAN).
 1. LAN shall be 10/100Mbps TCP/IP with the following minimum requirements:
 - a. Cable: 10 base-T, UTP-8 wire, category 5e or greater
 - b. Minimum throughput: 10Mbps with the ability to increase to 100Mbps
 2. Enterprise Level Communication Network (ELCN) shall provide communication between BBC's, B-OWS, remote B-OWS and Web Server using a B/IP LAN backbone.
 3. B-BC's shall connect directly to the LAN and communicate using B/IP without a TCP/IP Gateway or network server.

4. It shall be the responsibility of the BAS Contractor to coordinate implementation of the BAS on the Owner's LAN without disruption.
- G. BAS Manufacturer must natively support the following BACnet data links as defined in the ANSI/ASHRAE Standard 135-2008, BACnet:
 1. Point-to-Point (PTP)
 2. Master Slave/Token Passing (MS/TP)
 3. Ethernet (ISO 8802-3)
 4. BACnet IP (B/IP)
- H. Field sensors and control devices shall connect to peer-to-peer, fully programmable B-BC, B-AAC & B-ASC as required to achieve the point monitoring and Sequence of Control as specified herein. All devices are to be monitored by a B-OWS. Final control devices are to be electronic.
- I. Each Mechanical System and/or major piece of Mechanical Equipment shall have one (1) dedicated DDC controller with sufficient I/O capacity such that it shall be connected to ALL field devices and sensors associated with that system and/or piece of equipment. Distributed control of one (1) single piece of major mechanical equipment shall not be performed by multiple controllers.
- J. All BAS controllers, sensors and devices shall be UL listed.
 1. All BAS controllers and interface devices must be UL 916 Listed.

1.6 SYSTEM PERFORMANCE

- A. Comply with the following performance requirements:
 1. Graphic Display: Display graphic with minimum 50 dynamic points with current data within 10 seconds.
 2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
 3. Object Command: Reaction time of less than five seconds between operator command of a binary object and device reaction. Analog objects shall start to adjust within 10 seconds of being commanded to change.
 4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
 5. B-BC, B-AAC, & B-ASC shall be able to execute control loops at a selectable frequency at least 1 time every second. The controller shall scan and update the process value and output generated by this calculation at this same frequency at a minimum.
 6. Alarm Response Time: Annunciate alarm at workstation within 20 seconds. Multiple workstations must receive alarms within five seconds of each other.
 7. Program Execution Frequency: Run capability of applications as often as five seconds but selected consistent with mechanical process under control.
 8. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
 9. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
 - a. Water Temperature: Plus or minus 1 deg F.
 - b. Water Flow: Plus or minus 5 percent of full scale.
 - c. Water Pressure: Plus or minus 2 percent of full scale.
 - d. Space Temperature: Plus or minus 1 deg F.
 - e. Ducted Air Temperature: Plus or minus 1 deg F.
 - f. Outside Air Temperature: Plus or minus 2 deg F.
 - g. Dew Point Temperature: Plus or minus 3 deg F.
 - h. Temperature Differential: Plus or minus 0.25 deg F.
 - i. Relative Humidity: Plus or minus 5 percent.
 - j. Airflow (Pressurized Spaces): Plus or minus 3 percent of full scale.
 - k. Airflow (Measuring Stations): Plus or minus 5 percent of full scale.
 - l. Airflow (Terminal): Plus or minus 10 percent of full scale.
 - m. Air Pressure (Space): Plus or minus 0.01-inch wg.
 - n. Air Pressure (Ducts): Plus or minus 0.1-inch wg.
 - o. Carbon Monoxide: Plus or minus 5 percent of reading.
 - p. Carbon Dioxide: Plus or minus 50 ppm.
 - q. Nitrogen Dioxide: Plus or minus 50 ppm.

- r. Electrical: Plus or minus 5 percent of reading.
- 10. Overall combined system repeatability of sensors, controllers and readout devices for a particular application shall be plus or minus 2% of full scale of the operating range. Repeatability of overall combined system of sensor, controller and readout device in a control loop application will be plus or minus 5% of full scale of the operating range.
- 11. Long-term electronic drift shall not exceed 0.4% per year.
- 12. All components provided as part of this system shall operate under ambient environmental conditions of 20F to 104F dry bulb and 10% to 90% relative humidity, noncondensing as a minimum. Sensors and control elements shall operate under the ambient environmental temperature, pressure, humidity, and vibration conditions encountered for the installed location. B-OWS equipment (hardware only), such as CRTs and printers, shall, unless designated otherwise, operate properly under ambient environmental conditions of 45F to 90F and a relative humidity of 10% to 90%.
- 13. Networked components of the system shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80%.

1.7 SEQUENCE OF OPERATION

- A. See Sequence of Operations, Control Diagrams, and Point Lists in Plan Set.

1.8 ACTION SUBMITTALS

- A. Submit in writing and so delineated at the beginning of each submittal, known substitutions and deviations from requirements of Contract Documents. Deviation from Contract Documents must be approved by the Engineer of record prior to submittal.
- B. Complete BAS Engineering Design Submittal & Drawings shall be prepared pursuant with the following guidelines:
 - 1. Submittal documentation and drawings shall consistently use the same abbreviations, symbols, nomenclature and identifiers. Each control system element shall be assigned a unique identifier pursuant with the Contract Documents.
 - 2. Submittal documentation and drawings shall have at the beginning an Index and Design Drawing Legend.
 - a. Index shall list all design drawings and elements including the drawing number, sheet number, drawing title, etc.
 - b. Legend shall show and describe all symbols, abbreviations and acronyms used on the Design Drawings.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
 - 1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
 - 2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
 - 3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
 - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Riser diagram of Building Level Communication Network (BLCN) and Enterprise Level Communication Network (ELCN) shall outline execution and details of all network cabling, BAS & Network Hardware including the following:
 - a. All BAS/DDC Hardware with controller number, unique identifier/tag, location, equipment and service.
 - b. All Network Hardware with unique identifier, location and service.

- c. Network cabling configuration and execution specification.
- d. Location of all cabling termination points and End of Line (EOL) terminators.
- e. Location of all network interface jacks.
- f. A separate riser diagram shall be provided for each network segment.
5. A schedule of all control valves including the unique equipment identifier/tag, valve size, dimensions and installation/maintenance clearance, model number (including pattern and connections), close-off rating, flow, CV, pressure drop, pressure rating and location. The valve schedule shall also contain actuator selection data supported by calculations of the force required to move, close and seal the valve at design conditions.
6. A schedule of all control dampers. This shall include the unique equipment identifier, unique damper identifier/tag, damper size, pressure drop, blade configuration, orientation and axis of frame, blade rotation, location and selection criteria of actuators, nominal and actual sizes, and manufacturer and model number. The Damper Schedule shall include the AMCA 500-D maximum leakage rate at the operating static-pressure differential.
 - a. Refer to equipment and control devices by their specific unique identifiers/tags pursuant with the Contract Documents and BAS Submittal package.
 - b. Clearly represent actual Application Programming methodology and functional control operation. Do not merely provide a copy of Contract Document specified Sequence of Control.
 - c. Include description of functional system operation under normal and failure conditions.
7. DDC System Hardware:
 - a. Wiring diagrams for control units with termination numbers.
 - b. Schematic diagrams for field sensors and control hardware.
 - c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
8. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
9. Controlled Systems:
 - a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
 - b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
 - c. Written description of sequence of operation including schematic diagram.
 - d. Points list.
- E. Samples for Initial Selection: For each color required, of each type of thermostat or sensor cover with factory-applied color finishes.
- F. Samples for Verification: For each color required, of each type of thermostat or sensor cover.

1.9 INFORMATIONAL SUBMITTALS

- A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.
- B. Qualification Data: For Installer and manufacturer.
- C. Software Upgrade Kit: For Owner to use in modifying software to suit future systems revisions or monitoring and control revisions. Software upgrade shall be provided within 2 years from system acceptance by the Owner.
- D. Field quality-control test reports.

1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 1. Operator's Manual with Manufacturers' complete operating instructions.
 2. Programming Manual including:
 - a. Documentation of all project specific Application and DDC programs.
 - b. All necessary system Administrator-Level passwords and/or required access credentials.
 - c. Information required for programming BAS.

- d. Complete Final Point Schedule including all hardware and software data points and documentation of calibration and configuration values for all Inputs, Outputs, Variables and PID Loops at the conclusion of systems commissioning and functional testing.
 - e. Routine preventative maintenance procedures, corrective diagnostic troubleshooting procedures and calibration processes.
 - f. Final Bill of Material with all installed parts, manufacturers, manufacturers' part numbers and ordering information.
 - g. A schedule of recommended spare parts with part numbers and supplier.
 3. Complete system database as functional at the conclusion of systems commissioning and functional testing including all graphics and images used by and/or created for BAS on electronic format as accepted by Owner.
 4. Maintenance instructions and lists of recommended spare parts for each type of control device.
 5. Interconnection wiring diagrams with identified and numbered system components and devices.
 6. Keyboard illustrations and step-by-step procedures indexed for each operator function.
 7. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
 8. Calibration records and list of set points.
- B. Software and Firmware Operational Documentation: Include the following:
1. Software operating and upgrade manuals.
 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
 3. Device address list.
 4. Printout of graphic screens of major equipment such as chilled water plant, typical air handling unit.
 5. Software license required by and installed for DDC workstations and control systems.
- C. Project Record Documents. Upon completion of installation and systems commissioning submit record documents for review. As-Built Project Record Documents should include:
1. Project Record Application Engineering Drawings shall include all BAS System Engineering Design Submittal with Drawings updated to reflect actual field conditions, architecture and execution.

1.11 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish recommended list of materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Two Relays each type
 2. Two Space sensors each type
 3. One Duct sensor each type
 4. One actuator each type
 5. One duct pressure DPT
 6. One transformer each type
 7. One controller each type
 8. One Supervisory controller each type

1.12 QUALITY ASSURANCE

- A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with ASHRAE 135 for DDC system components.

1.13 DELIVERY, STORAGE, AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory-mounted on equipment, arrange for shipping of control devices to equipment manufacturer.
- B. System Software: Update to latest version of software at Project completion.

1.14 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

- B. Controls contractor shall coordinate with all related subcontractors and the associated manufacturers responsible for the system to determine the points that are to be mapped from the third party system to the BAS. At a minimum, provide mapping, alarm configuration, and graphic creation.
- C. Coordinate equipment with Section 281600 "Intrusion Detection" to achieve compatibility with equipment that interfaces with that system and with building master clock.
- D. Coordinate equipment with Section 281300 "Access Control" to achieve compatibility with equipment that interfaces with that system.
- E. Coordinate equipment with Section 284619 "PLC Electronic Detention Monitoring and Control Systems" to achieve compatibility with equipment that interfaces with that system.
- F. Coordinate equipment with Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
- G. Coordinate equipment with Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System" to achieve compatibility with equipment that interfaces with that system.
- H. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.
- I. Coordinate equipment with Section 260913 "Electrical Power Monitoring and Control" to achieve compatibility of communication interfaces.
- J. Coordinate equipment with Section 262416 "Panelboards" to achieve compatibility with starter coils and annunciation devices.
- K. Coordinate equipment with Section 262419 "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONTROL SYSTEM

- A. Reliable Controls Corporation, integrated by Pritchett Controls Inc.
- B. Alerton, a Honeywell Company.
- C. Automated Logic, a United Technologies Company.
- D. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, and accessories to control mechanical systems.
- E. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.
- F. Control system shall integrate to the following:
 - 1. Building lighting control system specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."
 - 2. Fire alarm system specified in Section 283111 "Digital, Addressable Fire-Alarm System" and Section 283112 "Zoned (DC Loop) Fire-Alarm System."

2.3 BACNET ADVANCED OPERATORS WORKSTATION PLATFORM (B-AWS)

- A. Provide as specified herein complete all associated Operating System, Operators Workstation Application Software and Third-Party Software Applications preloaded and configured.
- B. BACnet Advanced Operator Workstation Platform (B-AWS) shall reside on the Enterprise Level Communication Network (ELCN) or the Building Level Communication Network (BLCN) using the BACnet®/IP data link as specified in ANSI/ASHRAE Standard 135.
 1. Provide One PC-based microcomputer(s) with minimum configuration as follows:
 - a. Motherboard: With 4 integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 - b. Processor: Intel i5 7 Quad Core, 3.3 GHz.
 - c. SDRAM: 4 GB.
 - d. Graphics: HD Video Card.
 - e. Monitor: 19 inches, LCD color.
 - f. Keyboard: QWERTY, 105 keys in ergonomic shape.
 - g. Hard-Disk Drive: 8 TB.
 - h. DVD Read/Write Drive: 16X.
 - i. Mouse: Three button, optical.
 - j. Uninterruptible Power Supply: 2 kVa.
 - k. Operating System: Microsoft Windows 10 with high-speed Internet access.
 - 1) ASHRAE 135 Compliance: Workstation shall use ASHRAE 135 protocol and communicate using ISO 8802-3 (Ethernet) datalink/physical layer protocol.
 2. Printer: Color, ink-jet type as follows:
 - a. Print Head: 4800 x 1200 dpi optimized color resolution.
 - b. Paper Handling: Minimum of 100 sheets.
 - c. Print Speed: Minimum of 17 ppm in black and 12 ppm in color.
 3. Application Software:
 - a. I/O capability from operator station.
 - b. System security for each operator via software password and access levels.
 - c. Automatic system diagnostics; monitor system and report failures.
 - d. Database creation and support.
 - e. Automatic and manual database save and restore.
 - f. Dynamic color graphic displays with up to 50 screen displays at once.
 - g. Custom graphics generation and graphics library of HVAC equipment and symbols.
 - h. Alarm processing, messages, and reactions.
 - i. Trend logs retrievable in spreadsheets and database programs.
 - j. Alarm and event processing.
 - k. Object and property status and control.
 - l. Automatic restart of field equipment on restoration of power.
 - m. Data collection, reports, and logs. Include standard reports for the following:
 - 1) Current values of all objects.
 - 2) Current alarm summary.
 - 3) Disabled objects.
 - 4) Alarm lockout objects.
 - 5) Logs.
 - n. Custom report development.
 - o. Utility and weather reports.
 - p. Workstation application editors for controllers and schedules.
 - q. Maintenance management.
 4. Custom Application Software:
 - a. English language oriented.
 - b. Full-screen character editor/programming environment.
 - c. Allow development of independently executing program modules with debugging/simulation capability.
 - d. Support conditional statements.
 - e. Support floating-point arithmetic with mathematic functions.
 - f. Contains predefined time variables.
 5. System: With two integrated USB 2.0 ports, integrated Intel Pro 10/100 (Ethernet), integrated audio, bios, and hardware monitoring.
 6. Processor: Intel i3 Quad Core, 2.4 GHz.

7. SD Random-Access Memory: 2 GB.
 8. Graphics: HD Video Card.
 9. Monitor: 15 inches, LCD color.
 10. Keyboard: QWERTY 105 keys in ergonomic shape.
 11. Hard-Disk Drive: 2 TB.
 12. DVDRead/Write Drive Optical Drive: 8X.
 13. Pointing Device: Touch pad or other internal device.
 14. Operating System: Microsoft Windows 10 with high-speed Internet access.
- C. Communications and Protocols
1. B-AWS information access for the control system shall utilize the BACnet protocol only for communication to B-BC's, B-AAC's, B-ASC's and all other BAS DDC controllers.
 2. B-AWS shall reside on the same LAN as B-BC's. B-AWS shall as a minimum support point-to-point (PTP) and BACnet/IP physical/data link layer protocols.
 3. The B-AWS specified here may, at the Owner's option, be located remote from the BACnet internetwork. Other than the difference in B-AWS communication speed, the system shall be capable of remote operation via BACnet LAN types with no degradation in application performance.
 4. B-AWS Operating System (OS) Software shall be consistent on all B-AWS hardware platforms provided.
 5. B-AWS Application Software shall be provided and licensed to Owner. Provide latest versions of software available.

2.4 CONTROL SYSTEM ADVANCED OPERATORS WORKSTATION (B-AWS) APPLICATION SOFTWARE

- A. System Configuration
1. The workstation shall provide a complete engineering tool for the configuration of the system. This shall allow for future system changes under proper password protection including dynamic creation, deletion and modification of all configuration parameters, programs, graphics, trend logs, alarms, schedules and every BACnet object used in the installed system.
- B. Security
1. Each operator shall be required to log on to the system with a unique user name and password in order to view, edit, add or delete data.
 - a. Operators will be able to perform only those commands available for their respective passwords.
 2. System security permissions shall be multi layered and defined for each individual operator to restrict/permit day-to-day operations and system configuration.
 - a. A minimum of 10 levels of access shall be supported with a configurable matrix of operator actions allowed for each access level, broken down into at least 200 possible operator actions
 - b. A minimum of 50 passwords shall be supported at each B-OWS.
 3. An administrator-level operator shall have the ability to configure credentials for all other operators.
 4. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving B-AWS in an unsupervised logged-in state.
 5. Security data shall be stored in an encrypted format.
- C. Alarming and Event Notification
1. B-AWS shall utilize BACnet Alarm Events and Protocol Implementation Conformance Statement (PICS) shall support at a minimum the following BACnet Interoperability Building Blocks (BIBBs):
 - a. Alarm and Event – Acknowledge-A (AE-ACK-A)
 - b. Alarm and Event – Notification-A (AE-N-A)
 - c. Alarm and Event – Alarm Summary View-A (AE-AS-A)
 - d. Alarm and Event – View and Modify-A (AE-VM-A)
 - e. Alarm and Event – View Notifications-A (AE-VN-A)
 2. The workstation shall display and log alarms and events from any BACnet object in the system and shall support operator configuration of the alarm limits, differentials, states and reactions for each object in the system.
 3. B-AWS terminal shall provide audible, visual, and printed means of alarm and event notification.
 4. System shall provide log of notification messages. Complete Alarm log of all system and operator transactions shall be archived to the hard disk of the system B-AWS.
 5. Alarm messages shall be in user-definable text (English) and shall be entered either at the B-AWS terminal or via remote communication.

6. An alarm summary shall be available to show all alarms whether including but not limited to whether or not they have been acknowledged.
 7. System shall provide ability to prioritize and differentiate communications for at least 20 different levels of alarms.
 8. Alarm messages shall be fully customizable in size, content, behavior and sound.
 9. The operator shall be able to view all system alarms from any location in the internetwork. With the proper credentials, an operator shall be able to acknowledge and clear alarms. Alarm and Event Log shall be configurable per workstation and shall display at a minimum alarm time, received time, state, notification class, priority, message, source, time acknowledged, acknowledged by user and action.
- D. Weekly Annual and Special Event Scheduling
1. B-AWS Software shall utilize BACnet Schedules and PICS shall support at a minimum the following BIBBs:
 - a. Scheduling – Advanced View and Modify-A (SCH-AVM-A)
 2. Provide ability to view and modify the schedule for the calendar week and up to 255 special events in a graphical format. Each calendar day and special event shall provide at least ten time/value entries per day.
 3. Provide the ability for the operator to select scheduling for either binary, analog, or multi-state object values.
 4. Provide the ability for the operator to designate days, date ranges, or repeating date patterns as exception schedules.
 5. Provide the capability for the operator to define special or holiday schedules and to link the BACnet schedule to a BACnet calendar, thereby over-riding weekly schedule programming on holidays defined in the BACnet calendar.
 6. There shall be a provision with proper password access to manually override each schedule.
 7. Provide the capability to designate any exception schedule to be "Executed Once " then automatically cleared.
 8. Provide the ability to name each exception schedule with a user defined term to describe each special event.
 9. The schedule objects shall reside in each individual device. Workstation or server-based scheduling shall not be acceptable.
- E. Trend Log Graphing
1. The B-AWS shall support both the BACnet Trend Log and the BACnet Trend Log Multiple standard objects for defining custom trend logs for any object in the system. This definition shall include interval, length, start time and end time.
 - a. The trend data shall be sampled and stored in each individual BACnet® device where the object is stored. The workstation or another field level integration platform shall not be required for storage of custom trend logs.
 - b. All long-term data archival to hard-disk shall be performed by a BTL-Listed BACnet® device dedicated for this service.
 2. PICS shall support at a minimum the following BIBBs:
 - a. Trending – View-A (T-V-A)
 3. All data points (both hardware and software) system-wide shall be assignable to a historical trending program by gathering configurable historical samples of object data stored in the local controller (B-BC, B-AAC, B-ASC).
 4. All trend log information shall be displayable in text and graphic format. All information shall be able to be printed in black & white and color and exported directly to a Microsoft Excel Spreadsheet.
 5. The B-AWS shall perform the following at a minimum:
 - a. Be capable of automatically retrieving any trend-log from any device on the network without user-intervention.
 - b. Manage connection to internetwork automatically based upon configurable data acquisition thresholds; retrieving data only when necessary rather than streaming data.
 - c. Shall operate as a Microsoft Windows service.
 - d. Be capable of exporting data directly to Microsoft Excel.
 - e. Not require a separate "viewer" but shall seamlessly present all archived data together with real-time data stored in device using the standard B-AWS Trend Log Viewer.
- F. Runtime Log Information

1. B-OWS Software shall be capable of displaying Runtime and On/Off Cycle data of all Binary data points (both hardware and software) system-wide.
 2. Runtime data shall be sampled and stored in each individual BACnet® device where the object is stored using standard BACnet® objects and published properties. The workstation shall not be required for storage of custom runtime logs.
 3. At a minimum, the Runtime data shall include:
 - a. Total accumulated active time
 - b. Total accumulated active transitions and active transitions for the current day.
 - c. Timestamp and duration for each change of state for the last 100 transitions.
- G. System Configuration, Set-Up and Definition
1. Device and network status shall be displayed for any device on the BACnet internetwork. At a minimum the following Device Management BIBBs shall be supported:
 - a. Device Management – Automatic Device Mapping-A (DM-ADM-A)
 - b. Device Management – Automatic Network Mapping-A (DM-ANM-A)
 2. All control strategies and energy management routines shall be stored in the controller and shall allow modification and additions by the operator using the B-AWS software. No strategies or routines shall be stored on the B-AWS platform.
 3. B-AWS Software shall have the capability to back-up and restore the programming and database of any BACnet device on the BACnet internetwork. The B-AWS BTL listing shall support the Device Management – Backup and Restore-A (DM-BR-A) BIBB.
 4. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.
- H. Graphical User Interface (GUI)
1. B-AWS Software shall support at a minimum BMP, GIF, TIF, JPG, EMF, PNG, SWF and DIB graphic file formats and allow for the use of custom Flash animation objects and URL hyperlinks in every GUI.
 2. B-AWS Software shall provide a color graphics package to allow the user to generate custom dynamic graphics for graphical representation of system design and system parameters. Graphic images may reside on the B-AWS or server; however, all dynamic data and attributes must reside in the controller.
 - a. A listed set of symbols and graphic slides shall be available to allow operators to select from the graphics table to assist in graphic generation.
 - b. All color graphic displays shall be dynamic with current point data automatically updated from the BACnet internetwork to the B-AWS workstation without operator intervention.
 - c. The operator shall be able to manually adjust all data point values (hardware or software) in the system, adjust values of control loops, and command points to local mode or release points to automatic mode.
 - d. The windowing environment of the B-AWS shall allow the user to simultaneously view several graphics at the same time to analyze total building operation, and/or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
 - e. Pre-packaged animations for display of fans, pumps, dampers, etc., and shall allow custom user-created .swf and .gif animations to be used to display objects on graphic displays.
- I. The BAS shall be provided with fully automatic diagnostic procedures for verification of internetwork communication. In the event of communications failure, the system shall automatically Alarm the condition. B-AWS Software shall be capable of remote annunciation to printer, pager and e-mail.
- J. Control Summaries, Reports and Logging:
1. The system shall provide self-documentation reporting to summarize control strategies for any point or any user selected group of points within the Control System.
 2. The B-AWS reporting package shall allow the user to configure the point information display in custom format.
 3. The B-AWS shall enable operator to perform Wild Card data point sorting and searches.
 4. The B-AWS shall perform automated network back-up of runtime databases in all devices on the BACnet network according to operator configurable schedule and storage directory structure.

2.5 BUILDING LEVEL CONTROLLERS (B-BC)

- A. Building Level Controllers shall combine both network routing functions, control functions, and server functions into a single unit.
- B. The BACnet B-BC shall be classified as a “native” BACnet device, supporting the BACnet Building Level Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. B-BCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Building Level Controllers (B-BC).
- C. Furnish B-BC(s) as necessary to control large point count major mechanical equipment, and execution of BAS global strategies, and as noted in the execution portion of this specification.
 - 1. Each Mechanical System and/or major piece of Mechanical Equipment (e.g., Chilled Water, Heating Water, Large AHU, etc.) shall have one (1) dedicated DDC controller with sufficient I/O capacity such that it shall be connected to ALL field devices and sensors associated with that system and/or piece of equipment. Distributed control of one (1) single piece of major mechanical equipment shall not be performed by multiple controllers.
 - 2. Each B-BC shall support local hardware Inputs and Outputs (I/O) by the use of on-board I/O and/or I/O expansion modules.
- D. Building level controllers shall reside on the ELCN using the BACnet@/IP or BACnet@/Ethernet data links as specified in ANSI/ASHRAE Standard 135.
- E. B-BC shall be capable of locally executing global strategies for the BAS based on information from any object in the internetwork. Control Systems that require a higher-level host processor for update, time stamps, global point data, COS transfer, on-line control instruction, or communications control between B-BC panels shall not be acceptable.
- F. BAS shall communicate with all B-AWS, B-BC, B-AAC & B-ASC on a peer-to-peer basis, and shall provide real-time clock functions for scheduling and network-wide time synchronization.
- G. B-BC shall have sufficient memory to support its operating system, database, and programming requirements. Battery/capacitor shall retain static RAM memory and clock functions for a minimum of 72 hours.
 - 1. B-BC operating system, field database, and application programs shall reside in EEPROM.
 - 2. B-BC run-time field database and application programs shall reside in battery backed-up on-board memory of EEPROM.
- H. B-BC shall comply with the following Hardware Configuration:
 - 1. B-BC shall have integral power switch. If the device manufacturer provides no on-board switch then the System Contractor shall provide a separate dedicated transformer and switch within each enclosure for each controller present.
 - 2. B-BC shall provide diagnostic LEDs for power, communications and processor status. The B-BC shall continually check the status of its processor and memory circuits.
 - 3. Controller wiring terminals shall be removable terminal strips for ease of installation and service replacement.
 - 4. All hardware inputs shall be Universal (i.e., binary or analog) configured on hardware and/or in software.
 - a. Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC.
 - b. Pulse accumulation shall accommodate a maximum frequency of 40Hz.
 - c. Inputs shall have a minimum 10 Bit A/D conversion resolution.
 - d. 24VAC over-voltage protection
 - e. Status LED indicators for each input
 - 5. All hardware outputs shall be Universal and configured on hardware and/or in software.
 - a. Outputs shall provide configurable modulating voltage signal to industry standard 0-5VDC and 0-10VDC analog control devices and relays.
 - b. Outputs shall be capable of sourcing 75mA at 12VDC.
 - c. Outputs shall have a minimum 8 Bit D/A conversion resolution.
 - d. 24VAC over-voltage and short protection
- I. B-BC shall interact with the Control System Application Software in compliance with the following:

1. Database programming, configuration and modification shall be accomplished through the B-AWS online with the B-BC. The complete database and application program shall reside in the B-BC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents. Provide a copy of all programming on disc to the Owner.
 2. The B-BC shall function in a real-time, multi-tasking networked operating environment; able to display database values, programs, and control loops in real-time while functional and online using the B-AWS. The user shall be able to add, delete, or modify objects on-line as required without taking the B-BC offline. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary to execute the specified sequence of control.
 3. All required application programming shall be resident in the B-BC, B-AAC & B-ASC, and not in the B-AWS.
 4. B-BC shall manage system-wide alarms by performing distributed, independent alarm analysis and filtering. At no time shall the B-BC panel's ability to report alarms be affected by either operator activity at a B-AWS or local I/O device, or communications with other B-BC on the network.
 - a. B-BCs shall have capability to broadcast alarm conditions automatically across the BLCN or ELCN. Alarm Event notifications shall be sent to off-site computer or serial printer. A minimum of one B-BC per site shall be capable of sending SMTP email messages to an email server for configured alarm conditions.
 - b. Active Alarm Events log shall be stored on the B-BC and may be viewed locally or remotely.
 - c. All alarm or point change reports shall include the point's English language description, and the time and date of occurrence.
 - d. The user shall be able to define the specific system reaction for each point alarm and shall be able to customize reaction and filtering to minimize nuisance reporting. Each B-BC panel shall automatically inhibit the reporting of selected alarms during the standby power modes of operation, loss of power, fire alarm mode, and normal system shutdown and start-up. Users shall have the ability to manually inhibit alarm reporting for each point.
 - e. Alarm reports, messages, and files can be directed to a user-defined list of operator devices, or PCs used for archiving alarm information.
 5. B-BC shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
 - a. B-BC panels shall store point history files for all analog and binary inputs and outputs.
 - b. Measured and calculated analog and binary data shall also be assignable to user-definable trends.
 - c. Trend data shall be stored at the stand-alone B-BC panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired.
 6. Stand-alone B-BC panels shall automatically accumulate and store runtime hours for binary input and output points.
 7. B-BC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.
 8. B-BC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- J. Communication and Protocols
1. The B-BC shall continuously scan the BACnet network and maintain a current database of field data in on board battery/capacitor backed RAM or EEPROM, including alarms, passwords, binding tables, device status, etc. The B-BC shall communicate with BACnet devices on the BLCN using the BACnet physical data link MS/TP at a baud rate of no less than 76.8 Kbps where not limited by third party BACnet devices such as variable frequency drives, utility meters, etc.
 2. The B-BC shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the network using BACnet/IP.
 3. B-BC shall support and be capable of monitoring and controlling a network of communicating remote space sensors. These networked sensors shall occupy input/output hardware points in the B-BC.
 4. B-BC shall support at a minimum of two (2) distinct dedicated BACnet/IP (B/IP) data link networks using TCP/IP and one (1) BACnet/Ethernet data link network simultaneously.
 5. Building level controllers shall support the following communications requirements at a minimum:
 - a. Client and Server BACnet@Subscribe Change of Value (COV) Service.
 - b. Client and Server BACnet@ Read Property Multiple (RPM) Service.
 - c. BACnet@transmit and receive frame segmentation.

- d. Post-installation, field-configurable maximum information frames, APDU frame timeout, APDU segment timeout and APDU retries.
6. Building level controllers shall support SMTP and provide stand-alone remote annunciation of alarms via e-mail without additional hardware, B-AWS or web-server.

2.6 ADVANCED APPLICATION CONTROLLERS (B-AAC)

- A. B-AAC shall comply with all aforementioned BAS System Requirements and shall comply with or exceed the BACnet profile for Advanced Application Controllers (B-AAC).
- B. Furnish one dedicated B-AAC(s) for each small or medium sized mechanical system.
- C. Each B-AAC shall acquire, process, and store point input data on a real time basis for internal use and for sharing with other controllers. Each B-AAC shall also maintain and supervise digital and analog output signals to the control devices and have a real time operating system capable of time of day scheduling and other time based functions.
 1. If the hardware point requirements of any medium-sized system should exceed the I/O configuration of available B-AAC offerings then a B-BC must be used. Control of one piece of mechanical equipment may not be performed by more than one controller.
- D. B-AAC shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory.
- E. Each B-AAC shall be capable of sharing point information with other B-BC, B-AAC, or B-ASC on a peer-to-peer basis via the BACnet BLCN.
- F. Control systems that utilize programmable read only memory (PROM) level application programming are not acceptable.
- G. Once downloaded, a B-AAC shall not require further communication with the B-AWS except for data base changes, operator commands, and requests from the B-AWS for B-AAC data. Programming of B-AACs shall be completely modifiable in the field, over the installed BACnet network.
- H. Each B-AAC shall be provided with the ability to prevent unauthorized access to its software program.
- I. B-AAC shall have sufficient memory to support its operating system, database, and programming requirements.
 1. B-AAC operating system, field database, and application programs shall reside in EEPROM.
- J. B-AAC run-time field database and application programs shall reside in on-board memory or EEPROM.
- K. B-AAC shall feature real-time 24-hour clock and 365-day calendar. Battery or capacitor back-up of these functions is required where the B-AAC is installed as a standalone controller.
- L. B-AAC shall feature a software configurable audible enunciator which shall be configured to trigger on the occurrence of selected alarms, and shall be audible and acknowledgeable either to all users, or only to those users with sufficient password authority.
- M. B-AAC shall comply with the following Hardware Configuration:
 1. B-AAC shall provide diagnostic LEDs for power, communications and processor status. The B-AAC shall continually check the status of its processor and memory circuits.
 2. Universal field device hardware inputs shall be provided and configured on hardware and/or in software and comply with the following:
 - a. Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
 - b. Pulse accumulation shall accommodate a maximum frequency of 100Hz
 - c. Inputs shall have a minimum 10 Bit A/D conversion resolution
 - d. 24VAC over-voltage protection
 3. Hardware Outputs shall be configured as to be modular in nature.
 4. Universal hardware outputs shall be provided and configured on hardware or in software and comply with the following:
 - a. Universal Outputs shall provide configurable modulating voltage signal to industry standard 0-5VDC and 0-10VDC analog control devices and relays
 - b. Outputs shall be capable of sourcing 75mA at 12VDC and 24VDC
 - c. Outputs shall have a minimum 8 Bit D/A conversion resolution
 - d. 24VAC over-voltage and short protection

- N. Control System Application Software:
1. The B-AAC application software shall be the same as and indistinguishable from the B-BC specified interaction with the Control System Application Software.
 2. The controller software shall reside in a real time, multi-tasking, networking operating environment. Database definition shall be accomplished through the B-AWS online with the B-AAC. The complete database and application program shall reside in the B-AAC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents.
 3. The user shall be able to add, delete, or modify objects on-line as required. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary for proper sequence of control.
- O. Communications and Protocols
1. The B-AAC shall communicate with field devices and controllers on the BLCN using the BACnet physical data link MS/TP at 76.8 Kbps where not limited by third party devices such as variable frequency drives, utility meters, etc.
 2. The B-AAC shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the network.
 3. B-AAC shall support and be capable of monitoring and controlling a network of a minimum of four (4) communicating remote space sensors. These networked sensors shall not consume input/output hardware points in the B-AAC.
- P. B-AAC shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
1. B-AAC panels shall store point history files for all analog and binary inputs and outputs.
 2. Measured and calculated analog and binary data shall also be assignable to user-definable trends.
 3. Trend data shall be stored at the stand-alone B-AAC panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired.
- Q. Stand-alone B-AAC panels shall automatically accumulate and store runtime hours for binary input and output points.
- R. B-AAC panels shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis for user-selected analog and binary pulse input-type points.
- S. B-AAC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- T. B-AAC shall support, transmit, and receive of segmented messages.

2.7 APPLICATION SPECIFIC CONTROLLERS (B-ASC)

- A. B-ASC shall comply with all aforementioned BAS System Requirements and shall comply with the BACnet profile for Application Specific Controllers (B-ASC).
- B. B-ASC shall reside on the FLCN using the BACnet@MS/TP data link as specified in ANSI/ASHRAE Standard 135 in compliance with the following requirements at a minimum:
1. Automatically detect the baud of the MS/TP network and then configure the device's communication baud to match that of the MS/TP network.
- C. B-ASC shall support the following communications requirements at a minimum:
1. Client and Server BACnet@Subscribe Change of Value (COV) Service.
 2. Client and Server BACnet@Read Property Multiple (RPM) Service.
 3. BACnet@transmit and receive frame segmentation.
 4. Post-installation, field-configurable maximum information frames, APDU frame timeout, APDU segment timeout and APDU retries.
- D. Provide one dedicated B-ASC for each Terminal Unit Mechanical Device on the project. Those include Variable Air Volume (VAV) Air Terminal Units (ATU), Serial and Parallel Fan-Powered (FP) VAV ATU's, Unit Heaters (UH), Unit Ventilators (UV), Fan Coil Units (FCU) and Individual Fans.
- E. B-ASC shall provide microprocessor based self-contained stand-alone fully programmable operation of local process control loops. All local level application programs shall be installed on individual controllers in non-volatile memory.

- F. Each B-ASC shall be capable of sharing point information with other B-BC, B-AAC, or B-ASC on a peer-to-peer basis via the BACnet BLCN.
- G. Control systems that utilize programmable read only memory (PROM) level application programming are not acceptable.
- H. Once downloaded, a B-ASC shall not require further communication with the B-AWS except for data base changes, operator commands, and requests from the B-AWS for B-ASC data. Programming of B-ASCs shall be completely modifiable in the field, over installed BACnet Internetwork.
 - 1. Each B-ASC shall be provided with the ability to prevent unauthorized access to its software program.
 - 2. B-ASC shall have sufficient memory to support its operating system, database, and programming requirements.
 - 3. B-ASC operating system, field database, and application programs shall reside in EEPROM.
 - 4. B-ASC run-time field database and application programs shall reside in on-board non-volatile memory or EEPROM.
- I. B-ASC shall perform and manage historical data collection. Minimum sampling time shall be configurable with a minimum sample rate of once per second.
 - 1. B-ASC panels shall store point history files for all analog and binary inputs and outputs.
 - 2. Measured and calculated analog and binary data shall also be assignable to user-definable trends.
 - 3. Trend data shall be stored at the stand-alone B-ASC panels, and uploaded to hard disk storage automatically at preconfigured intervals when archival is desired.
- J. Stand-alone B-ASC panels shall automatically accumulate and store runtime hours for binary input and output points.
- K. B-ASC panels shall automatically sample, calculate and store consumption totals on a daily, weekly or monthly basis for user-selected analog and binary pulse input-type points.
- L. B-ASC panels shall have the ability to count and/or execute events on a daily, weekly, or monthly basis.
- M. B-ASC for VAV ATU's application shall comply with the following:
 - 1. B-ASC shall be provided with integral damper actuator. Actuator shall feature the following at a minimum:
 - a. 35 in-lbs of torque
 - b. Brushless DC Operator
 - c. Actual damper position feedback. Drive time or other software calculated damper position shall not be accepted
 - d. Damper End Switch using motor current sense or equivalent for positive feedback of both end stop positions.
 - e. Software selectable rotation.
 - 2. Airflow Calibration, Test and Air Balance, etc. shall be performed via dedicated handheld configuration tool connected directly to communication port located at ATU B-ASC sensor. Special proprietary software and/or applications loaded on a computer, tablet or other similar device shall not be acceptable to perform this function. Software internal to the controller and which automatically performs the Airflow Calibration, Test and Air Balance process is acceptable.
 - 3. B-ASC shall provide diagnostic LEDs for power, communications and processor status. The B-ASC shall continually check the status of its processor and memory circuits
- N. B-ASC for unitary applications shall comply with the following:
 - 1. B-ASC shall provide diagnostic LEDs for power, communications and processor status. The B-ASC shall continually check the status of its processor and memory circuits.
 - 2. Controller wiring terminals shall be removable terminal strips for ease of installation and service replacement.
 - 3. Universal field device hardware inputs shall be provided and configured on hardware and/or in software and comply with the following:
 - a. Inputs shall accept dry-contact, thermistor, 4-20 mA, and 0-5VDC
 - b. Pulse accumulation shall accommodate a minimum frequency of 40Hz
 - c. Inputs shall have a minimum 10 Bit A/D conversion resolution
 - d. 24VAC over-voltage protection
 - 4. Hardware Outputs shall be configured on hardware and/or in software and comply with the following:

- a. Universal Outputs shall provide configurable modulating voltage signal to industry 0-5VDC and 0-10VDC analog control devices and relays.
 - b. Each TRIAC Output shall source 500 mA current, 24 VAC 0.5 ACA
 - c. Universal Output shall be capable of sourcing 75mA at 12VDC
 - d. Outputs shall have a minimum 8 Bit D/A conversion resolution
 5. 24VAC over-voltage and short protection
- O. Control System Application Software:
1. The B-ASC application software shall be the same as and indistinguishable from the B-BC specified interaction with the Control System Application Software.
 2. The controller software shall reside in a real time, multi-tasking, networking operating environment. Database definition shall be accomplished through the B-AWS online with the B-ASC. The complete database and application program shall reside in the B-ASC. The System Contractor shall configure the software to attain the proper sequence of control and to accomplish all other control system functions indicated in the Contract Documents.
 3. The user shall be able to add, delete, or modify objects on-line as required. The programming shall provide all the necessary mathematics, logic, utility and control functions necessary for proper sequence of control.
- P. Communications and Protocols
1. The B-ASC shall communicate with field devices and controllers on the BLCN using the BACnet physical data link MS/TP at 76.8 Kbps where not limited by third party devices such as variable frequency drives, utility meters, etc.
 2. The B-ASC shall provide a communications port for connection of the Portable Operators Terminal using Point-to-Point BACnet physical data link layer protocol or a connection to the inter-network.
 3. B-ASC shall support, transmit, and receive of segmented messages.
- Q. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.
1. Binary Inputs: Allow monitoring of on-off signals without external power.
 2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
 3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
 4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation with three-position (on-off-auto) override switches and status lights.
 5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA) with status lights, two-position (auto-manual) switch, and manually adjustable potentiometer.
 6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
 7. Universal I/Os: Provide software selectable binary or analog outputs.
- R. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:
1. Output ripple of 5.0 mV maximum peak to peak.
 2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
 3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.8 ENCLOSURES AND SUB-PANELS

- A. Provide pedestal base or wall mounted local control enclosure to house all control components associated with each area, system or mechanical equipment room.
1. The enclosures shall be minimum 16 gauge steel or aluminum, totally enclosed on all sides and painted with a baked enamel finish. All enclosures must maintain a minimum separation of 1" from the back wall.
 2. Enclosures located in wet indoor conditions or located outdoors shall meet NEMA 4X.
 3. Penetrations are permitted on all sides of the enclosure. Do not make conduit penetrations in top or side of enclosure. Each enclosure shall be equipped with a wire gutter below with a minimum of six ¾" minimum conduit penetrations into the bottom of the enclosure to accommodate system wiring.

4. Where required by AHJ, enclosures located in mechanical or electrical rooms shall meet NEMA 2 requirements.
 5. Enclosures located in all other locations including but not limited to mechanical or electrical rooms not requiring NEMA 2, occupied spaces, above ceilings and plenums shall be the same NEMA classification as all other enclosures located in the same environment, except if location requires additional protection due to potential vandalism or environmental conditions and shall at a minimum meet NEMA 1 requirements.
 6. Enclosures provided as an integral (pre-packaged) part of another product and/or piece of equipment are acceptable.
 7. Provide a continuous piano hinged door, keyed locking latch and removable sub-panel. A single key shall be common to all control enclosures.
- B. Provide each DDC panel with a line filter, surge suppressor, electrical disconnect, control fuse, and control transformer. All sized and provided by the control system contractor.
- C. Provide power supplies located inside control enclosures shall be fully enclosed with external 24 Vac terminals, on/off control, equipment overcurrent protection, power indication, high/low voltage separation, and convenience 120VAC outlets.
- D. Provide insulated, modular, feed-through, clamp-style terminal blocks suitable for rail-mounting with end plates and partitions for the termination of all field wiring in control enclosures. Field wiring to equipment with integral terminals and/or unitary equipment (i.e., VAV ATU's, EF's, &c.) shall not be required to have terminal blocks.
- E. Rail mounted terminal blocks shall be color coded to match the associated conductor colors.

2.9 ELECTRONIC SENSORS

- A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
- B. Thermistor Temperature Sensors and Transmitters:
1. I.T.M. Instruments Inc.
 2. MAMAC Systems, Inc.
 3. RDF Corporation.
 4. ACI
 5. Siemens
 6. Accuracy: Plus or minus [0.5 deg F] [0.36 deg F] at calibration point.
 7. Wire: Twisted, shielded-pair cable.
 8. Insertion Elements in Ducts: Single point, [8 inches] [18 inches] long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 9. Averaging Elements in Ducts: as indicated on the control diagrams.
 10. Insertion Elements for Liquids: Brass or stainless-steel socket with minimum insertion length of 2-1/2 inches.
 11. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Concealed.
 - d. Color: White
 - e. Orientation: Vertical.
 12. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 13. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- C. RTDs and Transmitters:
1. BEC Controls Corporation.
 2. MAMAC Systems, Inc.
 3. RDF Corporation.
 4. Siemens
 5. Accuracy: Plus or minus 0.2 percent at calibration point.
 6. Wire: Twisted, shielded-pair cable.
 7. Insertion Elements in Ducts: Single point, [8 inches] [18 inches] long; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft..
 8. Averaging Elements in Ducts: as indicated on the control diagrams.
 9. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches.

10. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Concealed.
 - d. Color: White
 - e. Orientation: Vertical.
 11. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
 12. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.
- D. Humidity Sensors: Bulk polymer sensor element.
1. BEC Controls Corporation.
 2. General Eastern Instruments.
 3. MAMAC Systems, Inc.
 4. ROTRONIC Instrument Corp.
 5. TCS/Basys Controls.
 6. Vaisala.
 7. Siemens
 8. Accuracy: 5 percent full range with linear output.
 9. Room Sensor Range: 20 to 80 percent relative humidity.
 10. Room Sensor Cover Construction: Manufacturer's standard locking covers.
 - a. Set-Point Adjustment: Concealed.
 - b. Set-Point Indication: Concealed.
 - c. Thermometer: Concealed.
 - d. Color: White
 - e. Orientation: Vertical.
 11. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
 12. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor temperatures of 32 to 120 deg F.
 13. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.
- E. Pressure Transmitters/Transducers:
1. [Available]Manufacturers:
 - a. MAMAC Systems, Inc.
 - b. SETRA
 2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.
 - a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
 - b. Output: 4 to 20 mA.
 - c. Building Static-Pressure Range: -0.25- to 0.25-inch wg.
 - d. Duct Static-Pressure Range: 0- to 5-inch wg.
 3. Water Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure; linear output 4 to 20 mA.
 4. Water Differential-Pressure Transducers: Stainless-steel diaphragm construction, suitable for service; minimum 150-psig operating pressure and tested to 300-psig; linear output 4 to 20 mA.
 5. Pressure Transmitters: Direct acting for gas, liquid, or steam service; range suitable for system; linear output 4 to 20 mA.
- F. Room Sensor Cover Construction: Manufacturer's standard locking covers.
1. Set-Point Adjustment: Concealed.
 2. Set-Point Indication: Exposed.
 3. Thermometer: Concealed.
 4. Color: White
 5. Orientation: Vertical.
- G. Room sensor accessories include the following:
1. Insulating Bases: For sensors located on exterior walls.
 2. Adjusting Key: As required for calibration and cover screws.

2.10 STATUS SENSORS

- A. Status Inputs for Fans: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- B. Status Inputs for Pumps: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split-core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.
- D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.
- E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.
- F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.
- G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.
- H. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

2.11 GAS DETECTION EQUIPMENT

- A. Ebtron, Inc.
- B. Armstrong Monitoring
- C. Honeywell International Inc.; Home & Building Control.
- D. MSA Canada Inc.
- E. TSI Incorporated.
- F. Senva.
- G. Siemens.
- H. Carbon Monoxide Detectors: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F; with 2 factory-calibrated alarm levels at 50 and 100 ppm.
- I. Carbon Dioxide Sensor and Transmitter: Single detectors using solid-state infrared sensors; suitable over a temperature range of 23 to 130 deg F and calibrated for 0 to 2 percent, with continuous or averaged reading, 4- to 20-mA output; for wall mounting.
- J. Nitrogen Dioxide Sensor and Transmitter: Single or multichannel, dual-level detectors using solid-state plug-in sensors with a 3-year minimum life; suitable over a temperature range of 32 to 104 deg F and with a standard range of 0-10 ppm; with 2 factory-calibrated alarm levels at 2 and 5 ppm.

2.12 REFRIGERANT VAPOR DETECTION SYSTEM

- A. All alarms from the Refrigerant Vapor Detection System shall be annunciated through BAS at the ADVANCED OPERATORS WORKSTATION (B-AWS).
- B. See Specification Section 236416 - Centrifugal Water Chillers for additional information.

2.13 WATER FLOW METERS

- A. Acceptable Manufacturers
 1. Basis of design: Onicon
 2. Approved performance equal

- B. Provide an ONICON F-3200 Series Electromagnetic Flow Meter complete with integral electronics module. The electronics module shall include a backlit graphic display and keypad. Connections to the piping shall be ANSI class 150 flanges (ANSI class 300 available where required). The installing contractor is responsible for providing suitable mating flanges. The flow tube shall be epoxy coated steel; the sensing electrodes shall be 316SS; the liner shall be polypropylene or ebonite for low temperature service, PTFE for hot water service. Each flow meter shall be individually wet-calibrated and accurate to within $\pm 0.2\%$ of reading from 1.6 to 33 feet per second velocity. A certificate of calibration shall be provided with each flow meter. Output signals shall be 4-20 mA and programmable pulse. The flow meter shall be capable of measuring bi-directional flow. For installations in non-metallic pipe, install grounding rings between flanges. Each flow meter shall be factory programmed for its specific application, and shall be re-programmable using the integral keypad on the converter (no special interface device or computer required). Each flow meter shall be covered by the manufacturer's two-year warranty.

2.14 DUCT AIR FLOW MEASURING STATIONS

- A. Acceptable Manufacturers
1. EBTRON, Inc. model GTx116-P+ is the basis of design.
 2. Approved performance equal
- B. General
1. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
 - a. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.
 2. Substitution requests for acceptance less than 60 days prior to bid date or products submitted in non-conformance with the requirements of this specification will not be considered.
 - a. For any product to be considered for substitution, a written document shall be submitted to the engineer detailing exceptions and compliance, section-by-section with supporting documentation, before an approval will be considered.
 - b. Any product submitted as an equal shall be expected to comply with all performance capabilities and functional aspects of this specification.
 3. Excluded devices
 - a. Fan Inlet airflow measurement devices.
 - b. Measurement technologies using "chip-in-glass", "chip-in-epoxy" or other "chip" type thermistors for the heated sensor component are not acceptable.
 - c. Pitot tubes, Pitot arrays, Piezo rings and other differential pressure based devices are not acceptable.
 - d. Vortex shedding devices are not acceptable.
- C. Required product performance
1. Airflow Measurement Devices (AMD) with Temperature Output and Airflow Alarming Capability
 2. General
 - a. Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
 - b. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
 - 1) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
 - c. Airflow measurement shall be field configurable to determine the average Actual or Standard mass airflow rate.
 - 1) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
 - d. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature.
 3. Sensor Probes
 - a. Sensor probes shall be constructed of gold anodized, 6063 aluminum alloy tube, 316 stainless steel tube are available when required.
 - b. Sensor probe mounting brackets shall be constructed of 304 stainless steel.
 - c. Probe internal wiring between the connecting cable and sensor nodes shall be Kynar coated copper.

- 1) PVC jacketed internal wiring is not acceptable.
- d. Probe internal wiring connections shall consist of solder joints and spot welds.
 - 1) Internal wiring connections shall be sealed and protected from the elements. They shall be capable of direct exposure to water without affecting instrument operation.
 - 2) Connectors of any type within the probe are not acceptable.
 - 3) Printed circuit boards within the probe are not acceptable.
- e. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67° F to 392° F (-55° C to 200° C) and continuous and direct UV exposure.
 - 1) Plenum rated PVC jacket cables are not acceptable.
- f. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
- g. Each sensor probe shall contain one or more independently wired sensing nodes.
- h. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.
- i. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Upon request, the manufacture shall provide a written independent laboratory test result of 100% survival rate in a 30 day saltwater and acid vapor test.
 - 1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
 - 2) Devices with exposed leads are not acceptable.
- j. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
- k. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of $\pm 2\%$ of reading over the entire calibrated airflow range of 0 to 5,000 FPM (25.4 m/s).
 - 1) Upon request the manufacture shall submit for AMD approval a copy of the NIST report of calibration used for the reference standard used.
 - a) Devices claiming NIST traceability to third party laboratories and not directly to NIST are not acceptable.
 - b) Devices calibrated against standards other than the NIST LDA are not acceptable.
- l. Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
- m. The installed airflow accuracy shall be:
 - 1) Ducts - $\pm 3\%$ of reading when installed in accordance with the manufactures recommended placement guidelines.
 - 2) Non-ducted Outdoor Air intakes – better than or equal to $\pm 5\%$ of reading when installed in accordance with the manufactures recommended placement guidelines.
- n. Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.
- o. Each sensing node shall have a temperature accuracy of $\pm 0.15^\circ$ F (0.08° C) over an operating range of -20° F to 160° F (-28.9° C to 71.1° C) and humidity range of 0 to 100% RH.
4. Transmitter
 - a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
 - b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
 - c. All printed circuit board interconnects, edge fingers, receptacle plug pins and PCB test points shall be gold plated.
 - d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
 - e. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
 - f. The transmitter shall be capable of determining the airflow rate and temperature average of all connected sensor nodes in an array for a single location.
 - 1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).

- g. The transmitter shall be capable of providing a high and/or low airflow alarm with user-defined set point and % of set point tolerance. Alarm shall be capable of being manually or automatically reset and low-limit cutoff value may be selected to disable the alarm. An alarm delay function shall also be field defined.
 - h. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
 - i. The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.
 - j. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
 - k. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with either of the following:
 - 1) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection
 - 2) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection
 - l. The analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate and the second output (AO2) shall be field configurable to provide temperature information.
 - m. The transmitter shall also be available with a single isolated LonWorks Free Topology network interface. Transmitters shall be available alternatively with one USB connection for thumb-drive data logging of sensor data. Neither of these options shall include analog output signals.
 - n. The network communications RS-485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures. Individual node airflow rates and temperatures shall NOT be available via the network with Lon.
 - o. The transmitter shall have an on-off power switch. Isolation transformers shall not be required.
 - p. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @20 V-A maximum and use a switching power supply that is over-current and over-voltage protected.
 - q. The transmitter shall use a "watchdog" timer circuit to ensure automatic reset after power disruption, transients and brown-outs.
 - r. Each transmitter shall have an operating temperature range of -20° F to 120° F (-28.9° C to 48.9° C) and humidity range of 5 to 95% RH.
5. Listings and Certifications
- a. The AMD shall be UL/cUL 873 Listed as an assembly
 - 1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
 - b. All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed.
 - c. The AMD shall be tested for compliance with the EMC Directive's requirements and be certified to carry the CE Mark for European Union Shipments.
6. Installation
- a. Install in accordance with manufacturer's placement guidelines. A written report shall be submitted to the consulting mechanical engineer if any discrepancies are found.

2.15 FAN AIR FLOW MEASURING STATIONS

- A. Acceptable Manufacturers
 - 1. EBTRON, Inc. model GTx108-F is the basis of design.
 - 2. Approved performance equal
- B. General
 - 1. Airflow measurement devices shall use the principle of thermal dispersion and provide one self-heated bead-in-glass thermistor and one zero power bead-in-glass thermistor at each sensing node.
 - a. Thermal dispersion devices that indirectly heat a thermistor are not acceptable.

2. Substitution requests for acceptance less than 60 days prior to bid date or products submitted in non-conformance with the requirements of this specification will not be considered.
 - a. For any product to be considered for substitution, a written document shall be submitted to the engineer detailing exceptions and compliance, section-by-section with supporting documentation, before an approval will be considered.
 - b. Any product submitted as an equal shall be expected to comply with all performance capabilities and functional aspects of this specification.
 3. Excluded devices
 - a. Fan Inlet airflow measurement devices.
 - b. Measurement technologies using “chip-in-glass”, “chip-in-epoxy” or other “chip” type thermistors for the heated sensor component are not acceptable.
 - c. Pitot tubes, Pitot arrays, Piezo rings and other differential pressure based devices are not acceptable.
 - d. Vortex shedding devices are not acceptable.
- C. Required product performance
1. Airflow Measurement Devices (AMD) with Temperature Output and Airflow Alarming Capability
 2. General
 - a. Provide one AMD for each measurement location provided on the plans, schedules and/or control diagrams to determine the average airflow rate and temperature at each measurement location.
 - b. Each AMD shall be provided with a microprocessor-based transmitter and one or more sensor probes.
 - 1) Devices that have electronic signal processing components on or in the sensor probe are not acceptable.
 - c. Airflow measurement shall be field configurable to determine the average Actual or Standard mass airflow rate.
 - 1) Actual airflow rate calculations shall have the capability of being corrected by the transmitter for altitudes other than sea level.
 - d. Temperature measurement shall be field configurable with velocity weighted average as the default, or manual selection of arithmetic average temperature
 3. Sensor probes
 - a. Sensor probes shall consist of one sensor node mounted on a 304 stainless steel block with two adjustable zinc plated steel rods connected to 304 stainless steel pivoting mounting feet.
 - b. Sensor node internal wiring connections shall be sealed and protected from the elements and suitable for direct exposure to water.
 - c. Each sensor probe shall be provided with an integral, FEP jacket, plenum rated CMP/CL2P, UL/cUL Listed cable rated for exposures from -67°F to 392 °F (-55° C to 200° C) and continuous and direct UV exposure.
 - 1) Plenum rated PVC jacket cables are not acceptable.
 - d. Each sensor probe cable shall be provided with a connector plug with gold plated pins for connection to the transmitter.
 - e. Sensor node airflow and temperature calibration data shall be stored in a serial memory chip in the cable connecting plug and not require matching or adjustments to the transmitter in the field.
 - f. Each sensor node shall be provided with two bead-in-glass, hermetically sealed thermistors potted in a marine grade waterproof epoxy with sensor housings constructed of glass-filled polypropylene. Upon request, the manufacture shall provide a written independent laboratory test result of 100% survival rate in a 30 day saltwater and acid vapor test.
 - 1) Devices that use epoxy or glass encapsulated chip thermistors are not acceptable.
 - 2) Devices with exposed leads are not acceptable.
 - g. Each thermistor shall be individually calibrated at a minimum of 3 temperatures to NIST-traceable temperature standards.
 - h. Each sensor node shall be individually calibrated at 16 measurement points to airflow standards directly calibrated at NIST to the NIST Laser Doppler Anemometer (LDA) primary velocity standard and have an accuracy of $\pm 2\%$ of reading over the entire calibrated airflow range of 0 to 10,000 FPM (50.8 m/s).
 - 1) Upon request the manufacture shall submit for AMD approval a copy of the NIST report of calibration used for the reference standard used.

- a) Devices calibrated against standards other than the NIST LDA or against NIST temperature standards only are not acceptable.
 - 2) Accuracy shall include the combined uncertainty of the sensor nodes and transmitter.
 - 3) Devices whose overall accuracy is based on individual accuracy specifications of the sensor probes and transmitter shall demonstrate compliance with this requirement over the entire operating range.
 - i. Each sensing node shall have a temperature accuracy of $\pm 0.15^{\circ}\text{F}$ (0.08°C) over an operating range of -20°F to 160°F (-28.9°C to 71.1°C) and humidity range of 0 to 100% RH.
 - j. The number of independent sensor nodes provided shall be as follows:
 - 1) SWSI and DWDI fans: 2 probes x 1 sensor node/per probe in each fan inlet
 - 2) Fan Arrays (1 to 8 fans): 2 probes x 1 sensor node probe in each fan inlet
4. Transmitter
- a. A remotely located microprocessor-based transmitter shall be provided for each measurement location.
 - b. The transmitter shall be comprised of a main circuit board and interchangeable interface card.
 - c. All printed circuit board interconnects, edge fingers, and test points shall be gold plated.
 - d. All printed circuit boards shall be electroless nickel immersion gold (ENIG) plated.
 - e. All integrated circuitry shall be temperature rated as 'industrial-grade'. Submissions containing 'commercial-grade' integrated circuitry are not acceptable.
 - f. The transmitter shall be capable of determining the airflow rate and temperature of each fan
 - 1) Separate integration buffers shall be provided for display airflow output, airflow signal output (analog and network) and individual sensor output (IR-interface).
 - g. The transmitter shall have startup firmware to facilitate setup of multiple fans and fan areas.
 - h. The transmitter shall be capable of providing a low and/or high airflow set point alarm.
 - i. The transmitter shall be capable of providing individual fan alarming on fan array configurations.
 - j. The transmitter shall be capable of identifying an AMD malfunction via the system status alarm and ignore any sensor node that is in a fault condition.
 - k. The transmitter shall be capable of field configuration, diagnostics and include Field Output Adjustment Wizard that allows for a one or two point field adjustment to factory calibration for installations that require adjustment.
 - l. The transmitter shall be provided with a 16-character, alpha-numeric, LCD display.
 - m. The transmitter shall be provided with two field selectable (0-5/0-10 VDC or 4-20mA), scalable, isolated and over-current protected analog output signals (AO1=airflow, AO2=temperature or alarm), in combination with either of the following:
 - 1) one isolated RS-485 (field selectable BACnet MS/TP or Modbus RTU) network connection
 - 2) one isolated Ethernet (simultaneously supported BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) network connection
 - n. Analog signal capability shall include two output terminals: the first (AO1), shall provide the total airflow rate; while the second output (AO2) shall be field configurable to provide temperature.
 - o. The transmitter shall also be available with a single isolated LonWorks Free Topology network interface. Transmitters shall be available alternatively with one USB connection for thumb-drive data logging of sensor data. Neither of these options shall include analog output signals.
 - p. Network communications RS 485 (BACnet MS/TP or Modbus RTU) or Ethernet (BACnet Ethernet or BACnet IP, Modbus TCP and TCP/IP) shall provide: the average airflow rate, temperature, hi and/or low airflow set point alarm, system status alarm, individual sensor node airflow rates and individual sensor node temperatures. Individual node airflow rates and temperatures shall be available via the network with Lon.
 - q. The transmitter shall have an on-off power switch. Isolation transformers shall not be required.
 - r. The transmitter shall be powered by 24 VAC (22.8 to 26.4 under load) @16 V-A maximum and use a switching power supply that is over-current and over-voltage protected.
 - s. The transmitter shall use a "watchdog" timer circuit to ensure automatic reset after power disruption, transients and brown-outs.

- t. Each transmitter shall have an operating range of -20° F to 120° F (-28.9° C to 48.9° C) and humidity range of 5 to 95% RH.
- 5. Listing and Certifications
 - a. The AMD shall be UL/cUL 873 Listed as an assembly
 - 1) Devices claiming compliance with the UL Listing based on individual UL component listing are not acceptable.
 - b. All network-capable AMD models supplied with RS-485 interface and BACnet protocol shall be BTL Listed
- 6. Installation
 - a. Install in accordance with manufacturer's placement guidelines. A written report shall be submitted to the consulting mechanical engineer if any discrepancies are found.

2.16 THERMOSTATS

- A. Siemens
- B. Johnson Controls.
- C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.
 - 1. Automatic switching from heating to cooling.
 - 2. Preferential rate control to minimize overshoot and deviation from set point.
 - 3. Set up for four separate temperatures per day.
 - 4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
 - 5. Short-cycle protection.
 - 6. Programming based on every day of week.
 - 7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
 - 8. Battery replacement without program loss.
 - 9. Thermostat display features include the following:
 - a. Time of day.
 - b. Actual room temperature.
 - c. Programmed temperature.
 - d. Programmed time.
 - e. Duration of timed override.
 - f. Day of week.
 - g. System mode indications include "heating," "off," "fan auto," and "fan on."
- D. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
- E. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch or equivalent solid-state type, with heat anticipator; listed for electrical rating; with concealed set-point adjustment, 55 to 85 deg F set-point range, and 2 deg F maximum differential.
 - 1. Electric Heating Thermostats: Equip with off position on dial wired to break ungrounded conductors.
 - 2. Selector Switch: Integral, manual on-off-auto.
- F. Remote-Bulb Thermostats: On-off or modulating type, liquid filled to compensate for changes in ambient temperature; with copper capillary and bulb, unless otherwise indicated.
 - 1. Bulbs in water lines with separate wells of same material as bulb.
 - 2. Bulbs in air ducts with flanges and shields.
 - 3. Averaging Elements: Copper tubing with either single- or multiple-unit elements, extended to cover full width of duct or unit; adequately supported.
 - 4. Scale settings and differential settings are clearly visible and adjustable from front of instrument.
 - 5. On-Off Thermostat: With precision snap switches and with electrical ratings required by application.
 - 6. Modulating Thermostats: Construct so complete potentiometer coil and wiper assembly is removable for inspection or replacement without disturbing calibration of instrument.

2.17 HUMIDISTATS

- A. MAMAC Systems, Inc.

- B. ROTRONIC Instrument Corp.
- C. Johnson Controls
- D. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.18 ACTUATORS

- A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.
 - 1. Available manufacturers;
 - a. Belimo
 - b. Siemens
 - c. Johnson Controls
 - 2. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 3. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
 - 4. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 5. Spring-Return Motors for Valves Larger Than NPS 2-1/2: Size for running and breakaway torque of 150 in. x lbf.
 - 6. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
 - 7. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
- B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 1. Belimo Aircontrols (USA), Inc
 - 2. |Siemens
 - 3. IMI TA / Victaulic - Slider
 - 4. Honeywell.
 - 5. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 6. Dampers: Size for running torque calculated as follows:
 - a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. of damper.
 - b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. of damper.
 - c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft. of damper.
 - d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. of damper.
 - e. Dampers with 2- to 3-Inch wg of Pressure Drop or Face Velocities of 1000 to 2500 fpm: Increase running torque by 1.5.
 - f. Dampers with 3- to 4-Inch wg of Pressure Drop or Face Velocities of 2500 to 3000 fpm: Increase running torque by 2.0.
 - 7. Coupling: V-bolt and V-shaped, toothed cradle.
 - 8. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 9. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
 - 10. Power Requirements (Two-Position Spring Return): 24 120 -V ac.
 - 11. Power Requirements (Modulating): Maximum 25 VA at 24-V ac or 8 W at 24-V dc.
 - 12. Proportional Signal: 0-10vdc, 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
 - 13. Temperature Rating: Minus 22 to plus 122 deg F.
 - 14. Run Time: 12 seconds open, 5 seconds closed.
 - 15. The manufacturer shall provide 5-year limited warranty from the date of sale covering defects in material or workmanship.
 - 16. Installation
 - a. All actuators are to be installed by trained personnel from the manufacturer or by the mechanical contractor with guidance from the manufacturer representative.
 - b. All actuators are to be delivered with a detailed written installation instruction.

2.19 CONTROL VALVES

- A. Belimo
- B. Siemens
- C. Johnson Controls
- D. IMI TA / Victaulic – Modulator P or Fusion
- E. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.
- F. Hydronic system Characterized Ball valves shall have the following characteristics:
 - 1. 3" and Smaller: Nickel-plated forged brass body rated at no less than 400 psi, stainless steel ball and blowout proof stem, female NPT end fittings, with a dual EPDM O-ring packing design, fiberglass reinforced Teflon seats, and a TEFZEL or stainless steel flow characterizing disc.
 - 2. 2-1/2" through 6": GG25 cast iron body, ANSI 125, class B, stainless steel ball and blowout proof stem, flange to match ANSI 125 with a dual EPDM O-ring package design, PTFE seats, and a stainless steel flow characterizing disc.
 - 3. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
 - 4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - 5. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 - 6. Valve assemblies shall be maintenance free.
- G. Hydronic system Globe valves shall have the following characteristics:
 - 1. NPS 2 and Smaller: Class [125] [250] bronze body, bronze trim, rising stem, renewable composition disc, and screwed ends with backseating capacity repackable under pressure.
 - 2. NPS 2-1/2 and Larger: Class 125 iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc.
 - 3. Internal Construction: Replaceable plugs and stainless-steel or brass seats.
 - a. Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom.
 - b. Double-Seated Valves: Balanced plug; cage trim provides seating and guiding surfaces for plugs on top and bottom.
 - 4. Sizing: 5-psig maximum pressure drop at design flow rate or the following:
 - a. Two Position: Line size.
 - b. Two-Way Modulating: Either the value specified above or twice the load pressure drop, whichever is more.
 - c. Three-Way Modulating: Twice the load pressure drop, but not more than value specified above.
 - 5. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
 - 6. Close-Off (Differential) Pressure Rating: Combination of actuator and trim shall provide minimum close-off pressure rating of 150 percent of total system (pump) head for two-way valves and 100 percent of pressure differential across valve or 100 percent of total system (pump) head.
 - 7. Two- and three-way globe valves shall be used only if characterized control valves do not fit the sizing criteria or application.
- H. Hydronic system Butterfly Valves - Resilient Seat shall have the following characteristics:
 - 1. NPS 2 to 12: Valve body shall be full lugged ductile iron 200 psig body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize an internal spline. The shaft shall be supported at four locations by RPTFE bushings. A coated disc shell is not acceptable.
 - 2. NPS 14 and Larger: Valve body shall be full lugged ductile iron 200 psig body with a 304 stainless steel disc, EPDM seat, extended neck and shall meet ANSI Class 125/150 flange standards. Disc-to-stem connection shall utilize a dual-pin method to prevent the disc from settling onto the liner. The shaft shall be supported at four locations by RPTFE bushings. A coated disc shell is not acceptable.

3. Sizing: Two-Position (on/off) butterfly valves shall be sized using the 90⁰ Cv rating. Modulating butterfly valves shall be sized using the 60⁰ Cv rating.
 - a. Maximum pressure drop shall not exceed 5-psig at design flow rate.
 4. Flow Characteristics: Modified equal percentage, unidirectional dead end service.
 5. Close-Off Pressure Rating: Bubble-tight shutoff (no leakage).
 6. The combination of two 2-way butterfly valves in a tee configuration cross-linked to ensure proper flow orientation shall be permitted. The tee shall be constructed of cast iron/stainless steel.
- I. Hydronic system Butterfly Valves - High Performance shall have the following characteristics:
1. Valve body shall be full lugged carbon steel ANSI Class 150 body with a 316 stainless steel disc without a nylon coating, RTFE seat, and be ANSI Class 150300 flange standards. Blowout-proof shaft shall be 17-4ph stainless steel and shall be supported at four locations by glass-backed TFE bushings. Valve packing shall be Chevron TFE and shall include fully adjustable packing flange and separable packing gland. Valve body shall have long stem design to allow for 2" insulation (minimum). Valve face-to-face dimensions shall comply with API 609 and MSS-SP-68. Valve assembly shall be completely assembled and tested, ready for installation.
 2. Sizing: Two-Position (on/off) butterfly valves shall be sized using the 90⁰ Cv rating. Modulating butterfly valves shall be sized using the 60⁰ Cv rating.
 - a. Maximum pressure drop shall not exceed 5-psig at design flow rate.
 3. Flow Characteristics: Modified equal percentage, full rated, bi-directional, dead end service with either flange removed.
 4. Close-Off Pressure Rating: Bubble-tight shutoff (no leakage).
 5. Media Temperature Range: ANSI Class 150 limitations.
 6. Max Differential Pressure: 285 psi @ 100 deg F for ANSI 150.
 7. The combination of two 2-way butterfly valves in a tee configuration cross-linked to ensure proper flow orientation shall be permitted. The tee should be constructed of cast iron/stainless steel.
- J. Terminal Unit Control Valves: Bronze body, bronze trim, two or three ports as indicated, replaceable plugs and seats, and union and threaded ends.
1. Rating: Class 150 for service at 150 psig and 250 deg F operating conditions.
 2. Sizing: 3-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
 3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.

2.20 DAMPERS

- A. TAMCO (T. A. Morrison & Co. Inc.).
- B. Ruskin
- C. Greenheck
- D. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.
 1. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with oil-impregnated sintered bronze blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
 2. Operating Temperature Range: From minus 40 to plus 200 deg F.
 3. Edge Seals, Standard Pressure Applications: Closed-cell neoprene.
 4. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.21 CONTROL CABLE

- A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that conditioned power supply is available to control units and operator workstation.

3.2 GENERAL

- A. BAS component locations are the responsibility of the System Contractor. All control system components shall be installed in locations as required to properly sense the controlled medium.
- B. BAS Installation shall be performed by professionals in a workmanlike manner and in compliance with the Contract Documents, Division 26 Project Electrical System Specifications, the National Electric Code (NEC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ) and the following:
 - 1. Complete BAS installation including all DDC Devices, Enclosures, wiring, equipment, control devices and sensors shall be installed in accordance with the manufacturers' recommended installation procedures and as specified.
 - 2. All control devices are to be provided and installed with all required gaskets, seals, flanges, connection enclosures, thermal compounds, insulation, piping, fittings and valves as required for design operation, isolation, equalization, purging and calibration.
 - 3. Strap-on control devices shall not be permitted except as explicitly called out.
 - 4. All control devices mounted outdoors shall be protected by a weather-shield, integral outdoor enclosure, from ambient elements in such a manner as to not impede design functionality and/or sensing.
 - 5. BAS installation shall be such that it provides sufficient clearance for system maintenance by maintaining sufficient access for equipment, device and/or component service, calibration, removal, repair or replacement.
 - 6. BAS installation shall not interfere with required clearance for mechanical and/or electrical equipment maintenance.
 - 7. Penetrations through and mounting holes in the building exterior associated with the BAS installation shall be sealed and made water-tight.
 - 8. Dielectric isolation shall be provided where dissimilar metals are used in installation for connection and support.
 - 9. Installation, wiring and material shall be protected from damage by and during BAS installation by BAS Contractor.
- C. The Contractor shall be responsible for his/her work and equipment until finally inspected, tested and accepted. The Contractor shall protect his/her work against theft or damage, and shall carefully store material and equipment received on site that is not immediately installed.
- D. After completion of installation, calibrate and commission all components provided as part of the Control System and demonstrate proper sequence of operation in compliance with the specifications. BAS components not operating correctly shall be field corrected or replaced.

3.3 BAS APPLICATION SOFTWARE

- A. At time of acceptance all operating system, Third party and Control System Application software shall be at least the latest official release version available.
- B. Software programs are described to their general intent. It is recognized that Networked System manufacturer's software differ; however, the Application software provided shall incorporate the features described fully implemented and optimized to provide the sequences described, minimize energy consumption and prolong equipment life.
- C. When programming the system BACnet addressing rules will be strictly adhered to. All addressing strategies will have to be approved by Owner and Engineer of Record prior to configuring any LAN types.
- D. All analog and binary values shall be programmed with appropriate alarms.
- E. Except as specified otherwise, throttling ranges, proportional bands, and switching differentials shall be centered on the associated set point.
- F. All set points unless otherwise indicated are adjustable and shall be programmable for all control loops.

- G. Each control loop and/or interlock(s) for all mechanical system including terminal unit systems shall be programmed with a control loop specific graphical trend to trend all values associated with each specific control loop or system interlock.
- H. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the system start commands shall be staggered by 15-second (adj.) intervals to minimize inrush current.
- I. Scheduling shall be developed for each mechanical system. Final schedules shall be coordinated with the Owner and Engineer of Record prior to system commissioning.
- J. Optimal start/stop programs shall be applied to all regularly scheduled mechanical and electrical systems.
- K. At a minimum, trend log/historical data shall be implemented for every hardware point on the system. Additionally all software (virtual) points used as setpoints shall be trended. Point trends shall be grouped into logically interrelated points for individual mechanical and building systems. Initial set-up shall be to log values once every 5 minutes.
- L. B-AWS Graphical User Interface (GUI) must be approved by the Owner and Engineer of Record and shall incorporate at a minimum the following:
 - 1. At a minimum, all physical hardware, sensors, control devices and set points shall be visible on a B-AWS in graphical form.
 - 2. All mechanical systems shall have a programmed real time color graphic for primary graphical user interface.
 - 3. Individual floor plan graphics will be programmed for each floor or area of the building. All space sensors shall be visible on floor plan graphics and system graphic.

3.4 B-AWS HARDWARE

- A. Provide as specified for each PC-Based B-AWS.
- B. Assemble server components in a configuration that allows easy operator access to all necessary components from one position.
- C. Provide sufficient permanent and removable storage drives for 25% free memory after provision for all operating system, Third party and Control System Application software, all fully configured point databases, storage/back-up of all B-BC, B-AAC and B-ASC application programming, all graphic files, all user-defined reports and a three year archive of all trend and historical data described in this specification.
- D. Provide sufficient RAM to meet system performance requirements.

3.5 BACnet PROTOCOL VERIFICATION SOFTWARE

- A. Demonstrate exclusive communication utilizing the BACnet Protocol on all segments of the BACnet network.

3.6 BUILDING CONTROLLER (B-BC)

- A. Provide as required to meet performance requirements of the system with a 10% increase in connected B-AAC and B-ASC on any individual network. Provide a dedicated B-BC for all project specific equipment requiring this controller type.
- B. Locate strategically such that B-BC locations are as equally distributed throughout the project as possible.

3.7 ADVANCED APPLICATION CONTROLLERS (B-AAC)

- A. Provide a dedicated B-AAC for each medium-sized mechanical system.
- B. All points used for a single mechanical system shall be connected to the same B-AAC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.
- C. Provide spare additional I/O such that future use of spare capacity shall require providing only the field device, field wiring, point database definition and operational sequence programming changes as required. Additional point modules may be required to implement use of these spare points.
 - 1. Provide at least one (1) spare universal input and one (1) spare universal output or 5% spare I/O of the total capacity of each B-AAC whichever is greater.

2. If B-AAC I/O is not universal then provide at least one (1) spare analog input, one (1) spare digital input, one (1) spare analog output and one (1) spare digital output or 5% spare I/O of the total capacity for each point type of each B-AAC whichever is greater.

3.8 APPLICATION SPECIFIC CONTROLLERS (B-ASC)

- A. Provide a dedicated B-ASC for each Terminal Unit Mechanical Device on the project, including VAV and Fan Powered Terminal Units, Unit Heaters, and Individual Fans.
- B. All points used for a single Terminal Unit Mechanical Device shall be connected to a dedicated B-ASC. Points used for control loop reset based on outside air, or space/zone temperature, or extremely remote differential pressure sensors on slow acting control loops are exempt from this requirement.
- C. VAV ATU and FP-VAV ATU Controllers
 1. Provide networked B-ASC for each VAV ATU and FP-VAV ATU consisting of a controller, damper actuator, and velocity transducer.
 2. The ATU shall be provided with multi-point averaging type flow sensor factory piped to the velocity transducer.

3.9 LOCAL SYSTEM NETWORK INTERFACE

- A. At a minimum the Portable B-AWS shall be able to connect to the BACnet Internetwork within each mechanical equipment space within the project.

3.10 ENCLOSURES & SUB-PANELS

- A. All system components not designed for or required to be field installed shall be mounted in a control enclosure. Those components shall be sub panel mounted except components that are mounted on the panel face. Provide on/off power switch with over-current protection for control power sources in each local enclosure.
- B. All control enclosures shall be located so that visual observation and adjustment can be accomplished while standing flatfooted on the floor in a convenient location adjacent to the equipment served. Install all equipment in readily accessible location as defined by Chapter1 Article 100 Part A of the NEC.
- C. Label all control system components.
- D. A copy of the "As-built" application engineering for the system served shall be laminated in clear plastic, shall be legible and suspended within enclosure.
- E. All B-BC shall be mounted in an enclosure.

3.11 INSTALLATION

- A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.
- B. Connect and configure equipment and software to achieve sequence of operation specified.
- C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
 1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.
- D. Install guards on thermostats in the following locations:
 1. Entrances.
 2. Public areas.
 3. Where indicated.
- E. Install automatic dampers according to Section 233300 "Air Duct Accessories."
- F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.
- G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."
- H. Install hydronic instrument wells, valves, and other accessories according to Section 232113 "Hydronic Piping."

- I. Install steam and condensate instrument wells, valves, and other accessories according to Section 232213 "Steam and Condensate Heating Piping."
- J. Install refrigerant instrument wells, valves, and other accessories according to Section 232300 "Refrigerant Piping."
- K. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."
- L. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

3.12 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. General

- 1. It shall be the System Contractor's responsibility to provide all wiring required for a complete Control System.
- 2. Control system wiring and cabling installed for this project shall be performed by professionals in a workmanlike manner and in accordance with the Contract Documents, Division 26 Project Electrical System Specifications, the National Electric Code (NEC), and any/all applicable local codes and/or Authorities Having Jurisdiction (AHJ) and shall include but may not be limited to the following:
 - a. All power wiring required not indicated on the electrical plans and specifications.
 - b. Power to all actuators and sensors.
 - c. Provide all wiring and cabling for network communications except for owner provided LAN's/WAN's.
 - d. All sensor and control device input and output wiring.
 - e. All interconnecting cabling between and amongst network devices, PCs printers, etc.
 - f. Interlock wiring between devices, variable frequency drives and between motor starters.
 - g. All other necessary wiring for fully complete and functional system as specified.
 - h. Install piping, wiring/cabling routed parallel to or at right angles with the structure, properly supported every six (6) feet at a minimum and installed in a workmanlike manner.
- 3. Maximum allowable voltage for control wiring shall be 120-volts.
- 4. All wiring shall be installed as continuous links. Any required splices shall be made only within an approved junction box or other approved protective device with a maximum fill of 50%.
 - a. BACnet network cabling shall not be field spliced.
- 5. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
- 6. This Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.

B. Power Wiring and Cabling

- 1. Power wiring for all enclosures and controls equipment, including branch circuit wiring from circuit breaker panels shall be the responsibility of the System Contractor unless specifically shown on the Plans or Specifications to be provided under Division 26.
- 2. All B-AWS equipment shall be served from isolated ground receptacles via UPS by dedicated branch circuits.
- 3. All other enclosures, sensor and control devices shall be fed from separate circuits in the electrical distribution panels and shall not be served from the typical floor receptacle or lighting circuits.

C. Network Wiring and Cabling

- 1. Network installation shall strictly adhere to the manufacturer's networking installation instructions and procedures.
- 2. Network installation shall conform to standards for the LAN types and cabling types selected. Specific network rules inherent to the ANSI/AHRAE Standard 135-1995, BACnet shall be followed. Those include but are not limited to:
 - a. Only one path can exist from any BACnet device to another.
 - b. Each BACnet device connected to an internetwork LAN must have a unique device instance (0 - 4,194,303).
 - c. Each internetwork LAN must have a unique Network Number (1 - 65,545).
- 3. Primary LAN Network wire and cable shall be run separately from all other wiring.
- 4. Other LAN Network wire and cabling shall be installed separate from any wiring over thirty (30) volts.
- 5. All communications shielding shall be grounded as per Networked System manufacturer's recommendations.

D. Installation

1. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."
2. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
3. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."
 - a. Plenum rated cable is acceptable in concealed accessible locations such as drop ceilings.
 - b. All other wiring shall be in EMT conduit.
 - c. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
 - d. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
 - e. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
 - f. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
4. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.
5. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.13 ANALOG SENSORS

A. Temperature

1. All wires attached to sensors shall be air sealed in their conduits or in the wall to stop air transmitted from other areas affecting sensor readings.
2. Install and properly support all enclosures and sensing elements as much as possible in the center of duct cross section and in straight duct runs. In condensing environments use stainless steel flanges to support sensing elements.
3. Sensors mounted on air ducts having exterior insulation shall be provided with handy-box mounting with insulating material firmly fitted around handy-box.
4. Averaging type sensors: provide a minimum of 1 linear foot of sensor per 4 square feet of duct/coil area or equal to duct/coil width where installed, whichever is longer. Averaging sensing tubing shall serpentine vertically across airstream and be supported firmly by mechanical clips.
5. Temperature sensors installed in piping or tanks shall be in separable thermowells. Sensors shall be inserted into thermowells with conductive paste. Assembly shall allow removal of sensor without loss of fluid.
6. At a minimum one outside air temperature sensor shall be installed. It shall be mounted outside on a northern exposure as high as serviceable on the building. The sensor shall be mounted within a ventilated enclosure to shield the sensor from the effects of the sun. The sensor location shall be selected such that it may not be affected by artificial and/or mechanical airstreams (i.e., building exhaust, building relief, etc.).
7. Terminal Unit Sensors shall be provided one per terminal unit device.
 - a. They shall be wall mounted in the space served 60" above finished floor and located as shown on drawings.
 - b. Provide a minimum of 16' of coiled temperature sensor control wiring for equipment with space sensor not located on the Drawings.
8. In all areas where terminal unit sensor locations are not known at the time of building startup, sensors shall be hung approximately 24 inches from the ceiling in the area of the controlled zone and connected. Control wiring shall be neatly coiled and attached to ceiling grid.
9. Zone temperature sensors shall not be located on perimeter walls. Where explicitly indicated on drawings to do so and/or in locations near exterior walls and/or subject to drafts sensors shall have insulated mounting bases to prevent false room temperature readings.
10. Where wall sensors are mounted in an area subject to damage provide suitable protective guard.
11. Where wall sensors are mounted in public spaces with adjustable set points provide suitable security guard.

B. Wet Bulb

1. For outside air mount same as outside air temperature sensor.
2. For duct mounting execute same as duct mounted temperature sensor.

- C. Pressure
 - 1. Orient static pressure sensing taps faced directly down-stream in the airflow so as to eliminate velocity pressure effects. Locate pressure transducers within 10' of sensing point and use tubing sized such as to prevent signal phase lag.
 - a. Final location of static/differential pressure sensing taps shall be pursuant with Contract Documents and as indicated on drawings. Where not explicitly indicated on drawings, pressure sensing taps shall be located as follows:
 - 1) Duct static pressure control sensor tap shall be located 2/3 distance from the Air Handling Unit of the total duct length in a straight section of ductwork with a minimum of four (4) duct diameters in both directions.
 - 2) Positive static high-pressure safety cut-outs shall be located at Air Handling Unit immediately downstream of fan section.
 - 3) Mixed-Air static and/or differential sensor tap shall be located in mixing box section.
 - 4) Negative static pressure safety cut-outs shall be located immediately upstream of fan section.
 - 5) Filter differential pressure taps shall be installed on both filter inlet and outlet.
 - b. Mount air differential pressure taps so that true differential is sensed.
 - 2. Water gauge taps shall include snubbers and isolation valves.
 - 3. Water differential pressure sensors shall be piped through a five-valve bypass assembly with snubbers.

3.14 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
 - 2. Test and adjust controls and safeties.
 - 3. Test calibration of electronic controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
 - 4. Test each point through its full operating range to verify that safety and operating control set points are as required.
 - 5. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
 - 6. Test each system for compliance with sequence of operation.
 - 7. Test software and hardware interlocks.
- C. DDC Verification:
 - 1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
 - 2. Check instruments for proper location and accessibility.
 - 3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
 - 4. Check instrument tubing for proper fittings, slope, material, and support.
 - 5. Check installation of air supply for each instrument.
 - 6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
 - 7. Check pressure instruments, piping slope, installation of valve manifold, and self-contained pressure regulators.
 - 8. Check temperature instruments and material and length of sensing elements.
 - 9. Check control valves. Verify that they are in correct direction.
 - 10. Check DDC system as follows:
 - a. Verify that DDC controller power supply is from emergency power supply, if applicable.
 - b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
 - c. Verify that spare I/O capacity has been provided.
 - d. Verify that DDC controllers are protected from power supply surges.
- D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

- E. Commissioning, Calibrating and Adjusting:
1. As a part of this contract, the BAS Contractor shall fully commission the entire BAS. All commissioning shall be fully documented and all documentation shall be submitted prior to Demonstration and Acceptance testing. Commissioning shall include a "point-to-point" check-out of the following at a minimum:
 - a. Verify that all Temperature Control Panels (TCP), BAS equipment, controllers, devices and sensors are installed and operational according to the specifications, submittals and manufacturer's installation and application instructions.
 - b. Calibrate all inputs by comparing the actual site condition with the B-OWS point display.
 - c. Verify all outputs from B-OWS command to observed response of controlled device.
 - d. Verify failure response and fail-safe conditions of all devices and safeties.
 - e. Each control program shall be fully commissioned and tested for complete design intent compliance and functionality.
 - f. Verify overall network performance of BAS for complete design intent compliance and functionality with all devices on-line, communicating and fully-operational.
 - g. Subsystems not directly controlled by the BAS but associated with the ATC shall also be fully tested and commissioned as to design intent compliance and functionality.
 2. Calibrate instruments.
 3. Make three-point calibration test for both linearity and accuracy for each analog instrument.
 - a. Make single-point calibration for CO2 sensors.
 4. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
 5. Control System Inputs and Outputs:
 - a. Check analog inputs at 0, 50, and 100 percent of span.
 - b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
 - c. Check digital inputs using jumper wire.
 - d. Check digital outputs using ohmmeter to test for contact making or breaking.
 - e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
 6. Flow:
 - a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
 - b. Manually operate flow switches to verify that they make or break contact.
 7. Pressure:
 - a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
 - b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
 8. Temperature:
 - a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
 - b. Calibrate temperature switches to make or break contacts.
 9. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
 10. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
 11. Provide diagnostic and test instruments for calibration and adjustment of system.
 12. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.
- F. Adjust initial temperature and humidity set points.
- G. Occupancy Adjustments: 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 three visits to Project during other than normal occupancy hours for this purpose.
1. As a part of this contract, the BAS Contractor shall demonstrate compliance of the BAS with the contract documents and operational functionality pursuant with the design Sequences of Operation. Using the documented calibration and commissioning test data the Owner and/or his representative shall select, at random, results to be demonstrated. At least 95% of the results demonstrated must perform as specified and documented on commissioning data sheets or the system must be re-calibrated and re-commissioned before being re-tested.

2. When the Calibration, Commissioning, Demonstration and Acceptance process has been completed and approved by Owner, Contractor shall be provided with signed letter from Owner indicating Acceptance within thirty (30) days of approval.

3.15 TRAINING

- A. Refer to Section 017900 "Demonstration and Training."
- B. Provide 24 hours training onsite.
- C. Provide classroom training for one person, one class at BAS Manufacturer's factory training facility. Provide transportation cost to facility.
- D. As a part of this contract, the BAS Contractor shall provide instruction on the adjustment, operation and maintenance of the BAS as installed including all hardware and software provided by a manufacturer-trained, competent application engineer and/or technician with sufficient experience in the installation, programming and operation of the BAS. All training equipment and material shall be provided by this Contractor.
- E. Training shall cover the entire execution of the complete BAS and components. Training shall be performed on the Owner's ATC/BAS and shall include:
 1. Location of all TCP's, Control Enclosures, controllers, devices, sensors, etc.
 2. Equipment Layout.
 3. Sequences of Operation.
 4. Maintenance and Repair.
 5. Troubleshooting.
 6. Preventative Maintenance.
 7. Sensor Calibration.
 8. Proper Use of Service Tools and Materials.

3.16 WARRANTY, MAINTENANCE, NORMAL AND EMERGENCY SERVICE

- A. As a part of this contract, the BAS Contractor shall warranty all components of the BAS and installation to be free of defects in workmanship and material under normal expected service and use for a period of one (1) year from the date of final acceptance of the BAS by the Owner..
- B. During the installation warranty period the Contractor shall provide all labor and materials required to repair or to replace all items or components that fail due to defects in workmanship or manufacture at no charge or reduction in service to the Owner.
- C. Except in the event of property loss or damage, warranty service shall be provided during regular working hours Monday through Friday at no charge unless otherwise explicitly outlined in the Contract Documents.
 1. Emergency service performed outside of these parameters shall be performed for charge by BAS Contractor according to the provisions set forth in the Contract Documents.

END OF SECTION

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SECTION 231123 - FACILITY NATURAL-GAS PIPING

1.1 SUMMARY

- A. Natural-gas piping within the building and distribution on the Project site.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
 - 1. Piping and Valves: 100 psig.
 - 2. Service Regulators: 65 psig.
 - 3. Service Meters: 65 psig.
- B. Natural-Gas System Pressures within Buildings:
 - 1. Two Pressure Ranges: More than 0.5 psig but not more than 2 psig, and 0.5 psig or less.

1.3 MATERIALS

- A. Piping Specialties:
 - 1. Appliance flexible connectors.
 - 2. Quick-disconnect devices.
 - 3. Y-Pattern strainers.
 - 4. Weatherproof vent cap.
- B. Manual Gas Shutoff Valves:
 - 1. One- and two-piece ball valves.
 - 2. Two-piece, full -port bronze ball valves with bronze trim.
 - 3. Bronze plug valves.
 - 4. Cast-iron, nonlubricated and lubricated plug valves.
 - 5. PE ball valves.
 - 6. Valve boxes.
- C. Electrically operated motorized gas valves.
- D. Pressure Regulators:
 - 1. Service pressure regulators.
 - 2. Line pressure regulators.
 - 3. Appliance pressure regulators.
- E. Service Meters:
 - 1. Furnished by natural-gas supplier.
- F. Dielectric Fittings: Dielectric unions and dielectric-flange kits.
- G. Detectable warning tape for underground piping.

1.4 OUTDOOR PIPING SCHEDULE

- A. Underground Piping: Steel pipe with welded joints.
- B. Aboveground Piping: Steel pipe with threaded joints or steel pipe with welded joints.
- C. Branch Piping in Cast-in-Place Concrete: Annealed-temper copper tube with brazed joints.
- D. Containment Conduit: Steel pipe with welded joints.

1.5 INDOOR PIPING SCHEDULE FOR PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground Branch Piping NPS 1 and Smaller: Steel pipe with threaded joints.
- B. Aboveground Distribution Piping: Steel pipe with welded joints.
- C. Containment Conduit and Vent Piping: Steel pipe with welded joints.

1.6 INDOOR PIPING SCHEDULE FOR PRESSURES MORE THAN 0.5 PSIG AND LESS THAN 5 PSIG

- A. Aboveground Branch Piping NPS 1 and Smaller: Steel pipe with threaded joints.
- B. Aboveground Distribution Piping: Steel pipe with welded joints.
- C. Containment Conduit and Vent Piping: Steel pipe with welded joints.

END OF SECTION 231123

SECTION 232113 - HYDRONIC PIPING

1.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures and Temperatures:
1. Hot-Water Heating Piping: 125 psig at 200 deg F.
 2. Chilled-Water Piping: 125 psig at 200 deg F.
 3. Condenser-Water Piping: 125 psig at 150 deg F.
 4. Glycol Cooling-Water Piping: 125 psig at 150 deg F.
 5. Makeup-Water Piping: 80 psig at 150 deg F.
 6. Condensate-Drain Piping: 150 deg F.
 7. Blowdown-Drain Piping: 200 deg F.
 8. Air-Vent Piping: 200 deg F.
 9. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.2 QUALITY ASSURANCE

- A. Quality Standard: ASME B31.9.

1.3 PRODUCTS

- A. Bypass chemical feeder and chemicals and glycol for first year of operation.

1.4 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:
1. Copper tubing and soldered joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Steel pipe and welded and flanged joints.
- C. Hot-water heating piping installed belowground and within slabs shall be either of the following:
1. Copper tubing and soldered joints. Use the fewest possible joints.
 2. RTRP and RTRF with adhesive or flanged joints.
- D. Chilled-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Copper tubing and soldered joints.
- E. Chilled-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- F. Condenser-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Copper tubing, wrought-copper fittings, and soldered joints.
- G. Condenser-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:
1. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- H. Glycol cooling-water piping, aboveground, NPS 2 and smaller, shall be the following:
1. Copper tubing, wrought-copper fittings, and soldered joints.
- I. Glycol cooling-water piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
- J. Makeup-water piping installed aboveground shall be the following:
 1. Copper tubing, wrought-copper fittings, and soldered joints.
- K. Condensate-Drain Piping: Copper tubing, wrought-copper fittings, and soldered joints.
- L. Blowdown-Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.
- M. Air-Vent Piping:
 1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.
 2. Outlet: Copper tubing with soldered or flared joints.
- N. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed with metal-to-plastic transition fittings for plastic piping systems according to piping manufacturer's written instructions.

1.5 CHEMICAL TREATMENT

- A. Chemical Treatment: Water analysis by Owner.
- B. Glycol solutions for glycol cooling-water piping for freeze protection.

END OF SECTION 232113

SECTION 232113.13 - UNDERGROUND HYDRONIC PIPING

1.1 PIPING APPLICATION

- A. Hot-Water Heating Piping:
 - 1. Cased piping with polyurethane carrier-pipe insulation.
- B. Chilled-Water Piping:
 - 1. Cased piping with polyurethane carrier-pipe insulation.

END OF SECTION 232113.13

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SECTION 232116 - HYDRONIC PIPING SPECIALTIES

1.1 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressures and Temperatures:
1. Hot-Water Heating Piping: 125 psig at 200 deg F.
 2. Chilled-Water Piping: 125 psig at 150 deg F.
 3. Condenser-Water Piping: 125 psig at 150 deg F.
 4. Glycol Cooling-Water Piping: 125 psig at 150 deg F.
 5. Makeup-Water Piping: 80 psig at 100 deg F.
 6. Condensate-Drain Piping: 150 deg F.
 7. Blowdown-Drain Piping: 150 deg F.
 8. Air-Vent Piping: 200 deg F.
 9. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.2 PRODUCTS

- A. Valves:
1. Bronze, Calibrated-Orifice, Balancing Valves: Ball or plug type with calibrated orifice or venturi.
 2. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves: Ball, plug, or globe pattern with calibrated orifice or venturi.
 3. Pressure-Reducing Valves: ASME labeled bronze or brass, with glass and carbon-filled PTFE disc and brass seat.
 4. Safety Valves: ASME labeled bronze or brass, with glass and carbon-filled PTFE disc and brass seat.
- B. Air Control Devices:
1. Air Vents: Manual and automatic.
 2. Expansion Tanks: ASME labeled with bladder.
 3. Air Separators: Tangential type.
- C. Hydronic Piping Specialties:
1. Strainers: Y-pattern, basket, and T-pattern.
 2. Flexible Connectors: Fiber-reinforced, rubber spherical body.

1.3 VALVE APPLICATIONS

- A. Shutoff-duty valves for branch connection to supply mains, and at supply connection to each piece of equipment.
- B. Throttling-duty valves for branch connection to return main.
- C. Calibrated-orifice, balancing valves for return pipe of each heating or cooling terminal.
- D. Check valves for each pump discharge and elsewhere as required to control flow direction.
- E. Safety valves for hot-water generators.
- F. Pressure-reducing valves for makeup-water connection to regulate system fill pressure.

END OF SECTION 232116

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SECTION 232123 - HYDRONIC PUMPS

1.1 PRODUCTS

- A. Close-Coupled, In-Line Centrifugal Pumps:
 - 1. Casing: Radially split, cast iron.
 - 2. Impeller: Cast bronze.
 - 3. Pump Shaft: Type 304 stainless steel.
 - 4. Seal: Mechanical.

- B. Separately Coupled, Base-Mounted, End-Suction Centrifugal Pumps:
 - 1. Casing: Radially split, cast iron. Integral mount on volute to support the casing and attached piping to allow removal and replacement of impeller without disconnection piping or requiring realignment of pump and motor shaft.
 - 2. Impeller: Cast bronze.
 - 3. Pump Shaft: Type 304 stainless steel.
 - 4. Seal: Mechanical.
 - 5. Pump Bearings: Grease-lubricated ball bearings in cast-iron housing with grease fittings.
 - 6. Shaft Coupling: Drop-out type molded-rubber insert and interlocking spider with EPDM coupling sleeve for variable-speed applications.
 - 7. Coupling Guard: Dual rated, steel, removable, attached to mounting frame.
 - 8. Mounting Frame: Welded-steel frame and cross members.
 - 9. Motor Enclosure Type: Totally enclosed, fan cooled.
 - 10. Motor Efficiency: Premium efficient as defined in NEMA MG 1.
 - 11. Motor Speed: Variable.

- C. Automatic Condensate Pump Units: Package units with corrosion-resistant pump, aluminum tank with cover, and automatic controls.

- D. Specialty Fittings:
 - 1. Suction diffuser.
 - 2. Triple-duty valves.

- E. Integral Pump Motor Variable-Speed Controllers:
 - 1. For pumps indicated to be variable speed.
 - 2. Integrated Pump Controller: Direct BMS communication via BACnet™/MS/TP.

1.2 STARTUP SERVICE

- A. Startup service by Contractor.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.4 DEMONSTRATION

- A. By Contractor.

END OF SECTION 232123

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SECTION 232300 - REFRIGERANT PIPING

1.1 PERFORMANCE REQUIREMENTS

- A. Quality Standards: ASHRAE 15 and ASME B31.5.
- B. Line Test Pressure for Refrigerant R-134a:
 - 1. Suction Lines for Air-Conditioning Applications: 115 psig.
 - 2. Suction Lines for Heat-Pump Applications: 225 psig.
 - 3. Hot-Gas and Liquid Lines: 225 psig.
- C. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.2 PRODUCTS

- A. Copper Tube and Fittings: Type ACR with soldered fittings.
- B. Steel Pipe and Fittings: Schedule 40, black steel with wrought-steel fittings.

1.3 REFRIGERANTS

- A. R-134a.
- B. R-407C.
- C. R-410A.

1.4 PIPING APPLICATION SCHEDULES

- A. Piping Applications for Refrigerant R-134a: Maximum NPS 4.
 - 1. Suction, Hot-Gas, and Liquid Lines: Copper with brazed joints.
 - 2. Safety-Relief-Valve Discharge Piping: Copper with brazed joints.
- B. Piping Applications for Refrigerant R-410A: Maximum NPS 4.
 - 1. Suction Lines for Conventional Air-Conditioning Applications: Copper.
 - 2. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
 - a. NPS 2 and Smaller: Copper with brazed joints.
 - b. NPS 2-1/2 and Larger: Schedule 40, black steel with welded joints.
 - 3. Safety-Relief-Valve Discharge Piping:
 - a. NPS 2 and Smaller: Copper with brazed joints.
 - b. NPS 2-1/2 and Larger: Schedule 40, black steel with welded joints.
 - c. Schedule 40, black steel with welded joints.

END OF SECTION 232300

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SECTION 232516 - WATER TREATMENT FOR OPEN-LOOP HYDRONIC SYSTEMS

1.1 PRODUCTS

- A. Automatic Chemical-Feed Equipment:
1. Water Meter: Turbine-type, totalization meter.
 - a. Body: Epoxy-coated cast iron.
 - b. Controls: Flow-control switch with normally open contacts, rated for maximum 10 A, 250-V ac, that will close at adjustable increments of total flow.
 2. Inhibitor Injection Timers:
 - a. Microprocessor-based controller with digital display. Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - b. Programmable timers with infinite adjustment over full range.
 - c. Test switch.
 - d. Hand-off-auto switch for chemical pump.
 - e. Illuminated legend to indicate feed when pump is activated.
 - f. Programmable lockout timer with indicator light.
 - g. Digital display makeup totalizer.
 3. pH Controller:
 - a. Microprocessor-based controller. Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - b. Digital display and touch pad for input.
 - c. Sensor probe adaptable to sample stream manifold.
 - d. High, low, and normal pH indication.
 - e. High- or low-pH-alarm-light trip points, field adjustable; with silence switch.
 - f. Hand-off-auto switch for acid pump.
 - g. Internal adjustable hysteresis or deadband.
 4. TDS Controller:
 - a. Microprocessor-based controller. Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - b. Digital display and touch pad for input.
 - c. Sensor probe adaptable to sample stream manifold.
 - d. High, low, and normal conductance indication.
 - e. High- or low-conductance-alarm-light trip points, field adjustable; with silence switch.
 - f. Hand-off-auto switch for solenoid bleed-off valve.
 - g. Bleed-off valve activated indication.
 - h. Internal adjustable hysteresis or deadband.
 - i. Bleed Valves: Motorized ball valve, steel body, and TFE seats and seals.
 5. TSS Controller:
 - a. Microprocessor-based controller. Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - b. Digital display and touch pad for input.
 - c. Sensor probe adaptable to sample stream manifold.
 - d. High- or low-value-alarm-light trip points, field adjustable; with silence switch.

- e. Hand-off-auto switch for solenoid bleed-off valve.
- f. Bleed-off valve activated indication.
- g. Internal adjustable hysteresis or deadband.
- 6. Biocide Feeder Timer:
 - a. Microprocessor-based controller with digital display. Interface for start/stop and status indication at central workstation, as described in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - b. 24-hour timer with 14-day skip feature.
 - c. Precision, solid-state, bleed-off lockout timer and clock-controlled biocide pump timer. Prebleed and bleed lockout timers.
 - d. Solid-state alternator to enable use of two formulations.
 - e. 24-hour display of time of day.
 - f. 14-day display of day of week.
 - g. Battery backup, so clock is not disturbed by power outages.
 - h. Hand-off-auto switches for biocide pumps.
 - i. Biocide A and Biocide B pump running indication.
- B. Chemical Solution Tanks:
 - 1. High-density opaque polyethylene with minimum 110 percent containment vessel.
 - 2. Molded cover with recess for mounting pump.
 - 3. Capacity: 30 gal..
- C. Chemical Solution Injection Pumps:
 - 1. Self-priming, positive displacement.
 - 2. Adjustable flow rate.
 - 3. Metal and thermoplastic construction.
 - 4. Built-in relief valve.
 - 5. Fully enclosed, continuous-duty, single-phase motor.
- D. Stainless Steel Pipes and Fittings:
 - 1. Stainless steel tubing and fittings.
 - a. Two-piece, full-port, stainless steel ball valves.
- E. Chemicals recommended by water-treatment system manufacturer.

END OF SECTION 232516

SECTION 233113 - METAL DUCTS

1.1 QUALITY ASSURANCE

- A. Mockups for system static-pressure classifications higher than 3 inch wg.

1.2 MATERIALS

- A. Single-wall rectangular ducts and fittings.
- B. Single-wall round and flat-oval ducts and fittings.
- C. Sheet Metal Materials:
 - 1. Galvanized sheet steel.
 - 2. Stainless-steel sheets.
- D. Duct Liner:
 - 1. Fibrous glass, Type II, rigid.
 - a. With antimicrobial erosion-resistant coating.
 - 2. Flexible elastomeric.
 - 3. Fiberglass free.
- E. Sealant Materials:
 - 1. Two-part tape sealing system.
 - 2. Water-based joint and seam sealant.
 - 3. Solvent-based joint and seam sealant.
 - 4. Flanged joint sealant.
 - 5. Flange gaskets.
 - 6. Round duct joint O-ring seals.

1.3 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Clean the following items:
 - 1. Air outlets and inlets.
 - 2. Supply, return, and exhaust fans.
 - 3. Air-handling units.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.

1.4 DUCT SCHEDULE

- A. All ducts shall be galvanized steel except as follows:
 - 1. Laboratory Exhaust Ducts (connected to Fume Hoods, Snorkels and Canopies):
 - a. Exposed to View: Type 304, stainless-steel sheet, No. 4 finish.
 - b. Concealed: Type 304, stainless-steel sheet, No. 2D finish.
 - c. Flanged seams and joints.

END OF SECTION 233113

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SECTION 233300 - AIR DUCT ACCESSORIES

1.1 QUALITY ASSURANCE

- A. Installation Standards: NFPA 90A, NFPA 90B, and SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1.2 PRODUCTS

- A. Backdraft and Pressure Relief Dampers: Multiple blade, parallel action, gravity balanced with return springs.
- B. Barometric Relief Dampers: Horizontal or vertical mounting; multiple blade, parallel action, gravity balanced with return springs.
- C. Manual Volume Dampers: Multiple and single blade, parallel- and opposed-blade design, with linkage outside airstream.
 - 1. Standard, steel, manual volume dampers.
 - 2. Low-leak, aluminum, manual volume dampers.
- D. Control Dampers: Parallel Opposed-blade design; galvanized-steel frame and blades.
- E. Fire Dampers: Static and dynamic, replaceable heat-responsive device.
- F. Smoke Dampers:
 - 1. Multiple-blade type.
 - 2. Leakage: Class I Insert class.
- G. Combination Fire and Smoke Dampers: Static and dynamic, electric heat-responsive device.
- H. Flange connectors.
- I. Duct Silencers: Factory fabricated and tested, round or rectangular.
- J. Turning Vanes: Double-blade, galvanized sheet steel.
- K. Remote damper operators.
- L. Duct-Mounted Access Doors: Double wall, rectangular, galvanized sheet steel with insulation.
- M. Flexible Connectors: Indoor and outdoor, ; and with thrust limits for flexible connections at high-pressure fan discharge.
- N. Duct accessory hardware.

END OF SECTION 233300

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SECTION 233416 - CENTRIFUGAL HVAC FANS

1.1 SQUARE IN-LINE CENTRIFUGAL FANS

- A. Housing Material: Reinforced steel.
- B. Housing Coating: None.
- C. Drive: Direct or Belt.
- D. Wheels: Aluminum airfoil blades welded to aluminum hub.
- E. Motor Enclosure: Open, dripproof.

1.2 UTILITY SET FANS

- A. Housing Material: Reinforced steel or Shaped fiberglass-reinforced plastic .
- B. Housing Coating: Powder-baked enamel.
- C. Wheels: SWSI, aluminum or one-piece fiberglass-reinforced plastic, statically and dynamically balanced, spark-resistant construction according to AMCA 99, Type C.
- D. Wheel and Blade Coating: Hot-dip galvanized.
- E. Shafts: Statically and dynamically balanced; steel with keyway.
- F. Bearings: Prelubricated and sealed type, with ABMA 9, L(10) rating life of 120,000 hours.
- G. Drive: Direct or Belt.
- H. Belt Drives: Factory mounted and field adjustable.
 - 1. Service Factor: 1.2.
 - 2. Fan Pulleys: Cast iron or cast steel; split, tapered.
 - 3. Motor Pulleys: Adjustable pitch for motors through 5 hp; fixed pitch for larger motors.
- I. Motor Enclosure: Totally enclosed, fan cooled.

END OF SECTION 233416

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SECTION 233423 - HVAC POWER VENTILATORS

1.1 QUALITY ASSURANCE

- A. AMCA-Certified Ratings Seal.

1.2 CENTRIFUGAL VENTILATORS - ROOF DOWNBLAST

- A. Direct-driven or belt-driven centrifugal type, with spun-aluminum dome top and outlet baffle; square, one-piece aluminum base with venturi inlet cone.
- B. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.
- C. Accessories:
 - 1. Variable-speed motor controller.
 - 2. Disconnect switch outside fan housing.
 - 3. Bird screens.
 - 4. Backdraft dampers.
 - 5. Motorized dampers.
 - 6. Galvanized-steel roof curbs with built-in raised cant and mounting flange.
 - 7. Prefabricated roof curb.

1.3 SIDEWALL PROPELLER FANS

- A. Direct-drive or belt-driven propeller type, with galvanized-steel housing and orifice ring.
 - 1. Fan Wheels: Extruded aluminum.
- B. Accessories:
 - 1. Disconnect switch.
 - 2. Gravity backdraft dampers.
 - 3. Motorized dampers.
 - 4. Motor-side back guard.
 - 5. Wall sleeve.
 - 6. Weathershield hood.
 - 7. Weathershield front guard.

END OF SECTION 233423

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SECTION 233600 - AIR TERMINAL UNITS

1.1 PRODUCTS

- A. Modulating, Single-Duct Air Terminal Units:
 - 1. Configuration: Volume-damper assembly inside unit casing with multi-point velocity sensors.
 - 2. Casing: Galvanized steel, single wall.
 - a. Lining: 1/2-inch- thick, flexible elastomeric duct liner.
 - 3. Volume Damper: Normally closed, galvanized steel with maximum damper leakage of 2 percent at 3-inch wg inlet static pressure.
 - 4. Attenuator Section: Steel, sheet.
 - a. Lining: 1/2-inch- thick, flexible elastomeric duct liner.
 - 5. Hydronic Heating Coils: Copper tube and aluminum fins.
 - 6. Factory-mounted and -wired, DDC microprocessor-based controls.
- B. Parallel Fan-Powered Air Terminal Units:
 - 1. Configuration: Volume-damper assembly and fan in parallel arrangement inside unit casing with multi-point velocity sensor on primary and induced air inlets.
 - 2. Casing: Galvanized steel, single wall.
 - a. Lining: 1/2-inch- thick, flexible elastomeric duct liner.
 - 3. Volume Damper: Normally closed, galvanized steel with maximum airflow leakage of 2 percent at 3-inch wg inlet static pressure.
 - 4. Velocity sensors.
 - 5. Motor:
 - a. Type: Permanent-split capacitor with SCR for speed adjustment Electronically commutated motor.
 - b. Enclosure: Totally enclosed, fan cooled Open, externally ventilated .
 - 6. Filters: Polyurethane foam Pleated cotton-polyester media, 1 inch thick.
 - 7. Attenuator Section: Steel sheet.
 - a. Lining: 1/2-inch- thick, flexible elastomeric duct liner.
 - 8. Hydronic Heating Coils: Copper tube and aluminum fins.
 - 9. Factory-mounted and wired, DDC controls.
- C. Laboratory Control Valve (Supply and Exhaust) Single-Duct Terminal:
 - 1. Configuration: Two-surface airflow control assembly, with compression section and factory-mounted digital vortex airflow measuring device for high speed actuation.
 - 2. Basis of Design: AccuValve AVT6000.
 - 3. Casing: Stainless steel 304, 20 gauge,, single wall.
 - 4. Volume Damper: Normally closed, 304 stainless steel, 16 gauge, with maximum damper leakage of 2 percent at 6-inch wg inlet static pressure.
 - 5. Attenuator Section: Aluminum, sheet.
 - a. Lining: 1/2-inch- thick, flexible elastomeric duct liner.
 - 6. Controls: DDC microprocessor-based.

1.2 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION 233600

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SECTION 233713.13 - AIR DIFFUSERS

1.1 PRODUCTS

- A. Rectangular and square ceiling diffusers, adjustable.
- B. Linear bar diffusers with narrow core spacing arrangement.
- C. Linear slot diffusers.
- D. Ceiling-integral continuous diffusers.
- E. High-capacity, drum louver diffusers.

END OF SECTION 233713.13

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SECTION 233713.23 - AIR REGISTERS AND GRILLES

1.1 PRODUCTS

- A. Registers: Adjustable with adjustable opposed-blade damper.
- B. Grilles: Adjustable and fixed.
- C. Linear bar grilles with perforated face arrangement.

END OF SECTION 233713.23

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SECTION 235100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Listed double-wall vents.
 - 2. Field-fabricated metal breechings.

PART 2 - PRODUCTS

2.1 LISTED SPECIAL GAS VENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Heat-Fab, Inc.
 - 2. Metal-Fab, Inc.
 - 3. Selkirk Inc.; Selkirk Metalbestos and Air Mate.
 - 4. Z-Flex; Flexmaster Canada Limited.
- B. Description: Double-wall metal vents tested according to UL 1738 and rated for 480 deg F continuously, with positive or negative flue pressure complying with NFPA 211.
- C. Construction: Inner shell and outer jacket separated by at least a 1/2-inch airspace.
- D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.
- E. Outer Jacket: Aluminized steel.
- F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.
 - 1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.
 - 2. Termination: Round chimney top designed to exclude minimum 98 percent of rainfall.
 - 3. Termination: Exit cone with drain section incorporated into riser.
 - 4. Termination: < Insert termination.>

2.2 FIELD-FABRICATED METAL BREECHINGS AND CHIMNEYS

- A. Fabricate chimneys and vent connectors from ASTM B 209, Type 1100 or 3003, aluminum or stainless steel, complying with NFPA 211 for the following minimum metal thicknesses:
 - 1. Aluminum: 0.027 inch.
 - 2. Stainless Steel: 0.012 inch.
- B. Fabricate cleanout doors from compatible material, same thickness as breeching, bolted and gasketed.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Listed Special Gas Vent: Condensing gas appliances.
- B. Field-Fabricated Metal Breechings and Chimneys: Oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

END OF SECTION

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SECTION 235216 - CONDENSING BOILERS

1.1 WARRANTY

- A. Warranty Period for Floor-Mounted Fire-Tube Condensing Boilers:
 - 1. Heat Exchanger and Tank: Free from defects in material and workmanship.
 - 2. Warranty Coverage: Prorated Year 0 to 5 - 100 percent; Year 6 to 7 - 50 percent; Year 8 to 9 - 30 percent; Year 10 - 10 percent for 10 years from date of Substantial Completion.

1.2 PERFORMANCE REQUIREMENTS

- A. Quality Standard: ASME Boiler and Pressure Vessel Code.
- B. Minimum Efficiency: ASHRAE/IES 90.1.
- C. UL Compliance: UL 795.

1.3 MANUFACTURED UNITS

- A. Floor-Mounted, Forced-Draft, Fire-Tube Condensing Boilers:
 - 1. Primary Heat Exchanger: Corrosion-resistant Type 316 stainless steel .
 - 2. Secondary Heat Exchanger: Corrosion-resistant Type 316 stainless steel .
 - 3. Combustion Chamber and Flue Pipes: Corrosion-resistant stainless steel .
 - 4. Pressure Vessel: Carbon steel with welded heads and tube connections.
 - 5. Burner: Natural, forced draft.
 - 6. Blower: Centrifugal fan.
 - 7. Gas Train: Combination gas valve with manual shutoff and pressure regulator.
 - 8. Ignition: Direct-spark ignition or silicone carbide hot-surface ignition with 100 percent main-valve shutoff with electronic flame supervision.
 - 9. Casing: Factory-finished sheet metal jacket, with insulation.
- B. Trim:
 - 1. Aquastat controllers.
 - 2. Safety Relief Valve: ASME rated.
 - 3. Pressure and temperature gauge.
 - 4. Boiler Air Vent: Automatic.
 - 5. Drain valve.
 - 6. Circulation pump.
- C. Controls:
 - 1. Boiler Operating Controls:
 - a. Control transformer.
 - b. Set-point adjust.
 - c. Operating temperature control.
 - d. High Cutoff: Manual reset.
 - e. Low-Water Cutoff Switch: Manual reset.
 - f. Blocked inlet safety switch.
 - g. Audible alarm.
 - 2. Building management system interface.
- D. Electrical Power: Single-point field power connection.
- E. Venting Kits:

1. Exhaust kit.
2. Combustion air intake kit.

F. Condensate-Neutralization Units: Capsule.

1.4 SOURCE QUALITY CONTROL

A. Boilers: Factory tested and inspected.

END OF SECTION 235216

SECTION 236426.16 - WATER-COOLED, ROTARY-SCREW WATER CHILLERS

1.1 QUALITY ASSURANCE

- A. Certification and Performance Ratings: AHRI 370, AHRI 575, AHRI 550, and AHRI 550/590.
- B. ASHRAE Compliance: ASHRAE 15 and ASHRAE 147.
- C. ASHRAE/IES Compliance: ASHRAE/IES 90.1.
- D. ASME Compliance: ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1.2 PACKAGED, WATER-COOLED, MULTIPLE-COMPRESSOR CHILLERS

- A. Compressor: Hermetic.
- B. Capacity Control: On-off compressor cycling and modulating slide-valve assembly or port unloaders combined with hot-gas bypass, if necessary, to achieve performance indicated.
 - 1. Operating Range: From 100 to 10 percent of design capacity.
 - 2. Condenser-Fluid Unloading Requirements over Operating Range: Drop-in, entering condenser-fluid temperature of 2.5 deg F drop for each 10 percent in capacity reduction.
- C. Oil Lubrication System: Pump if required, filtration, heater, cooler, factory-wired power connection, and controls.
- D. Refrigerant Circuit:
 - 1. Refrigerant Type: R-134a.
 - 2. Spring-loaded, pressure relief valve.
 - 3. Refrigerant circuit isolation valves.
- E. Evaporator: Shell-and-tube type.
- F. Condenser: Shell-and-tube type, with integral condenser.
- G. Electrical Power: Single-point, field-power connection to nonfused disconnect switch.
- H. Compressor Motor Controllers: Solid state.
- I. Controls: Microprocessor based.
 - 1. Enclosure with electrical power devices or separate enclosure.
 - 2. Operator Interface: Keypad or touch screen. Multiple-character, digital display.
 - 3. Interface with DDC System for HVAC: Communication interface.
- J. Insulation for Cold Surfaces: Closed-cell, flexible elastomeric.
- K. Finish: Manufacturer's standard paint.
- L. Accessories:
 - 1. Flow Switch: Chilled water.
 - 2. Vibration Isolation: Neoprene pads.
 - 3. Tool kit.
- M. Packaged, Portable Refrigerant Recovery Unit
- N. Packaged portable unit consisting of compressor, air-cooled condenser, recovery system, tank pressure gages, filter-dryer, and valving.
- O. Heat-Exchanger, Brush-Cleaning System
- P. For each chiller condenser and consisting of brushes in individual tubes; four-way automatic flow diverting valve; and control panel.

1.3 SOURCE QUALITY CONTROL

- A. Factory [run] [and] [sound] tested.
- B. Evaporator and Condensers: Factory tested and inspected according to ASME Boiler and Pressure Vessel Code.

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT - GMP3, GMP4
27 SEPTEMBER 2019

END OF SECTION 236426.16

SECTION 236514.14 - OPEN-CIRCUIT, INDUCED-DRAFT, CROSSFLOW COOLING TOWERS

1.1 QUALITY ASSURANCE

- A. ASHRAE/IES 90.1 for energy efficiency.
- B. CTI Certification: Cooling tower thermal performance according to CTI STD 201RS.
- C. FM Global: Approval and listing in the latest edition of FM Global's "Approval Guide."

1.2 WARRANTY

- A. Materials and Workmanship: Five years.

1.3 DESIGN ARRANGEMENT

- A. Crossflow design with airflow from two sides and induced-draft, top-mounted axial fan and gravity distribution basin.

1.4 PRODUCTS

- A. Open-Circuit, Induced-Draft, Crossflow Cooling Towers:
 - 1. Casing and Frame: Polymer-coated galvanized steel.
 - 2. Collection Basin: Polymer-coated galvanized steel.
 - 3. Collection Basin Makeup-Water Assembly: Electric/electronic water-level controller with solenoid valve.
 - 4. Collection Basin Heater: Electric.
 - 5. Gravity Water Distribution Basin: Polymer-coated galvanized steel.
 - 6. Fill: PVC.
 - 7. Drift Eliminators: FRP or PVC.
 - 8. Air-Intake Louvers: Matching casing.
 - 9. Fan: axial; aluminum galvanized-steel thermoplastic blades with field-adjustable blade pitch.
 - 10. Fan Drive: Multiple V-belt.
 - 11. Fan Motor: Totally enclosed air over (TEAO) ; complying with ASHRAE/IES 90.1 ; NEMA Premium Efficient ; severe-duty rating.
 - 12. Air Discharge Stack: Low-profile; same material as casing; and having factory-installed access doors.
 - 13. Electrical: Factory-furnished factory-installed variable-frequency controller for each fan motor.
 - 14. Vibration Switch: For each fan drive with manual-reset button.
 - 15. Controls: Factory installed and wired, and functionally tested at factory before shipment.
 - 16. Water Treatment: Chemical free.
 - 17. Service Access: Ladders and cages, platforms, and handrails, constructed of aluminum.
 - 18. Hoisting Assembly: Pedestal base, davit arm, and winch.

1.5 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.
- B. Test Procedure: CTI ATC 105.

END OF SECTION 236514.14

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SECTION 237323 - CUSTOM, OUTDOOR, CENTRAL-STATION AIR-HANDLING UNITS

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 custom, outdoor, central-station air-handling units (AHU) with the following components and accessories:
 - 1. Chilled water cooling coils.
 - 2. Hot water heating coils.
 - 3. Total energy recovery wheels.
 - 4. Supply and relief fan arrays.
 - 5. Dampers
 - 6. Particulate filtration.
 - 7. Acoustical silencers.
 - 8. Roof curbs.
- B. Related Sections include the following:
 - 1. Section 230513 - Common Motor Requirements for HVAC Equipment.
 - 2. Section 230519 – Meters and Gages for HVAC Piping.
 - 3. Section 230523.12 – Ball Valves for HVAC Piping and Section 230523.13 – Butterfly Valves for HVAC Piping and Section 230523.14 – Check Valves for HVAC Piping.
 - 4. Section 230719 – Hydronic Piping Insulation and Section 232113 – Hydronic Piping and Section 232116 – Hydronic Piping Specialties.

1.3 DEFINITIONS

- A. BAS: Building automation system providing centralized HVAC instrumentation and control.
- B. DDC: Direct-digital controls.
- C. ECM: Electrically commutated motor.
- D. Supply-Air Fan: The array of fans providing conditioned outside air to the space.
- E. Relief-Air Fan: The array of fans providing relief air from the conditioned space, including all air that is neither locally nor centrally exhausted from the building through a dedicated exhaust fan(s).
- F. AHU: Air-handling unit. As used in this Section, this abbreviation means custom, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.

1.4 PERFORMANCE REQUIREMENTS

- A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted in the article Manufacturers, the equipment must:
 - 1. Perform to the scheduled and specified capacities.
 - 2. Make no additional demands on other systems, such as domestic, heating and chilled water, or electricity.
 - 3. Fit in the available space, maintaining all clearances for service and for overhaul or removal of components without impact to design disciplines and trades.
 - 4. Meet or exceed all specified requirements.
- B. Air-Handling unit manufacturer shall install damper actuators in factory as furnished by Controls Contractor. Provide pathways for control wiring (conduit) in factory, in coordination with Controls Contractor's submittal. Any factory-installed penetrations required by the Controls Contractor for field-installation of control components shall be coordinated at factory. Air-handling unit manufacturer shall ensure sufficient access space is available for installation of all devices and panels included in Controls Contractor's submittal.

- C. Air-Handling unit manufacturer shall design and install all coil connections and distribution piping within the Service Vestibule. Refer to drawings for coil connection details. Coordinate piping to terminate 18-inches above the floor in the location of the heating hot water and chilled water services to the Vestibule. Air-handling unit design shall include a pipe chase for each service with a continuous 2-inch lip around the opening (see floor construction). Controls Contractor shall ship control valves for factory installation (final wiring provided in the field by Controls).

1.5 ACTION SUBMITTALS

- A. Product data and shop drawings shall be assembled in a single submittal .PDF file that is bookmarked in coordination with an overall submittal Table of Contents.
- B. Product Data: Include manufacturer's technical data for each AHU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.
1. Certified fan performance curves with system operating conditions indicated including clean and dirty filter conditions and with simulated (single) fan failure. Fan performance shall include system effects attributed to back draft dampers and any other accessories not considered in AMCA certified performance.
 2. Certified unit (inlet, discharge and radiated) sound power ratings for each octave band.
 3. Certified coil performance ratings with system operating conditions indicated.
 4. Certified total energy recovery wheel performance with system operating conditions indicated.
 5. Certified dehumidification heat piping performance with system operating conditions indicated.
 6. Motor ratings and electrical characteristics and fan accessories.
 7. Unit Construction materials: Gages, finishes and insulation values.
 8. Filter type and performance at clean and dirty conditions.
 9. Dampers, including housings, linkages, and operators.
- C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Include proposed shipping modules, rigging plan and procedures, and detailed description of field assembly.
 2. Elevations and isometric view of equipment assemblies.
 3. Piping Diagrams: Provide details of piping for coils. Differentiate between manufacturer factory-installed piping, manufacturer field-installed piping and field-installed piping.
 4. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer factory-installed wiring, manufacturer field-installed wiring, and field-installed wiring.
 5. Roof Curb: Provide dimensions, weights, proposed shipping modules, rigging plan and procedures, detailed description of field assembly and detailed procedure(s) for attachment to structure and flashing.
- D. Unit shown on drawings is based on dimensions of the basis of unit. If another acceptable manufacturer's unit is proposed, ascertain that it will fit in the available space without additional clearance requirements for service and unit overhaul.

1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members to which AHUs will be attached.
 2. Roof openings locations for all piping services.
 3. Roof curbs and flashing.
- B. LEED Submittals: Signed by manufacturer certifying that products comply with specified requirements and with requirements of ASHRAE 62.1 (IEQ1) and 90.1 (EA1).
- C. Source quality-control reports.
- D. Field quality-control reports.
- E. Warranty: Special warranty specified in this Section.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For AHUs to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters (of each type) for each unit.

1.9 QUALITY ASSURANCE

- A. ARI Compliance:
 - 1. Comply with ARI 410 for testing and rating heating and cooling coils for AHUs.
 - 2. Comply with ARI 270 for testing and rating sound performance for RTUs.
- B. ASHRAE Compliance:
 - 1. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
 - 2. Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
- C. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.
- D. UL Compliance: Comply with UL 1995. Listing shall be for the complete unit as an assembly. Listing of individual components, or control panels only, is not acceptable.
- E. Fan Certification: Tested and rated in accordance with applicable AMCA 204 Standard Test Code and Certified Rating Program and bearing AMCA Certified Air Rating Seal.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.10 SOURCE QUALITY CONTROL

- A. Assembly and factory test unit each unit prior to shipping. Correct deficiencies in unit performance at the factory prior to shipping.

1.11 FIELD QUALITY CONTROL

- A. At the conclusion of field-installation of all system components and controls, perform pre-functional testing of the entire assembled system.
- B. Submit proposed test procedure to the A/E for approval, detailing methods, equipment and techniques to be employed for each specific test. Equipment will not be considered approved until written approval of testing procedures is attained. Testing shall include operation of all system components, including, but not limited to, the following:
 - 1. Supply / Relief fan array(s).
 - 2. Cooling / Heating coil(s) and valve control.
 - 3. Total energy recovery wheel.
 - 4. Energy recovery coil.
 - 5. Outside air damper control.
 - 6. Bypass air damper control.

1.12 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and protect units. Encapsulate each module to protect from rain and dirt. Repair / restore damage to "like-new" condition. Include written instructions, hardware and materials for field installation.
- B. Deliver air-handling units as factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.13 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of AHUs that fail in materials or workmanship within three-year period from date of shipment, including components incorporated into unit by AHU manufacturer that are furnished from a third party manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Energy Labs.
 - 2. Ingenia.
 - 3. TMI Climate Solutions (BOD).

2.2 MATERIALS

- A. Galvanized steel members, fabrications and assemblies: Hot-dip galvanized after fabrication, in accordance with ASTM A 653/A653M, and as specified below. Galvanized thickness – G90.
- B. Galvanized steel bolts, nuts, washers and hardware: ASTM A 153.
- C. Steel tubing for frame: ASTM A 500, Grade B, cold-formed carbon steel, electric resistance welded, square and rectangular type, minimum yield strength 46,000 psi.
- D. Insulation: Except as further specified for particular locations, fiberglass, ASTM C 1071, Type I, flexible, nominal density two pounds per cubic foot; or Type II, rigid, nominal density three pounds per cubic foot.
- E. Aluminum sheet, framing and hardware.

2.3 MANUFACTURED UNITS

- A. Provide factory-fabricated custom air-handling unit, of size, configuration and capacity indicated on the drawings and as specified.
- B. Unit shall be factory-fabricated to completion as a fully assembled unit, tested and then separated into individual sections for shipment. Each section shall be self-supporting.
 - 1. Each section shall be engineered for field assembly. Fabricate the mating upper frame of each section with a flanged perimeter, drilled connection holes and a continuous gasket for assembly.
- C. Factory-install all internal components, electrical and control devices, wiring and conduits. Terminate and label wiring in junction boxes within the service vestibule of the unit with knockout in location for final field connections.
- D. Access: Provide service vestibule as indicated on drawings. Where required, provide additional removable panels to facilitate fan and coil removal.
- E. Structural Support: Support fans, coils, heat recovery devices, filters and access doors from unit structure and not from unit panels.
- F. Pipe and conduit connections: Provide sleeved and sealed openings for piping and conduit penetrating the unit floor within the service vestibule and make airtight. Penetrations shall have sufficient tolerance to facilitate installation of unit given piping stubs from building. Provide isolation valves at termination of piping in service vestibule above point of penetration for connection to building services during installation.
- G. Fasteners: Casing seams shall be bolted, gasketed and caulked air and watertight.
- H. Pressure and leakage: Design and construct unit enclosure to withstand 10 inches wc positive pressure in the fan module and 6 inches wc negative pressure upstream of the fan module. Air leakage shall be less than 1 percent of the scheduled supply airflow at 6 inches wc positive or negative pressure, as applicable.
- I. Deflection: Design cabinet enclosure to deflect not more than 1/200th of the unit's span in either direction at 1.5 times the total static pressure, positive or negative pressure, as applicable.

2.4 BASE

- A. Perimeter base shall be welded and fabricated using heavy gauge structural steel tubing. C-Channel cross supports shall be welded to the perimeter base steel tubing and located on a maximum 24-inch centers (or as necessary to accommodate unit without sagging or distortion of the unit housing during lifting, shipping and rigging).
- B. Provide at least four lifting lugs welded to the structural base of each module.
- C. Paint frame and base with industrial phenolic coating for long term corrosion resistance.
- D. Provide stair tread fastened to base rail for access to service vestibule. Stair shall be shipped loose for field-install.
- E. Provide thermal break construction.

2.5 FLOOR AND DRAIN PANS

- A. Flooring (internal) shall be minimum 0.100-inch-thick aluminum tread plate, continuously welded, thermal break construction.
 - 1. Sub- (outer) floor shall be 16-gauge galvanized steel.
 - 2. Spray foam insulated floor cavity, minimum 3-inches thick, with seams sealed for air and water tight construction.
 - 3. Provide a fully welded 2-inch lip for full perimeter of service vestibule and at all floor penetrations.
 - 4. Service vestibule shall be provided with same flooring construction as air tunnel.
 - 5. Provide a fully welded and recessed drain, with removable cover, within the service vestibule. Piping shall be insulated and shall extend to the base rail exterior (shipped with cap). Drain lines shall be manifolded where possible to limit base rail penetrations.
 - 6. All equipment located in the service vestibule shall be mounted on a minimum 2-inch high pedestal continuously welded to the floor.
 - 7. Screws, bolts or mechanical fasteners shall not penetrate the unit flooring.
- B. Drain pans shall be minimum 16-gauge Type 304 stainless steel; self-draining, pitched in four directions toward the condensate outlet.
 - 1. Condensate drain shall be minimum 1.5-inch Type L copper or stainless-steel, insulated, and shall be manifolded and extended through accessible side of unit base in one location per coil bank.
 - 2. Provide full length primary drain pans for each bank of cooling coils, minimum 3 inches deep. Extend 6-inches upstream of coils and 30-inches downstream. Provide walk-on Type 304 stainless steel grating over primary drain pans.
 - 3. Provide 1-inch deep intermediate drain pans for the top coils in stacked cooling coil configuration. Extend pans minimum 4-inches upstream and 9-inches downstream of the coil assembly. Provide 1-inch copper Type L or stainless-steel downspouts that drain the intermediate drain pans into the primary drain pans.
 - 4. Primary and intermediate drain pans shall extend the entire width of the casing section.

2.6 CASING

- A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed. Removal of casing panels shall not affect structural integrity of the AHU.
 - 1. Cabinet enclosure, including service vestibule, shall not accumulate water on surfaces.
 - 2. Gaskets: Weather resistant, closed-cell neoprene.
 - 3. Base compatible with weathertight roof curb.
 - 4. Roof provided with gutter and downspout system for spill to roof.
- B. Casing Finish and Color: Selected by architects from manufacturer's standard color offerings. Finish shall include epoxy primer and weather-resistant industrial enamel top coat.
- C. Double-Wall Construction: Fill space between walls with 3-inch spray foam insulation, R-4 per 1-inch of thickness.
 - 1. Fasteners shall not penetrate the unit interior.
 - 2. Flanges shall be not less than 1-inch and shall be sealed with neoprene gaskets.
 - 3. Joints shall be sealed water- and air-tight with neoprene gaskets. Wall and roof panel joints shall be recessed and covered with a removable trim strip.

- D. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
 - 1. Exterior Casing Thickness: 16-gauge.
- E. Inner Casing Fabrication Requirements:
 - 1. Inside Casing: Galvanized steel (G90), 20-gauge.
- F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- G. Access doors shall be the same construction as wall and roof panels. Provide access doors in all sections of the unit and permit access to all components of the unit (and as shown in mechanical details). Position and size access doors to provide a clear, unobstructed opening of not less than 24-inches wide and 72-inches high. Provide larger door openings, if required, in fan, coil and energy recovery device sections for removal of components.
 - 1. Hinges: Galvanized-steel continuous hinges.
 - 2. Latches: Provide a minimum of 2 latches, high-compression type, equal to Ventlok 333 on outward-opening doors and Ventlok 310 on inward-opening doors. One latch on each exterior (service vestibule to roof) door shall have a keyed lock.
 - 3. Gaskets: Double-gasketed, neoprene and EPDM, hollow compression type with inner aluminum clips, rated for constant exposure to temperature range of minus 20 to 160 deg F, around entire perimeter of each door.

2.7 FANS

- A. Direct-Driven Supply-Air Fans: Double width, backward inclined, centrifugal; with permanently lubricated, inverter duty rated motor for multispeed operation resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.
- B. Supply- and Relief-Air Fans: Unit shall be provided with supply- and relief-air fan arrays, made up of individual fan cells, designed for use in multiple fan arrangement. Each fan array shall meet the scheduled performance requirements with duty point selected on a steep section of the fan curve.
 - 1. Fans shall be mounted on a structural steel, welded, integral base.
 - 2. Each separate fan in the array shall be independently isolated with vibration isolators.
 - 3. Fans shall be statically and dynamically balanced and designed for continuous operation at maximum rated fan speed and horsepower.
 - 4. Fans shall be spaced in the air tunnel cross-section to provide uniform air flow and velocity profile across the entire air tunnel and components contained therein.
- C. Fan Construction:
 - 1. Class III, direct-drive airfoil centrifugal type fan.
 - 2. Cell Housing: Galvanized steel with perforated inner liner, insulation and solid outer panel.
 - 3. Blades: Hollow airfoil, double skin welded to the center and wheel-side plates.
 - 4. Hubs: Cast or welded, with straight bores and keyways, screwed to the shaft with no fewer than two set screws.
 - 5. Provide discharge safety cages and inlet screens.
- D. Fan Motor: Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
- E. Fan Service: Unit shall include gantry rail system to facilitate removal of fan motor from supply and return air stream, into and across the length of the service vestibule and down the floor of the service vestibule at the service vestibule entrance with manual chain fall.
- F. Backdraft Dampers: Each fan in multi-fan array shall be provided with an integral back flow prevention device to prohibit recirculation of air in the event of a fan(s) becoming disabled. Discharge side and motorized devices shall not be acceptable. Damper shall be counter-weighted, adjustable, back flow type for final adjustment in field.
- G. Airflow Monitoring: Fans shall have thermal dispersion airflow measurement device mounted in face of fan inlet as required in Section 230900 – Instrumentation and Controls for HVAC.
 - 1. Airflow monitoring shall be part of packaged damper / airflow monitoring station system. Unit shall be shipped to factory for installation by AHU manufacturer.
 - 2. Digital airflow readout (CFM and temperature) shall be mounted in service vestibule of unit.
 - 3. Output control signal transmitter for monitoring and control by BAS.

2.8 COILS

- A. Hydronic Pre-heat and Cooling Coils:
 - 1. Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor designed to operate at 250 psig and 300 deg F.
 - 2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
 - 3. Coil Split: Interlaced.
 - 4. Condensate Drain Pan: Stainless steel formed with pitch and drain connections complying with ASHRAE 62.1. Unit Manufacturer shall provide common condensate collection drain pipe from all drain pans. Coordinate location of penetration of Service Vestibule floor penetration and 3-inch condensate drain connection on level below (see plumbing drawings).
 - 5. Freeze Protection: Provide circulation pump and piping for freeze protection circuit. Locate pump in bypass position.
- B. Energy Recovery Coils:
 - 1. xxx.

2.9 ENERGY RECOVERY WHEEL

- A. Total energy recovery wheel to be aluminum fluted energy transfer media, with coating to maximum latent energy recovery. Provide aluminum spokes and extruded aluminum center hub and rim assembly. Perimeter seal held in place using stainless steel retaining clips, no contact with any rotating surface. Low leakage brush seals separate the two airstreams.
- B. Rotor pillow block bearings shall be maintainable or replaced without removal of the rotor from casing or media from spoke system.
- C. Rotor to utilize self-adjusting belt drive system intended for variable speed applications.
- D. Recovery wheel media must be cleanable with hot water and light detergent without degradation of latent recovery capacity.
- E. Unit to be AHRI certified and UL-900 compliant for smoke generation and fire resistance.
- F. Energy recovery wheel to be provided and factory installed by AHU manufacturer. AHU manufacturer to warrant energy recovery wheel as component of overall AHU system.

2.10 AIR FILTRATION

- A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pre-Filter: MERV 8, 2-inches thick.
 - 2. Final Filter: MERV 13, 12-inches thick.

2.11 DAMPERS

- A. Low-Leakage Dampers: Galvanized steel (aluminum for outdoor air isolation and control), designed for industrial applications. When tested in accordance with AMCA 500, leakage shall not exceed 4.6 cfm per sf at 4-inches wc. Pressure drop shall not exceed 0.15-inch wc at 1000 fpm.
 - 1. Frames: 16-gauge galvanized steel C channel, with extruded bearing holes.
 - 2. Blades: 16-gauge, airfoil triple-V grooved design, with low leakage stainless steel lip and edge seals. Blades shall be rated for a velocity of 1500 fpm without excess noise.
 - 3. Linkage: Concealed in the frame and out of the air stream; stainless steel ball bearings.
 - 4. Shafts: Square, providing the proper alignment and positively locking connections.
 - 5. Motor: Modulating with adjustable minimum position.
- B. Outside-air damper shall combine the functions of control damper and flow measurement station in one assembly. Provide air straightener and galvanized steel sleeve. Flow measurement shall utilize thermal dispersion technology, with one self-heated bead-in glass thermistor and one zero power bead-in-glass thermistor. Flow measurement shall be accurate to within +/- 2% of reading over an operating range of 0 to 5,000 fpm face velocity and shall be calibrated according to NIST LDA standards.
- C. Fire / Smoke Damper: Provide fire / smoke dampers in the supply and relief openings to the AHU. Dampers shall be rated per NFPA code and shall be UL listed for use in smoke control application. Electric operators must be furnished by damper manufacturer and shall be 120 VAC, 2-position type. Provide contact for interface to fire alarm control panel.

- D. Service vestibule shall utilize bypass damper to supply and return air from the unit to the service vestibule. Airflow shall be primary means of heating and cooling service vestibule (with backup electric heat from unit heater).
 - 1. Electric Unit Heater: 10 kW, wall-hung, horizontal throw, unit heater. Refer to Section 238239 "Unit Heaters."
- E. Damper Applications:
 - 1. Outdoor Air Isolation and Control: Opposed.
 - 2. Supply Air Isolation: Opposed.
 - 3. Relief Air Isolation: Opposed.
 - 4. Bypass Air Control: Parallel.

2.12 ACOUSTICAL ATTENUATION

- A. Provide AHU meeting the following sound power requirements per octave band (dB):
 - 1. Discharge (Supply): 63Hz – 91; 125Hz – 81; 250Hz – 80; 500Hz – 76; 1000Hz – 55; 2000Hz – 55; 4000Hz – 60; 8000Hz – 71.
 - 2. Inlet (Relief): 63Hz – 85; 125Hz – 74; 250Hz – 70; 500Hz – 68; 1000Hz – 44; 2000Hz – 39; 4000Hz – 34; 8000Hz – 39
 - 3. Radiated (Casing): 63Hz – 76; 125Hz – 77; 250Hz – 79; 500Hz – 64; 1000Hz – 47; 2000Hz – 37; 4000Hz – 27; 8000Hz – 27
- B. In the event the noise levels are exceeded by the Manufacturer's substituted mechanical equipment, it shall be the option of the Manufacturer, if approved by the AE / Acoustical Consultant, to provide additional noise control devices to supplement the present design in order to comply with the specified noise levels.
- C. The Manufacturer shall provide test data, computer model, or other means to substantiate the maximum allowable sound power levels have not been exceeded. Alternatively, an independent acoustical testing laboratory or acoustical consulting firm may substantiate that the noise levels of the Manufacturer's mechanical equipment and any additional noise control devices, meet or do not exceed, the maximum specified sound levels.

2.13 CONTROLS

- A. AHU manufacturer will be provided the wiring diagram from the Controls Contractor for use in coordination of factory-installed conduit pathways and penetrations. Field-fabricated penetrations are not acceptable.
- B. AHU manufacturer will conduct coordination meeting with Controls Contractor to ensure all pathways and devices are captured. Identification of pathways in field and at all shipping splits will be as determined by AHU manufacturer and Controls Contractor.

2.14 ELECTRICAL POWER CONNECTION

- A. Provide for single connection of power to unit with unit-mounted non-fused disconnect switch accessible from outside unit (NEMA 12) and control-circuit transformer with built-in overcurrent protection. Panel shall provide power to each VFD in supply and relief fan array, control power transformer, 120V transformer(s) and panel(s) for lights and receptacles and HOA switch(es) for the unit, provided by the AHU manufacturer. All panels shall bear ETL label.
- B. Unit shall be provided with pre-wired and switched non-corroding vapor-tight LED lights in each compartment that has an access door and in the service corridor.
- C. Provide duplex 20-amp GFI receptacles in two locations within service vestibule. Provide single exterior receptacle with weatherproof enclosure.
- D. Each VFD shall be wired to a UL 508E motor protection panel provided by AHU manufacturer, providing individual non-fused disconnect switches and overcurrent and short circuit protection to each fan, mounted in a NEMA 1 enclosure adjacent to the access door of the associated fans. Panel shall include interlocking contactors to be wired back to VFD.
- E. Each VFD shall be wired with relay for signal from fire-alarm system.
- F. Provide dedicated emergency power circuit to single fan in supply and relief fan array. Fans shall be capable of operation during normal power interruption to maintain make-up air to laboratory spaces with fume hood or point exhaust.

2.15 ROOF CURBS

~~A.~~ AHU manufacturer to coordinate provision of ~~Roof curbs with vibration isolators and wind or seismic restraints are specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."~~

~~B.A.~~ pre-fabricated, double-wall insulated roof curb with custom roof curb manufacturer. Field assembly and installation of roof curb by Contractor.

~~C.B.~~ Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards. Provide reinforcement necessary for continuous unit support at shipping splits (shipped disassembled for field installation).

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or II.
 - b. Thickness: 2 inches.

~~D.C.~~ Curb Height: 14 inches.

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 AHUs.
- B. Examine roughing-in for AHUs to verify actual locations of piping and duct connections before equipment installation.
- C. Examine roofs for suitable conditions where AHUs will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install AHUs on curbs and coordinate roof penetrations and flashing with roof construction specified in Section 077200 "Roof Accessories." Secure AHUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.3 CONNECTIONS

- A. Install condensate drain, minimum connection size, with trap and combine into single drain line. Coordinate location of penetration through service vestibule floor to indirect connection to condensate drain line on level below (see plumbing plans).
- B. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:
 1. Provide AHUs with duct collar at all unit openings. Connect supply and relief ducts to AHUs with rigid flanged construction to limit leakage airflow from unit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.
- B. Air Leakage Testing: Test unit at the pressure indicated in casing construction requirements by measuring the airflow into and out of the unit. Measure airflow with a chambered nozzle with variable supply system, as described in AMCA 210. The unit will pass if the test indicates a leakage rate not exceeding 1 percent of the design airflow.
- C. Deflection Testing: See air leakage testing procedure. The unit will pass if enclosure deflection is measured to be no more than 1/200th of the unit's span in either direction.
- D. Tests and Inspections:

1. After installing AHUs and after electrical circuitry has been energized, test units for compliance with requirements.
 2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 5. Perform fan vibration test for fan wheel and shaft assemblies with an electronic balance analyzer with a tunable filter. Vibration shall be less than 0.157 in/sec velocity.
- E. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
- B. Complete installation and startup checks according to manufacturer's written instructions and do the following:
1. Inspect for visible damage to unit casing.
 2. Inspect for visible damage to coils and fans.
 3. Inspect internal insulation.
 4. Verify that labels are clearly visible.
 5. Verify that clearances have been provided for servicing.
 6. Verify that controls are connected and operable.
 7. Verify that filters are installed.
 8. Clean coil(s) and inspect for construction debris.
 9. Remove packing from vibration isolators.
 10. Verify lubrication on fan and motor bearings.
 11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 12. Start unit according to manufacturer's written instructions.
 - a. Start refrigeration system.
 - b. Do not operate below recommended low-ambient temperature.
 - c. Complete startup sheets and attach copy with Contractor's startup report.
 13. Inspect and record performance of interlocks and protective devices; verify sequences.
 14. Operate unit for an initial period as recommended or required by manufacturer.
 15. Calibrate thermostats.
 16. Adjust and inspect high-temperature limits.
 17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
 18. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
 19. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
 - a. Supply-air volume.
 - b. Relief-air volume.
 - c. Outdoor-air intake volume.
 20. Inspect the following:
 - a. Low-temperature safety operation.
 - b. Filter high-pressure differential alarm.
 - c. Economizer to minimum outdoor-air changeover.
 - d. Relief-air fan operation.
 - e. Smoke and firestat alarms.
 21. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.6 CLEANING AND ADJUSTING

- A. Occupancy Adjustments: 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 four visits to site during other-than-normal occupancy hours for this purpose.
- B. After completing system installation and testing, adjusting, and balancing AHU and air-distribution systems, clean filter housings and install new filters.

3.7 DEMONSTRATION

- A. Engage a factory-authorized service representative to provide up to 4 hours of training for Owner's maintenance personnel to adjust, operate, and maintain AHUs. Refer to Section 017900 "Demonstration and Training." Manufacturer shall provide video recording of the training session.

END OF SECTION

MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT – GMP3, GMP4
27 SEPTEMBER 2019

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**SECTION 238123.11 - SMALL-CAPACITY (6 TONS (21 KW) AND SMALLER), COMPUTER-ROOM
AIR-CONDITIONERS, FLOOR-MOUNTED UNITS**

1.1 WARRANTY

- A. Materials and Workmanship for Control Boards: Three years.

1.2 MANUFACTURED UNITS

- A. Cabinet and Frame: Welded tubular-steel frame with removable steel panels, insulated, and with baked-enamel finish.
- B. Supply-Air Fan: Forward curved, centrifugal, belt driven.
- C. Hydronic Cooling Coil: Copper tubes expanded into aluminum fins with modulating control valve with stainless-steel drain pan having an automatic condensate pump.
- D. Pre-Filter: 2 inches thick.
- E. Filter: 2 inches thick.
- F. Disconnect Switch: Locking.
- G. Control System: Microprocessor unit -mounted panel with solid-state temperature- and humidity-control modules.

END OF SECTION 238123.11

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SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

1.1 COMPONENTS

- A. Wall- or Ceiling-Mounted, Evaporator-Fan Components:
 - 1. Enameled-steel cabinet.
 - 2. Copper-tube refrigerant coil.
 - 3. Electric heating coil.
 - 4. Centrifugal fan.
 - 5. Multispeed motor.
 - 6. Disposable filters.

- B. Air-Cooled, Compressor-Condenser Components:
 - 1. Enameled-steel casing.
 - 2. Hermetically sealed scroll compressor.
 - 3. Copper-tube refrigerant coil.
 - 4. Heat-pump components.
 - 5. Aluminum-propeller fan.

- C. Accessories: Low-voltage thermostat Automatic-reset timer Refrigerant line kits.

END OF SECTION 238126

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SECTION 238219 - FAN COIL UNITS

1.1 PRODUCTS

- A. Ducted Fan Coil Units:
1. Fan Coil Unit Configurations: Row split.
 - a. Number of Heating Coils: One.
 - b. Number of Cooling Coils: One with four-pipe system.
 2. Coil Section Insulation: 1-inch- thick.
 3. Main and Auxiliary Drain Pans: Insulated galvanized steel with plastic liner.
 4. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panel.
 5. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.
 - a. Sheet metal supply- and return-air and mixing plenums.
 - b. Dampers: Galvanized steel.
 6. Filters.
 7. Hydronic Coils: Copper tube, with aluminum fins.
 8. Indoor Refrigerant Coils: Copper tube, with aluminum fins.
 9. Steam Coils: Copper tube, with aluminum fins.
 10. Electric-Resistance Heating Coils: Nickel-chromium heating wire.
 11. Fan and Motor Board: Removable.
 - a. Fan: Forward curved, double width, centrifugal; direct driven.
 - b. Motor: Permanently lubricated, multispeed; resiliently mounted.

END OF SECTION 238219

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SECTION 238239.13 - CABINET UNIT HEATERS

1.1 PRODUCTS

- A. Cabinet Unit Heaters: Factory-assembled and -tested unit complying with AHRI 440.
- B. Coil Section Insulation Materials: Glass-fiber duct liner with aluminum-foil facing.
- C. Cabinet Material: Steel with standard baked-enamel finish.
 - 1. Vertical Unit, Exposed Front Panels: Galvanized sheet steel, removable panels.
- D. Filters: Glass fiber, MERV 5.
- E. Coils:
 - 1. Hot-Water Coil: Copper tube with aluminum fins. Include manual air vent and drain.
- F. Controls:
 - 1. Fan and Motor Board: Removable.
 - 2. Factory, Hot-Water Piping Package:
 - 3. Basic Unit Controls:
 - a. Wall -mounted temperature sensor.
 - b. Data entry and access port.
 - 4. DDC terminal controller.
 - 5. Interface with DDC system for HVAC.

END OF SECTION 238239.13

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SECTION 238239.19 - WALL AND CEILING UNIT HEATERS

1.1 MANUFACTURED UNITS

- A. Cabinets:
 - 1. Front Panel: Stamped-steel louver.
 - 2. Finish: Standard color baked enamel.
- B. Fan and Motor:
 - 1. Fan: Aluminum propeller directly connected to motor.
 - 2. Motor: Permanently lubricated, multispeed.
- C. Controls:
 - 1. Controls: Unit-mounted thermostat.
 - 2. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

END OF SECTION 238239.19

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SECTION 260513 - MEDIUM-VOLTAGE CABLES

1.1 SYSTEM DESCRIPTION

- A. Quality Standards: IEEE C2 and NFPA 70.

1.2 COMPONENTS

- A. Cables:
 - 1. Type: MV105.
 - 2. Conductor: Copper.
 - 3. Conductor Stranding: Compact round, concentric lay.
 - 4. Strand Filling: Conductor interstices are filled with impermeable compound.
 - 5. Conductor Insulation: Ethylene-propylene rubber.
 - a. Voltage Rating: 15 kV.
 - b. Insulation Thickness: 133 percent.
 - 6. Shielding: Copper tape.
 - 7. Shielding and Jacket: Corrugated copper drain wires embedded in extruded, chlorinated, polyethylene jacket.
- B. Connectors:
 - 1. Copper-Conductor Connectors: Copper barrel crimped or Copper shear bolted.
- C. Solid Terminations:
 - 1. Multiconductor Cable Sheath Seals: Compound-filled, cast-metal body and cold-shrink heat-shrink cast-epoxy-resin sheath seal kit.
 - 2. Shielded-Cable Terminations: Class 1, modular, heat shrink Class 1, modular kit, indoors, with stress-relief tube Class 2, indoors, kit with stress-relief tube Class 3 with stress cone.
- D. Separable insulated connectors with load-break cable terminators dead-break cable terminators dead-front terminal junctions test-point fault indicators.
- E. Splice Kits: Combination tape and cold-shrink-rubber sleeve, heat shrink, premolded, cold-shrink rubber premolded EPDM splicing body and separable multiway splice system.
- F. Fault indicators.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.
- B. By Contractor.

END OF SECTION 260513

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SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

1.1 CONDUCTORS AND CABLES

- A. Copper Building Wire, Rated 600 V or Less:
 - 1. Insulation: Type THHN Type THWN-2 Type XHHW-2.
- B. Metal-Clad Cable, Type MC:
 - 1. Conductor: Aluminum.
- C. Armored Cable, Type AC:
 - 1. Conductor: Copper.
- D. Photovoltaic Cable, Type PV:
 - 1. Conductor: Copper.
- E. Mineral-insulated cable, Type MI.
- F. Fire-Alarm Wire and Cable: Complying with NFPA 70, Article 760.
 - 1. Signaling Line Circuits: Twisted, shielded pair.
 - 2. Non-Power-Limited Circuits: Solid-copper conductors, 600 V, 75 deg C.
 - a. Low-Voltage Circuits: No. 16 AWG, minimum.
 - b. Line-Voltage Circuits: No. 12 AWG, minimum.
 - c. Multiconductor Armored Cable: Type MC.
 - 3. Consolidation Points:
 - a. Number of Connectors per Field: One for each four-pair conductor group of indicated cables.
 - b. Mounting: Recessed in ceiling Wall.
 - 4. Cable Management System: Computer-based cable management system, with integrated database and graphic capabilities.

1.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

1.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway
Armored cable, Type AC.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- J. Branch Circuits Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.

- L. Branch Circuits Between a Junction Box and Final Terminating Device within the Same Space: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.
- M. Wiring Method of Fire-Alarm System: Installed in a dedicated raceway system that is not used for any other wire or cable.
- N. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- O. VFC Output Circuits: Type XHHW-2 in metal conduit.

1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor.
- B. Infrared Scanning: For each splice in cables and conductors No. 3 AWG and larger.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4:
 - 1. Environmental product declarations.
 - 2. Health product declarations.
 - 3. Sustainability reports.
- B. IgCC:
 - 1. Environmental product declarations: For each product.

1.2 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An NRTL with a field supervisor certified by BICSI as an RCDD.
- B. Backboards: Plywood, fire-retardant treated.
- C. Balanced Twisted Pair Cable:
 - 1. 100 ohm, four pair, Category 5e, Category 6.
 - 2. Plenum rated, riser rated and general purpose.
- D. Balanced Twisted Pair Cable Hardware:
 - 1. Connecting Blocks: 110-style IDC for Category 5e and 6, or 66-style IDC for Category 5e.
 - 2. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 3. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack.
 - 4. Patch Cords: Factory made, 48 inches.
 - 5. Workstation Outlets: Four-port-connector assemblies mounted in multigang faceplate.
 - 6. Faceplates: Metal.
- E. RS-485 Cable: Standard, Type CMG Plenum rated, Type CMP, two twisted pairs, No. 22 AWG, stranded copper, unshielded.
- F. Low-Voltage Control Cable:
 - 1. Paired Cable: Copper, unshielded, twisted pair, No. 18 AWG, Type CMG and No. 18 AWG, plenum-rated, Type CMP.
 - 2. Class 1 Control Circuits: Stranded copper, Type THHN-2-THWN-2 or Type XHHW-2, in raceway.
 - 3. Class 2 Control Circuits: Stranded copper, Type THHN-2-THWN-2, in raceway or Type XHHW-2, in raceway.

1.3 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner Contractor engaged.

1.4 INSTALLATION

- A. Wiring Method: In raceways.

1.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION 260523

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SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

1.1 QUALITY ASSURANCE

- A. Quality Standard for Grounding and Bonding Materials and Equipment: UL 467.

1.2 PRODUCTS

- A. Conductors:
 - 1. Insulated Conductors: Copper wire or cable.
 - 2. Bare Copper Conductors:
 - a. Bonding cable.
 - b. Bonding conductor.
 - c. Bonding jumper.
 - d. Tinned bonding jumper.
 - 3. Grounding Bus: Predrilled rectangular copper bars with stand-off insulators.
- B. Connectors:
 - 1. Welded.
 - 2. Bus-bar connectors.
 - 3. Beam clamps.
 - 4. Cable-to-cable connectors.
 - 5. Cable tray ground clamp.
 - 6. Conduit hubs.
 - 7. Ground rod clamps.
 - 8. Lay-in lug connector.
 - 9. Service post connectors.
 - 10. Signal reference grid.
 - 11. Straps.
 - 12. Tower ground clamps.
 - 13. U-bolt clamps.
 - 14. Water pipe clamps.
- C. Grounding Electrodes:
 - 1. Ground Rods: Copper-clad steel, sectional type.
 - 2. Ground plates.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: engaged a qualified testing agency to perform tests and inspections.

END OF SECTION 260526

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SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

1.1 PRODUCTS

- A. Support, Anchorage, and Attachment Components:
 - 1. Steel slotted support systems with metallic and nonmetallic [painted] coatings.
 - 2. Nonmetallic slotted support systems.
 - 3. Raceways and cable supports.
 - 4. Steel conduits and cable hangers, clamps, and associated accessories.
 - 5. Support for nonarmored conductors and cables in vertical conduit risers.
 - 6. Structural steel for fabricated supports and restraints.
 - 7. Mounting, Anchoring, and Attachment Components:
 - a. Powder-actuated fasteners.
 - b. Mechanical-expansion anchors.
 - c. Concrete inserts.
 - d. Clamps for attachment to steel structural elements.
 - e. Steel springhead toggle bolts.
 - f. Threaded hanger rods.
- B. Fabricated Metal Equipment Support Assemblies: Welded or bolted steel shapes.
- C. Concrete Bases: 3000-psi, 28-day compressive-strength concrete.

END OF SECTION 260529

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SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 IgCC:
 - 1. VOC limits for adhesives and sealants.

1.2 MATERIALS

- A. Metal Conduits and Fittings:
 - 1. GRC.
 - 2. ARC.
 - 3. PVC-coated rigid steel conduit or IMC.
 - 4. EMT.
 - 5. FMC: Zinc-coated steel.
 - 6. LFMC.
 - 7. Fittings:
 - a. Conduit fittings for hazardous (classified) locations.
 - b. EMT: Steel, compression type.
 - c. Expansion fittings.
 - d. PVC coated.
- B. Nonmetallic Conduit and Fittings:
 - 1. ENT.
 - 2. RNC.
 - 3. LFNC.
 - 4. HDPE.
 - 5. Fittings: Match conduit.
- C. Metal Wireways and Auxiliary Gutters: Sheet metal with hinged screw flanged-and-gasketed covers.
- D. Surface Metal Raceways: Metal, galvanized steel, with snap-on covers.
- E. Surface Nonmetallic Raceways: Two- or three-piece, rigid PVC.
- F. Boxes, Enclosures, and Cabinets:
 - 1. Metal Outlet and Device Boxes: Ferrous alloy or Aluminum.
 - 2. Nonmetallic outlet and device boxes.
 - 3. Metal Floor Boxes: Cast or sheet metal, fully adjustable.
 - 4. Nonmetallic Floor Boxes: Non-adjustable, rectangular.
 - 5. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb.
 - 6. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
 - 7. Small sheet metal pull and junction boxes.
 - 8. Cast-metal access, pull, and junction boxes.
 - 9. Box extensions.
 - 10. Gangable boxes are allowed.
 - 11. Hinged-Cover Enclosures: Metal and Nonmetallic.
 - 12. Cabinets: Galvanized steel.
- G. Handholes and Boxes for Exterior Underground Wiring: Polymer concrete with polymer-concrete or Fiberglass with polymer-concrete frame and cover, prototype tested for compliance with SCTE 77.
 - 1. Configuration: Closed bottom.
 - 2. Weatherproof cover.
 - 3. Cover Legend: "ELECTRIC."

1.3 RACEWAY APPLICATION

- A. Outdoors:
 - 1. Exposed: GRC.
 - 2. Concealed, Aboveground: GRC.
 - 3. Underground: RNC, Type EPC-40-PVC and Type EPC-80-PVC, concrete encased.
 - 4. Connection to Vibrating Equipment: LFMC.
 - 5. Boxes and Enclosures, Aboveground: Type 3R.

- B. Indoors:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Damage: IMC.
 - 4. Concealed: EMT.
 - 5. Connection to Vibrating Equipment: FMC, except LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: IMC.
 - 7. Boxes and Enclosures: Type 1, except Type 4 stainless steel in damp or wet locations.
 - 8. Within Mechanical Rooms: IMC.
- C. Minimum Indoor Raceway Size: 3/4-inch trade size.
- D. Minimum Outdoor Raceway Size: 2-inch trade size.
- E. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Threaded rigid steel conduit fittings.
 - 2. PVC Externally Coated, Rigid Steel Conduits: Fittings listed for use with this type of conduit with SCH-80 for elbows transitioning from below to above grade
 - 3. EMT: Setscrew or compression, steel cast-metal fittings.
 - 4. Flexible Conduit: Fittings listed for use with flexible conduit.

END OF SECTION 260533

SECTION 260536 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

1.1 CABLE TRAY TYPES

- A. Ladder.
- B. Wire mesh.
- C. Single rail.
- D. Solid bottom.
- E. Trough.
- F. Channel.
- G. Fiberglass.
- H. Fiberglass channel.

1.2 MATERIALS

- A. Cable Trays, Fittings, and Accessories: Steel.
 - 1. Factory-standard primer, with chromium-zinc-plated hardware.
 - 2. Mill galvanized before fabrication, with galvanized hardware.
 - 3. Electrogalvanized before fabrication, with galvanized hardware.
 - 4. Hot-dip galvanized after fabrication, with chromium-zinc-plated or Type 316 stainless-steel hardware.
 - 5. Black oxide finish for support accessories and miscellaneous hardware.
 - 6. .
- B. Cable Trays, Fittings, and Accessories: Aluminum: With stainless-steel hardware.
- C. Cable Trays, Fittings, and Accessories: Stainless steel: With stainless-steel hardware.
- D. Cable Trays, Fittings, and Accessories: Fiberglass: With fiberglass-encapsulated, stainless-steel hardware.
- E. Cable Tray Accessories:
 - 1. Covers: Solid type.
 - 2. Barrier strips.
 - 3. Cable tray supports and connectors.
- F. Warning signs.

1.3 SOURCE QUALITY CONTROL

- A. Tested according to NEMA FG 1 and NEMA VE 1.

END OF SECTION 260536

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SECTION 260539 - UNDERFLOOR RACEWAYS FOR ELECTRICAL SYSTEMS

1.1 FLUSH, FLAT-TOP UNDERFLOOR RACEWAYS

- A. Description:
 - 1. Material: Steel.
 - 2. Cross-Section Shape: Rectangular, single channel and multichannel, separated by steel wall(s).
 - 3. Listed and labeled for installation with top flush with concrete floor.
 - 4. Number of Levels: One.
- B. Service Raceways: Fitted with preset inserts.
 - 1. Number of Longitudinal Channels per Multichannel Raceway: Two or Three.
 - 2. Number of Single-Channel Raceways per Run: One, Two, or Three unless otherwise indicated.
- C. Trench duct crossunder fittings.
- D. Header raceways.

1.2 ACCESSORIES

- A. Supports, raceway fittings, and hardware.
- B. Junction Boxes: With raceway openings arranged to accommodate raceway layout.
- C. Service Fittings/Activations:
 - 1. Brushed aluminum exposed parts.
 - 2. Flush, single-system service fitting for round inserts.
 - 3. Flush, single- multiple-system service fitting for rectangular inserts.
 - 4. Surface-mounted service fitting.

1.3 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION 260539

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SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

1.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Quality Standard: ANSI C2.

1.2 COMPONENTS

- A. Metal conduits and fittings.
- B. Rigid nonmetallic duct.
- C. Flexible nonmetallic duct.
- D. Duct accessories.
- E. Precast concrete handholes and boxes.
- F. Handholes and Boxes Other than Precast Concrete:
 - 1. Polymer concrete handholes and boxes with polymer concrete cover.
 - 2. Fiberglass handholes and boxes with polymer concrete frame and cover.
 - 3. Fiberglass handholes and boxes with covers of polymer concrete and fiberglass.
- G. Precast concrete manholes.
- H. Utility Structure Accessories:
 - 1. Iron frames and covers.
 - 2. Chimney components.
 - 3. Sump frame and grate.
 - 4. Pulling eyes.
 - 5. Pulling-in and lifting irons.
 - 6. Bolting inserts for concrete utility structure cable racks and other attachments.
 - 7. Ground rod sleeve.
 - 8. Expansion anchors.
 - 9. Cable rack assemblies.
 - 10. Fixed and portable ladders.

1.3 SOURCE QUALITY CONTROL

- A. Prototype testing by manufacturer.

END OF SECTION 260543

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SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

1.1 MATERIALS

- A. Sleeves:
 - 1. Schedule 40 steel pipe.
 - 2. Cast-iron pipe.
 - 3. Galvanized-steel sheet for conduits penetrating non-fire-rated gypsum-board assemblies.
 - 4. Schedule 40 PVC pipe.
 - 5. Molded-PVC pipe.
 - 6. Molded-PE or -PP pipe.
 - 7. Galvanized-steel sheet for rectangular openings.
- B. Sleeve-Seals:
 - 1. EPDM rubber sealing elements.
 - 2. Carbon-steel, with corrosion-resistant coating, connecting bolts and nuts.
- C. Hydraulic-cement grout.
- D. Silicone Sealants:
 - 1. Single-component, silicone-based, neutral-curing elastomeric sealant.
 - 2. Multicomponent, silicone-based liquid elastomeric nonshrinking foam.

END OF SECTION 260544

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MONTGOMERY COLLEGE PROJECT #FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT
27 SEPTEMBER 2019

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - 260548.16GENERAL (Not Applicable)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 260548

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SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

1.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: <Insert value>.
 - 2. Building Classification Category: I II III IV.
 - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction and 45 degrees either side of normal.

- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: A B C D E F.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I II III.
 - a. Component Importance Factor: 1.0 1.5 Insert value.
 - b. Component Response Modification Factor: 1.5 2.5 3.5 5.0 Insert value.
 - c. Component Amplification Factor: 1.0 2.5 Insert value.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): <Insert percentage>.
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: <Insert percentage>.

1.2 COMPONENTS

- A. Restraint Channel Bracings: MFMA-4, shop- or field-fabricated bracing assemblies.
- B. Restraint Cables: ASTM A603 galvanized ASTM A492 stainless-steel cables.
- C. Hanger-Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections Reinforcing steel angle clamped to hanger rod.
- D. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- F. Anchor Bolts: Mechanical Adhesive type, seismic rated.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 260548.16

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SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

1.1 PRODUCTS

- A. Equipment Identification Labels:
 - 1. Black letters on a white field.
 - 2. <Insert specific requirements for equipment to be labeled, such as transformers, panelboards, etc.>
- B. Labels:
 - 1. Vinyl wraparound labels.
 - 2. Snap-around labels.
 - 3. Self-Adhesive Wraparound Labels: Preprinted, polyester or vinyl flexible labels with pressure-sensitive adhesive.
 - 4. Self-Adhesive Labels: Polyester or Vinyl, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels.
- C. Bands and Tubes:
 - 1. Snap-around color-coding bands.
 - 2. Heat-shrink preprinted tubes.
- D. Tapes and Stencils:
 - 1. Marker tapes.
 - 2. Self-adhesive vinyl tape.
 - 3. Tape and stencil.
 - 4. Floor marking tape.
 - 5. Underground-line warning tape.
- E. Tags:
 - 1. Brass or aluminum metal tags.
 - 2. Polyethylene preprinted tags.
- F. Signs:
 - 1. Preprinted aluminum baked-enamel signs.
 - 2. Metal-backed butyrate signs.
 - 3. Laminated acrylic or melamine plastic signs.
- G. Cable Ties:
 - 1. General-purpose cable ties.
 - 2. UV-stabilized cable ties.
 - 3. Plenum-rated cable ties.

END OF SECTION 260553

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SECTION 260573.13 - SHORT-CIRCUIT STUDIES

1.1 SUMMARY

- A. Computer-based, fault-current study.

1.2 SOFTWARE CAPABILITY

- A. Comply with IEEE 399 and IEEE 551.

1.3 EXECUTION

- A. Fault-Current Study: Electrical distribution system from normal and alternate power sources.
- B. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- C. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on the one-line or riser diagram.

END OF SECTION 260573.13

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SECTION 260573.16 - COORDINATION STUDIES

1.1 SUMMARY

- A. Computer-based, overcurrent protective device coordination studies. Series-rated devices will not be used.

1.2 SOFTWARE CAPABILITY

- A. Comply with IEEE 242 and IEEE 399.
- B. Computer software program for plotting and diagramming time-current-characteristic curves and for reporting settings and ratings of all overcurrent protective devices.
- C. Optional Computer Program Features:
 - 1. Arcing faults.
 - 2. Simultaneous faults.
 - 3. Explicit negative sequence.
 - 4. Mutual coupling in zero sequence.

1.3 EXECUTION

- A. Begin analysis at the service, extending down to the system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- B. Study electrical distribution system from normal and alternate power sources.
- C. Coordination study shall include the following:
 - 1. Transformer primary overcurrent protective devices.
 - 2. Motors served by voltages more than 600 V.
 - 3. Conductor protection.
 - 4. Generator protection.
 - 5. Protective device evaluation.
- D. Load-flow and voltage-drop study.
- E. Motor-starting study.
- F. Field Adjusting: Adjust relay and protective device settings to the settings provided by the coordination study.

END OF SECTION 260573.16

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SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

1.1 SUMMARY

- A. Computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.2 SOFTWARE CAPABILITY

- A. Comply with IEEE 1584 and NFPA 70E.
- B. Produce 3.5-by-5-inch labels for each work location included in the analysis.

1.3 EXECUTION

- A. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- B. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- C. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- D. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

END OF SECTION 260573.19

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SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

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 Cx process requirements for the following electrical components, systems, assemblies, and equipment:
 - 1. Electrical equipment connected to Normal power systems, including the following:
 - a. Transformers.
 - b. Primary and secondary service electrical systems.
 - c. Distribution and branch-circuit panelboards.
 - d. Lightning protection systems.
 - e. Grounding systems.
 - 2. Electrical equipment connected to Essential power systems that provide an alternative source of power in the absence of power from the Normal power system, including the following:
 - a. Primary and secondary service electrical systems.
 - b. Distribution and branch-circuit panelboards.
 - c. Lighting protection systems.
 - d. Grounding systems.
 - e. Generators.
 - f. UPS.
 - 3. Controls and instrumentation, including the following:
 - a. Equipment monitoring systems.
 - b. Energy monitoring and control systems.
 - c. Electrical metering and metering system.
 - d. Demand response systems.
 - e. Lighting control systems.
 - f. Security systems.
 - g. Fire-alarm systems.
 - h. .
 - 4. Systems testing and verification, including Normal and Essential power systems, and transitions from Normal to Essential power systems and back.
 - 5. .
- B. Related Requirements:
 - 1. Section 019113 "General Commissioning Requirements" for general Cx process requirements and CxA responsibilities.

1.3 DEFINITIONS

- A. BoD: Basis-of-Design Document, as defined in Section 019113 "General Commissioning Requirements."
- B. Cx: Commissioning, as defined in Section 019113 "General Commissioning Requirements."
- C. CxA: Commissioning Authority, as defined in Section 019113 "General Commissioning Requirements."
- D. Essential Power Systems: A power system that a facility transitions to in the absence of Normal power. This power includes all systems classified as "standby" or "emergency," including "legally required."
- E. Low Voltage: 600 V and below.
- F. Medium Voltage: 601 V and above.
- G. Normal Power Systems: A power system that provides primary power to a facility.
- H. OPR: Owner's Project Requirements, as defined in Section 019113 "General Commissioning Requirements."

- I. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For BAS and electrical testing technician.
- B. Construction Checklists: Draft construction checklists will be created by CxA for Contractor review.
- C. Construction Checklists: Include the following and comply with requirements in Section 019113 "General Commissioning Requirements" for construction checklists:
 - 1. Instrumentation and control for electrical systems.
 - 2. Instrumentation and control for lighting control systems.
 - 3. Low-voltage power cables.
 - 4. Control voltage power cables.
 - 5. Electrical feeders and branch circuits.
 - 6. Dry-type transformers.
 - 7. Instrument transformers.
 - 8. Switchgear and switchboard assemblies rated 1200 A or greater.
 - 9. Metal-enclosed bus duct.
 - 10. Busway.
 - 11. Low-voltage motor starters.
 - 12. Low-voltage air circuit breakers.
 - 13. Low-voltage insulated case circuit breakers.
 - 14. Low-voltage network protectors.
 - 15. Low-voltage air switches.
 - 16. Low-voltage surge protective devices.
 - 17. Medium-voltage power cables.
 - 18. Metering devices.
 - 19. Molded-case circuit breakers.
 - 20. Low-voltage power circuit breakers.
 - 21. Grounding systems.
 - 22. Ground-fault protection systems.
 - 23. Panelboards.
 - 24. Receptacles and devices.
 - 25. Engine generators.
 - 26. Automatic transfer switches.
 - 27. Variable-frequency drives.
 - 28. AC synchronous motors and generators.
 - 29. AC induction motors and generators.
 - 30. DC motors and generators.
 - 31. Battery systems.
 - 32. Battery chargers.
 - 33. Flooded lead-acid batteries.
 - 34. Flooded lead-calcium batteries.
 - 35. VRLA batteries.
 - 36. UPS systems.
 - 37. Lighting.
 - 38. Vehicle charging equipment.
 - 39. .

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electrical systems and components to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Electrical Testing Technician Qualifications: Technicians to perform electrical Construction Checklist verification tests, Construction Checklist verification test demonstrations, Cx tests, and Cx test demonstrations shall have the following minimum qualifications:
1. Journey level or equivalent skill level. Vocational school four-year-program graduate or an Associate's degree in electrical systems, or similar field. Degree may be offset by three years' experience as an apprentice or a journey-level electrician. Generally, required knowledge includes electrical and HVAC&R concepts, building operations, and application and use of tools and instrumentation to measure performance of electrical equipment, assemblies, and systems.
 2. Minimum three years' experience installing, servicing, and operating systems manufactured by approved manufacturer.
- B. Testing Equipment and Instrumentation Quality and Calibration: For test equipment and instrumentation required to perform electrical Cx work, perform the following:
1. Submit test equipment and instrumentation list. For each equipment or instrument, identify the following:
 - a. Equipment/instrument identification number.
 - b. Planned Cx application or use.
 - c. Manufacturer, make, model, and serial number.
 - d. Calibration history, including certificates from agencies that calibrate the equipment and instrumentation.
 2. Test equipment and instrumentation shall meet the following criteria:
 - a. Capable of testing and measuring performance within the specified acceptance criteria.
 - b. Be calibrated at manufacturer's recommended intervals with current calibration tags permanently affixed to the instrument being used.
 - c. Be maintained in good repair and operating condition throughout duration of use on Project.
 - d. Be recalibrated/repared if dropped or damaged in any way since last calibrated.
- C. Proprietary Test Instrumentation and Tools:
1. Equipment Manufacturer's Proprietary Instrumentation and Tools: For installed equipment included in the Cx process, test instrumentation and tools manufactured or prescribed by equipment manufacturer to service, calibrate, adjust, repair, or otherwise work on its equipment or required as a condition of equipment warranty, perform the following:
 - a. Submit proprietary instrumentation and tools list. For each instrument or tool, identify the following:
 - 1) Instrument or tool identification number.
 - 2) Equipment schedule designation of equipment for which the instrument or tool is required.
 - 3) Manufacturer, make, model, and serial number.
 - 4) Calibration history, including certificates from agencies that calibrate the instrument or tool, where appropriate.
 - b. Include a separate list of proprietary test instrumentation and tools in operation and maintenance manuals.
 - c. Electrical proprietary test instrumentation and tools become property of Owner at the time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONSTRUCTION CHECKLISTS

- A. Prepare detailed construction checklists for electrical systems, subsystems, equipment, and components. Complete and submit construction checklists.

3.2 CONSTRUCTION CHECKLIST REVIEW

- A. Review and provide written comments on draft construction checklists. CxA will create required draft construction checklists and provide them to Contractor.
- B. Return draft Construction Checklist review comments within [10] <Insert number> days of receipt.
- C. When review comments have been resolved, CxA will provide final construction checklists, marked "Approved for Use, (date)."
- D. Use only construction checklists, marked "Approved for Use, (date)."

3.3 GENERAL TESTING REQUIREMENTS

- A. Certify that electrical systems, subsystems, and equipment have been installed, calibrated, and started and that they are operating according to the Contract Documents and approved Shop Drawings and submittals.
- B. Certify that electrical instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents and approved Shop Drawings and submittals, and that pretest set points have been recorded.
- C. Set systems, subsystems, and equipment into operating mode to be tested according to approved test procedures (for example, normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- D. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.
- E. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.
- F. Construction Checklists: Prepare and submit detailed construction checklists for electrical systems, subsystems, equipment, and components.
 - 1. Contributors to development of construction checklists shall include, but are not limited to, the following:
 - a. Electrical systems and equipment installers.
 - b. Electrical instrumentation and controls installers.
- G. Perform tests using design conditions, whenever possible.
 - 1. Simulated conditions may, with approval of Architect, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by CxA, and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
 - 2. Cx test procedures may direct that set points be altered when simulating conditions is impractical.
 - 3. Cx test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.
- H. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to Owner. After deficiencies are resolved, reschedule tests.
- I. If seasonal testing is specified, complete appropriate initial performance tests and documentation and schedule seasonal tests.
- J. Coordinate schedule with, and perform Cx activities at the direction of the CxA.
- K. Comply with Construction Checklist requirements, including material verification, installation checks, startup, and performance tests requirements specified in Sections specifying electrical systems and equipment.
- L. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
 - 1. Performance tests.
 - 2. Demonstration of a sample of performance tests.

3. Cx tests.
4. Cx test demonstrations.

3.4 Cx TESTS FOR ELECTRICAL SYSTEMS

- A. Verification of Normal Power System Operation:
1. Prerequisites: Acceptance of results for construction checklists for Division 26 electrical components associated with Normal power system.
 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
 3. Test Purpose: Verify operation of Normal power system.
 4. Test Conditions: Energize components of Normal power system, one at a time.
 5. Acceptance Criteria: Proper operation of Normal power system over a [24] [48] <Insert number>-hour period.
- B. Verification of Essential Power System Operation:
1. Prerequisites:
 - a. Acceptance of results for construction checklists for Division 26 electrical components associated with Essential power system.
 - b. Completion of "Verification of Normal Power System Operation" tests.
 2. Equipment and Systems to Be Tested: Division 26 electrical equipment.
 3. Test Purpose: Verify operation of Essential power system.
 4. Test Conditions:
 - a. Energize components of Normal power system.
 - b. Simulate a failure of Normal power system.
 5. Acceptance Criteria: Transfer of power from Normal to Essential power system within OPR.
- C. Verification of Control and Instrumentation:
1. Prerequisites: Acceptance of results for construction checklists.
 - a. Section 260913 "Electrical Power Monitoring and Control."
 - b. Section 260926 "Lighting Control Panelboards."
 - c. Section 260936 "Modular Dimming Controls."
 - d. Section 260943.16 "Addressable-Luminaire Lighting Controls."
 - e. Section 260943.23 "Relay-Based Lighting Controls."
 - f. Section 262713 "Electricity Metering."
 - g. Section 263533 "Power Factor Correction Equipment."
- D. Test Purpose: Verify operation of control and monitoring systems for Normal and Essential power systems.
- E. Test Conditions:
1. Energize components of Normal power system.
 2. Test operation of equipment.
- F. Acceptance Criteria: Operation of equipment according to OPR.

END OF SECTION 260800

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SECTION 260913 - ELECTRICAL POWER MONITORING AND CONTROL

1.1 SYSTEM DESCRIPTION

- A. Microprocessor-based monitoring and control of electrical power distribution system(s) that includes the following:
 - 1. Electrical meters that monitor, control, and connect to the data transmission network.
 - a. Include multiple PC-based workstations with web access, with its operating system and application software, connected to data transmission network.

1.2 SYSTEM DESCRIPTION

- A. Quality Standards for Meters: Comply with NFPA 70. Listed and labeled as complying with UL 61010-1.

1.3 PERFORMANCE REQUIREMENTS

- A. Surge protection.
- B. Addressable devices.
- C. DDC interface.
- D. Backup power.

1.4 POWER METERS

- A. Separately mounted, modular, permanently installed, solid-state, digital I/O instrument for power monitoring and control; complying with UL 61010-1.
- B. Enclosure: IP51 for the front and IP30 for the body.
- C. Overvoltage: Comply with UL 61010-1.
- D. Accuracy: Comply with ANSI C12.20, Class 0.5.
- E. Data link.
- F. Backlit LCD capable of displaying four user-selected values at one time.
- G. Sampling Rate: No less than 32 samples per cycle.
- H. Meters:
 - 1. Instantaneous.
 - 2. Harmonic distortion.
 - 3. Energy.
 - 4. Demand.
 - 5. Minimum and maximum values.
- I. Power demand, user selectable.
- J. Data recording.
- K. Alarms.
- L. Output signals.

1.7 PC OPERATING SYSTEM SOFTWARE

- A. Description: System software shall monitor, analyze, display, control, and save all the parameters and features available at the connected meter.

1.8 NETWORKED PC OPERATING SYSTEM SOFTWARE

- A. Description: System software shall monitor, analyze, display, control, and save parameters and features available at each of the connected meters.
- B. Configured to run on a single PC and able to control multiple devices simultaneously.

1.9 POWER MONITORING AND CONTROL SOFTWARE

- A. Data storage and data sharing.
- B. Project-specific graphics, including a site plan and system schematic.

1.10 NETWORK CONFIGURATION SOFTWARE

- A. Network management graphical interface.
- B. Database maintenance.
- C. Web reporter.

1.11 MONITORING AND CONTROL OF POWER DISTRIBUTION EQUIPMENT

- A. Power Distribution Equipment: Web-enabled, direct connected to the LAN or intranet.
- B. Instrument Transformers: Comply with IEEE C57.13.
- C. Ethernet connectivity.
- D. Ethernet gateways.
- E. Distribution equipment monitoring.

1.12 SYSTEM OPERATOR INTERFACES

- A. Desktop workstation.
- B. Portable workstation.
- C. Remote connection using an outside of system PC, tablet, phone, or internet-connected device.

1.13 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner engaged.

1.14 INSTALLATION

- A. Wiring Method: In raceways.

1.15 FIELD QUALITY CONTROL

- A. Testing Agency: Owner engaged.

END OF SECTION 260913

SECTION 260923 - LIGHTING CONTROL DEVICES

1.1 PRODUCTS

- A. Time Switches: Electronic, programmable units.
- B. Daylight-harvesting switching controls.
- C. Daylight-harvesting dimming controls.
- D. Indoor Occupancy Sensors:
 - 1. Wall or Ceiling-mounted, solid-state indoor vacancy sensors.
 - 2. Passive infrared, Ultrasonic, and Dual technology.
 - 3. Integrated and Separate power pack.
 - 4. Hardwired connection to switch and BAS.
- E. Switchbox-mounted occupancy sensors: Wall-switch sensor with manual on-off switch, single gang switchbox mount, with provisions for connection to BAS.
- F. High-bay occupancy sensors.
- G. Lighting Contactors: Electrically operated and mechanically held , with nonfused disconnect and interface to connect to BAS.
- H. Emergency Shunt Relay: Normally closed, electrically held, arranged for wiring in parallel with manual[or automatic] switching contacts.
- I. Control Cables:
 - 1. Power Cables: Not smaller than No. 12 AWG.
 - 2. Class 2 and 3 Control Cables: Stranded-copper conductors, not smaller than No. 18 AWG.
 - 3. Class 1 Control Cables: Stranded-copper conductors, not smaller than No. 14 AWG.

END OF SECTION 260923

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SECTION 260933 - CENTRAL DIMMING CONTROLS

1.1 SYSTEM DESCRIPTION

- A. Microprocessor-based digital central dimming controls, including:
 - 1. Control network.
 - 2. Master-control stations and manual switches.
- B. Operation: Software preset Rocker switch Push button Slider.
- C. Control the following light sources:
 - 1. Fluorescent lamps with electronic magnetic ballasts.
 - 2. LED lamps.
 - 3. Incandescent lamps.
 - 4. Cold cathode lamps.
 - 5. Non-dimmed loads.
 - 6. <Insert special lighting equipment>.
- D. Interface with controls for the following accessory functions:
 - 1. Curtains and drapes.
 - 2. Projector screens.
 - 3. Motorized manually positioned partitions.
- E. Memory: 90 days.
- F. Control Network: 24- or 10-V dc ESTA E1.11/USITT DMX 512-A.

1.2 PRODUCTS

- A. Touchscreen Controls:
 - 1. Backlit, color, LCD, with 640 by 480 SVGA resolution with 16-bit color graphics.
 - 2. Master-Control Station Screen Size: 5.7 inches 3.6 inches Insert dimension.
 - 3. Partitioned-Space Master-Control Station Screen Size: 5.7 inches 3.6 inches Insert dimension.
 - 4. Wall-Station Screen Size: 5.7 inches 3.6 inches Insert dimension.
 - 5. Control Option: Backlit, push-button controls Software-defined controls.
 - 6. Mounting Location: Wall Rack Lectern Insert location.
 - 7. Powerpack: 12-V dc 24-V dc 120-V ac Insert voltage.
 - 8. Communications: Ethernet Wireless.
- B. Keypad Controls:
 - 1. Field configurable, backlit keypad with custom-engraved buttons.
 - 2. Mounting: Single, flush wall box.
 - 3. Device Plates: Hinged transparent locking cover.
- C. Control Network:
 - 1. Control stations linked to dimmer cabinet with a common network data cable.
 - 2. Functions of Network Control Stations:
 - a. Control Voltage: 24- or 10-V dc.
 - b. Comply with ESTA E1.11/USITT DMX 512-A for data transmission.
 - c. Communications: Ethernet Wireless.
- D. Master-Control Stations:
 - 1. Control adjustment of lighting level for each scene of each zone, and adjustment of fade-time setting for each scene change from one preset scene to another using digital rocker switches with LCD graphic display keypad controls touchscreen controls Insert control option.
 - 2. Master channel.
 - 3. Fade rate for each scene is adjustable from zero to [60] <Insert number> seconds.
 - 4. Fade override.
 - 5. Recall each preset scene and allow adjustment of scene zone controls.
 - 6. Lockout switch.
 - 7. On and off scene controls for non-dim channel contactors.
 - 8. Emergency-control push button bypasses all controls, turning all dimmers to full bright and turning on non-dim channel contactors.

9. Master on and off switch; off position enables housekeeping controls to turn on selected luminaires.
 10. Enable and disable wall stations.
 11. Interface to program the master station.
 12. Indicate lighting-level setting and fade-rate setting graphically.
 13. Native communication with building audiovisual system.
 14. BAS interface.
 15. Hinged transparent locking covers.
- E. Wall Stations:
1. Wall stations function as a submaster to a master station, containing limited control of selected scenes of the master station.
 2. [Touchscreen]controls .
 3. Numbered push buttons to select scenes.
 4. Off switch to turn master station off.
 5. On switch turns all scenes of master station to full bright.
 6. Push-button controls for accessory functions.
 7. Mounting: Flush, wall box.
- F. Dimmer Cabinets: Factory wired, convection cooled without fans, with barriers to accommodate 120- and 277-V feeders and suitable to control designated lighting equipment or accessory functions.
1. Temperature: 60 to 95 deg F.
 2. Relative Humidity: 10 to 90 percent, noncondensing.
 3. Filtered air supply.
 4. Solid-state SCR dimmers.
 5. Dimming Range: Zero to 100 percent, full output voltage not less than 98 percent of line voltage.
 6. Protect controls of each dimmer with a fuse[and SPDs].
- G. Control Option: Software-defined controls for on-screen menu navigation.
- H. Remote Programming: Web browser based interface.
- I. Conductors and Cables:
1. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors.
 2. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors.
 3. Twisted-Pair Data Cable: Category 5e or Category 6.

1.3 INSTALLATION

- A. Wiring Method: In raceways.

1.4 FIELD QUALITY CONTROL

- A. Testing: By Contractor-engaged agency.

END OF SECTION 260933

SECTION 260936 - MODULAR DIMMING CONTROLS

1.1 MANUFACTURED UNITS

- A. Wall-Box Multiscene Dimming Controls:
 - 1. Manual wall-box-mounted master controller[and indicated number of wall-box zone stations]. Each zone is adjustable to indicated number of scenes, which reside in the memory of zone controller.
 - 2. Cover mounted switches including master off, all bright, and selectors for each scene.
 - 3. Cover mounted LED indicator lights.
 - 4. Infrared receiver.
- B. Multipreset Modular Dimming Controls:
 - 1. Manual dimming equipment consisting of the following:
 - a. Master controller.
 - b. Remote control stations.
 - c. Controls and dimmers integrated for mounting in a multigang wall box under a single wall plate.
 - d. Each zone adjustable to indicated number of scenes, which reside in the memory of zone controller.
 - 2. Dimmer Panels:
 - a. Modular, plug-in type.
 - b. Integrated short-circuit rating of [10 kA at 120-V ac] or [14 kA at 277-V ac].
 - 3. Circuit Breakers: Switch duty.
- C. Configurable Zone Loads:
 - 1. LED lamps.
 - 2. Non-dim, on-off switching only.
 - 3. .
- D. Wiring:
 - 1. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
 - 2. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors.

1.2 INSTALLATION

- A. Wiring Method: In raceways.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 260936

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MHEC PROJECT #CC-01-MC16-458
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SECTION 260936.19 – STANDALONE MULTIPRESET MODULAR DIMMING CONTROLS

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION XXXXXX

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SECTION 260943.16 - ADDRESSABLE-LUMINAIRE LIGHTING CONTROLS

1.1 WARRANTY

- A. Materials and Workmanship: Three years.

1.2 COMPONENTS

- A. Interface with DDC system for HVAC.
- B. Bus power supply.
- C. Controller gateways.
- D. User interface accessed by [PC] [tablet computer] [and] [web interface].
- E. Luminaire switching and dimming modules.
- F. Ballast switching and dimming modules.
- G. Relays.
- H. Occupancy and daylight harvesting sensors.
- I. Conductors and cables.

END OF SECTION 260943.16

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SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

1.1 PRODUCTS

- A. General Transformer Requirements:
 - 1. Coils: Copper, continuous windings without splices except for taps.
- B. Distribution Transformers:
 - 1. Core: One leg per phase.
 - 2. Coils: Copper, continuous windings without splices except for taps.
 - 3. Enclosure:
 - a. Ventilated.
 - b. Type 2.
 - 4. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.
 - 5. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
 - 6. Insulation Class: 220 deg C, with maximum 115 deg C rise above 40 deg C.
 - 7. Features:
 - a. K-factor rating.
 - b. Electrostatic shielding.
 - c. Neutral: Rated 200 percent of full load current for K-factor rated transformers.
 - d. Wall brackets.
 - e. Low sound level.
- C. Buck-Boost Transformers: Self-cooled, two-winding dry type.
 - 1. Coils: Copper, continuous windings without splices except for taps.
 - 2. Enclosure: Ventilated, NEMA 250, Type 2.

1.2 SOURCE QUALITY CONTROL

- A. Transformers: Factory tested and inspected.
- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Contractor.

END OF SECTION 262200

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SECTION 262413 - SWITCHBOARDS

1.1 PRODUCTS

- A. Quality Standards: NEMA PB 2, NFPA 70, and UL 891.
- B. Manufactured Units:
 - 1. Front-connected, front-accessible switchboards.
 - a. Main Devices: Panel Fixed, individually mounted.
 - b. Branch Devices: Panel mounted.
 - c. Sections front and rear aligned.
 - 2. Nominal System Voltage: 480Y/277 V.
 - 3. Main-Bus Continuous: 4000 and 1600 A.
 - 4. Constructed to withstand seismic forces.
 - 5. Indoor Enclosures: Steel, Type 2.
 - a. Finish: Standard gray color.
 - 6. Barriers: Between adjacent switchboard sections.
 - 7. Insulation and Isolation: Main bus of main section and main and vertical buses of feeder sections.
 - 8. Cubical space heaters.
 - 9. Utility metering compartment.
 - 10. Customer metering compartment.
 - 11. Bus transition and incoming pull sections.
 - 12. Removable, hinged rear doors and compartment covers.
 - 13. Hinged front panels.
 - 14. Pull box on top of switchboard.
 - 15. Buses and Connections: Three phase, four wire, plus ground; copper.
 - 16. Future device provisions.
 - 17. Bus-bar insulation.
- C. Surge Protection Devices:
 - 1. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase not less than 200 kA.
 - 2. Protection modes and grounded wye circuits with 480Y/277 V, three-phase, four-wire circuits shall be as follows:
 - a. Line to Neutral: 1200 V for 480Y/277 V.
 - b. Line to Ground: 1200 V for 480Y/277 V.
 - c. Neutral to Ground: 1200 V for 480Y/277 V.
- D. Disconnecting and Overcurrent Protective Devices:
 - 1. Molded-case circuit breaker (MCCB), with interrupting capacity to meet available fault currents.
 - a. Lugs: Mechanical style.
 - b. Ground-Fault Protection: Integrally mounted.
 - c. Zone-selective interlocking.
 - d. Communication Capability: , Integral, or Din-rail-mounted communication module.
 - e. Shunt trip.
 - f. Undervoltage trip.
 - 2. Fused Switch: NEMA KS 1, Type HD.
- E. Instrumentation:
 - 1. Potential transformers.
 - 2. Current transformers.
 - 3. Control-power transformers.
 - 4. Current transformers for neutral and ground-fault current sensing.
 - 5. Multifunction digital-metering monitor.
 - 6. Ammeters, voltmeters, and power-factor meters.
 - 7. Instrument switches.
 - 8. Feeder ammeters.
 - 9. Watt-hour meters and wattmeters.
 - 10. Impulse-totalizing demand meter.

- F. Accessories:
 - 1. Accessory set including tools.
 - 2. Spare-fuse cabinet.

- G. Identification:
 - 1. Mimic bus self-adhesive label laminated acrylic or melamine plastic signs continuously integrated, factory applied to front of switchboard.
 - 2. Painted graphics.
 - 3. Service equipment label.

1.2 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.
- B. Tests: Infrared scanning, ground-fault protection, and NETA ATS.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

1.1 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.2 WARRANTY

- A. Panelboards: 18 months.
- B. SPD: Five years.

1.3 PRODUCTS

- A. General Requirements for Panelboards:
 - 1. Constructed to withstand seismic forces.
 - 2. Enclosures: Flush and Surface mounted.
 - a. Front: Hinged cover.
 - b. Directory card.
 - 3. Incoming Mains: Top, Bottom, or Convertible between top and bottom.
 - 4. Phase, Neutral, and Ground Buses: Copper.
 - a. Optional Buses: Equipment ground, full-sized neutral, and extra-capacity neutral.
 - 5. Conductor Connectors:
 - a. Material: Hard-drawn copper.
 - b. Main and Neutral Lugs: Mechanical type.
 - c. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - d. Feed-Through Lugs: Mechanical type.
 - e. Gutter Tap Lugs: Mechanical type.
 - f. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs.
 - 6. Percentage of Future Space Capacity: 10 20 percent.
- B. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.
 - 1. Mains: Circuit breaker or Lugs only.
 - 2. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 3. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- C. Lighting and Appliance Branch-Circuit Panelboards:
 - 1. Mains: Circuit breaker or lugs only.
 - 2. Branch Overcurrent Protective Devices: Bolt-on circuit-breaker type.
 - 3. Doors: Concealed hinge.
- D. Disconnecting and Overcurrent Protective Devices:
 - 1. MCCB: Interrupting capacity.
 - a. Circuit Breakers: Thermal-magnetic electronic-trip GFEP types.
 - b. MCCB Features and Accessories:
 - 1) Lugs: Mechanical style.
 - 2) Shunt Trip: 120-V trip coil.
 - 3) Rating Plugs: Three-pole breakers with ratings greater than 150 A.
 - 4) Multipole units enclosed in a single housing with a single handle or.
 - 5) Handle padlocking devices.
 - 2. Type HD fused switch.
- E. Identification:
 - 1. Panelboard labels.
 - 2. Breaker labels.
 - 3. Circuit Directory: Computer generated, transparent card holder metal frame with transparent protective cover.
- F. Accessories:

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1. Accessory set including tools.
2. Portable test set.

1.4 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 262416

SECTION 262713 - ELECTRICITY METERING

1.1 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Two years.
- B. Upgrade Service: Two years.

1.2 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

- A. Utility-company-compliant, current-transformer cabinets.
- B. Meter sockets.
- C. Modular Meter Center: Factory-coordinated assembly includes a main service disconnect device, tenant meter socket modules, and tenant feeder circuit breakers.
 - 1. Minimum Short-Circuit Rating: 100,000 A symmetrical at rated voltage.
 - 2. Main Disconnect Device: Circuit breaker with Surge protection device.

1.3 ELECTRICITY METERS

- A. Accuracy: 0.2 percent of reading.
- B. Kilowatt-Hour Meter: Electronic single- and three-phase meters, measuring electricity used. Digital LCD.
- C. Kilowatt-Hour/Demand Meter: Electronic single- and three-phase meters, measuring electricity use and demand. Digital LCD, including historic peak demand.
 - 1. Demand Signal Communication Interface: Match signal to remote building automation system.
 - 2. Programmable contact module.
 - 3. Memory Backup: Self-contained to maintain memory throughout power outages of 72 hours, minimum.
- D. Data Transmission: Transmit KYZ pulse data over Class 1 control-circuit conductors in raceway.
- E. Software: PC based, suitable for calculation of utility cost allocation and billing.

END OF SECTION 262713

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SECTION 262726 - WIRING DEVICES

1.1 PRODUCTS

- A. Standard-Grade Receptacles, 125 V, 20 A:
 - 1. Duplex receptacles.
 - 2. Tamper-resistant duplex receptacles.
 - 3. Weather-resistant duplex receptacles.
- B. Standard-Grade Receptacles, 125 V, 15 A:
 - 1. Duplex receptacles.
 - 2. Tamper-resistant duplex receptacles.
 - 3. Weather-resistant duplex receptacles.
- C. USB Receptacles: USB charging receptacles and tamper-resistant duplex (125 V, 20 A) and USB charging receptacles.
- D. GFCI Receptacles, 125V, 20A:
 - 1. Duplex GFCI receptacles.
 - 2. Tamper-resistant duplex GFCI receptacles.
- E. Twist-Locking Receptacles:
 - 1. Twist-lock, single receptacles, 120 V, 20-30 A.
 - 2. Twist-lock, single receptacles, 250 V, 20-30 A.
- F. Pendant cord-connector devices with external cable grip.
- G. Cord and plug sets.
- H. Toggle Switches: 120/277 V, 20 A.
 - 1. Switches:
 - a. Single pole.
 - b. Two poles.
 - c. Three way.
 - d. Four way.
 - 2. Pilot-light switches.
 - 3. Key-operated switches.
- I. Decorator-Style Devices: Square face, 20 A.
 - 1. Decorator duplex receptacles, 125 V, 20 A.
 - 2. Decorator, tamper-resistant, duplex receptacles, 125 V, 20 A.
 - 3. Decorator, tamper- and weather-resistant, duplex receptacles, 125 V, 20 A.
 - 4. Decorator, single-pole switches, 120/277 V, 20 A.
- J. Occupancy Sensors:
 - 1. Wall switch sensor light switch, dual technology.
 - 2. Wall switch sensor light switch, passive infrared.
 - 3. Wall switch sensor light switch, ultrasonic.
- K. Timer Light Switch: Digital timer light switch.
- M. Wall-Box Dimmers:
 - 1. Modular, full-wave, solid-state units with slider control.
 - a. LED lamp dimmer switches.
- N. Wall Plates:
 - 1. Material for Finished Spaces: Steel with baked enamel, Thermoplastic, Satin-finished stainless steel Brushed brass.
 - 2. Material for Damp and Wet Locations: Cast aluminum.
- O. Floor Service Fittings: Modular, dual service, with power receptacle and voice and data communication outlet.

1. Type: Flush.
 2. Service Plate: Rectangular, die-cast aluminum.
 3. Voice and Data Communication Outlet: Blank cover with bushed cable opening or Two modular, keyed, RJ-45 jacks.
- P. Poke-Through Assemblies: Below-floor junction box with multichanneled, through-floor raceway/firestop and detachable floor service-outlet assembly.
1. Service-Outlet Assembly: Flush type.
 2. Size: To fit core-drill.
- Q. Multioutlet Assemblies: Metal raceways.
- R. Finishes:
1. Connected to Normal Power System: Selected by Architect.
 2. Connected to Emergency Power System: Red.
 3. TVSS Devices: Blue.

END OF SECTION 262726

SECTION 262813 - FUSES

1.1 PRODUCTS

- A. Quality Standards: NEMA FU 1 for cartridge fuses.
- B. Cartridge Fuses: Nonrenewable.
- C. Spare-Fuse Cabinet: Wall-mounted steel unit with fuse pullers for each size of fuse.

1.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Feeders: Class RK1, time delay Class RK5, time delay Class J, time delay.
 - 2. Motor Branch Circuits: Class RK1 Class RK5, time delay.
 - 3. Other Branch Circuits: Class RK1, time delay Class RK5, time delay.

END OF SECTION 262813

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SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

1.1 PRODUCTS

- A. Fusible Switches: Type HD, UL 98 and NEMA KS 1 rated.
- B. Nonfusible Switches:
 - 1. Type HD, three pole, single throw, [240] or [600]-V ac, 1200 A and smaller.
 - 2. Accessories: Equipment ground kit neutral kit Class R fuse kit.
- C. Shunt Trip Switches: Type HD, three pole, single throw.
 - 1. nonfusible.
 - 2. 600-V ac.
 - 3. Control circuit.
 - 4. Accessories: Oiltight key switch and indicators neutral kit auxiliary contact kit.
- D. Molded Case Circuit Breakers: UL 489.
- E. Molded Case Switches: UL 489.
- F. Enclosures: NEMA 250 Type 1 or Type 3R.

1.2 SOURCE QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

1.3 INSTALLATION

- A. Wiring Method: In raceways.

1.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.
- B. Test Procedure: NETA ATS.

END OF SECTION 262816

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SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

1.1 PRODUCTS

- A. Motor Starting Switches: Configuration: [Nonreversing] [Reversing] [Two speed].
- B. Combination Full Voltage Magnetic Motor Controllers: Controller, SCPD and OCPD, in a single enclosure.
 - 1. Configuration: Standard duty; nonreversible.
 - 2. Control Circuit: 24 -V ac, integral CPT, with primary and secondary fuses; with 50 VA spare capacity.
 - 3. Overload Relay: [Melting alloy], [Bimetallic], or [Solid state].
- C. Combination Reduced-Voltage Magnetic Controllers:
 - 1. Configuration: [Wye delta], [Part winding], or [Autotransformer].
 - 2. Control Circuit: 24 -V ac, integral CPT, with primary and secondary fuses; with 50 100 200 VA spare capacity.
 - 3. Overload Relay: [Melting alloy], [Bimetallic] or [Solid state].
- D. Enclosures; NEMA ICS 6:
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
- E. Accessories:
 - 1. Push Buttons: Covered Lockable Recessed types; maintained as indicated.
 - 2. Pilot Lights: LED types; colors as indicated; push to test.
 - 3. Selector Switches: Rotary type.

1.2 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION 262913.03

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SECTION 262913.06 - SOFT START MOTOR CONTROLLERS

1.1 PRODUCTS

- A. Enclosed Soft-Start Motor Controllers:
 - 1. Configuration: Insert configurations.
 - 2. Control Circuit: Integral CPT with 100 -VA spare capacity.
 - 3. Controller Diagnostics and Protection: Microprocessor based with line voltage protection and input isolation contactor.
 - 4. Cover-mounted display.
 - 5. Interface Panel: Mounted remotely within 50 feet.
 - 6. Remote outputs.
 - 7. Digital communications module.
- B. Combination Soft-Start Motor Controllers:
 - 1. Configuration: Standard duty.
 - 2. Contactor: Bypass contactor.
 - 3. Control Circuit: Integral CPT with 100 -VA spare capacity.
 - 4. Controller Diagnostics and Protection: Microprocessor based with line voltage protection and input isolation contactor.
 - 5. Cover-mounted display.
 - 6. Interface Panel: Mounted remotely within 50 feet.
 - 7. Remote outputs.
 - 8. Digital communications module.
 - 9. Disconnect: Fusible.
- C. Bypass Motor Controller:
 - 1. Configuration: Across-the-line-start, electrically held.
 - 2. Control Circuit: 24 -V ac, integral CPT, with primary and secondary fuses with 50 -VA spare capacity.
 - 3. Overload Relays: Thermal.
 - 4. Digital communications module.
 - 5. Disconnect: Fusible.
- D. Enclosures: NEMA ICS 6.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
- E. Accessories:
 - 1. Push Buttons: Covered Lockable types; maintained as indicated.
 - 2. Pilot Lights: LED types; colors as indicated; push to test.
 - 3. Selector Switches: Rotary type.

1.2 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 262913.06

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SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

1.1 PRODUCTS

- A. Manufactured Units: Pulse-width modulated; variable torque for inverter-duty motors.
- B. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range 66 Hz, with torque constant as speed changes; maximum voltage equals input voltage.
- C. Unit Operating Requirements:
 - 1. Internal Adjustability:
 - a. Minimum Speed: 5 to 25 percent of maximum rpm.
 - b. Maximum Speed: 80 to 100 percent of maximum rpm.
 - c. Acceleration: 0.1 to 999.9 seconds.
 - d. Deceleration: 0.1 to 999.9 seconds.
 - e. Current Limit: 30 to minimum of 150 percent of maximum rating.
 - 2. Self-Protection and Reliability Features:
 - a. Surge suppression.
 - b. Loss of input signal protection.
 - c. Under- and overvoltage trips.
 - d. VFC and motor-overload/overtemperature protection.
 - e. Critical frequency rejection.
 - f. Loss-of-phase protection.
 - g. Reverse-phase protection.
 - h. Motor-overtemperature fault.
 - 3. Bidirectional autospeed search.
 - 4. Torque boost.
 - 5. Motor temperature compensation at slow speeds.
 - a. Panel-mounted operator station.
 - b. Historical logging information and displays.
 - c. Digital indicating devices.
 - 6. Control Signal Interfaces: Electric.
 - 7. PID control interface.
 - 8. DDC system for HVAC Protocols for Network Communications: ASHRAE 135.
- D. Line Conditioning:
 - 1. Input line conditioning.
 - 2. Output filtering.
 - 3. EMI/RFI filtering.
- E. Bypass Systems:
 - 1. Bypass Mode: Manual operation only.
 - 2. Bypass Controller: Two-contactor style, with bypass and output isolating contactors[and isolating switch].
 - 3. Bypass Controller: Three-contactor style, with bypass and input and output isolating contactors[and isolating switch].
 - 4. Bypass Contactor Configuration: Full-voltage (across the line) type.
- F. Source Quality Control: Test each VFC while connected to a motor that is comparable to that for which the VFC is rated.

1.2 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 262923

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SECTION 263100 - PHOTOVOLTAIC COLLECTORS

PART 1 - products

1.1 SYSTEM DESCRIPTION

- A. Interactive PV System: Collectors connected in parallel to the electrical utility; and capable of providing power for Project and a distributed network.
 - 1. System Components:
 - a. PV modules.
 - b. Array frame.
 - c. Utility-interactive inverter.
 - d. Overcurrent protection, disconnect, and rapid shutdown devices.
 - e. Mounting structure.
 - f. Utility meter.
 - g. .
- B. Hybrid PV System: Collectors connected to provide power to dc and ac loads, connected to utility through interactive inverters or meters, and connected to energy storage.
 - 1. System Components:
 - a. PV modules.
 - b. Array frame.
 - c. Charge controller.
 - d. Energy storage.
 - e. System control.
 - f. Inverter.
 - g. Overcurrent protection, disconnect, and rapid shutdown devices.
 - h. Mounting structure.
 - i. Meter.
 - j. .

1.2 MANUFACTURED UNITS

- A. Cell Materials: Amorphous silicon (a-Si).
- B. Cell Materials: Copper indium (di)selenide (CIS).
- C. Cell Materials: Copper indium gallium (di)selenide (CIGS).
- D. Cell Materials: Cadmium telluride (CdTe).
- E. Cell Materials: Cadmium sulfide.
- F. Cell Materials: Polycrystalline Monocrystalline.
 - 1. c-Si.
 - 2. Gallium arsenide (GaAs).
- G. Front Panel: Tempered glass.
- H. Backing Material: Tempered glass.
- I. Junction Box:
 - 1. IP Code: IP67.
- J. Charge controller.
- K. Inverter Control Type: Pulse-width-modulation control.
- L. Disconnects: Rated for system voltage and conductor.
- M. System Overcurrent Protection: Circuit breakers.

1.3 FRAMING

- A. Entire assembly listed for [Class A] or [Class C] fire rating according to UL 1703.

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B. Finish: Anodized aluminum.

1.4 INVERTER

A. Central.

B. Galvanized steel, NEMA 250, Type 3R enclosure.

1.5 MOUNTING

A. Roof Mount: Extruded aluminum.

END OF SECTION 263100

SECTION 263213.16 - GASEOUS EMERGENCY ENGINE GENERATORS

1.1 WARRANTY

- A. Materials and Workmanship: Five years.

1.2 MAINTENANCE SERVICE

- A. Full-Maintenance Service: 12 months.

1.3 PERFORMANCE REQUIREMENTS

- A. Environmental Conditions:
 - 1. Ambient Temperature: 5 to 40 deg C.
 - 2. Relative Humidity: Zero to 95 percent.
 - 3. Altitude: Sea level to 1000 feet.
- B. Unusual Service Conditions: Engine generator equipment will operate under the following conditions:

1.4 ASSEMBLY DESCRIPTION

- A. EPSS Class: Engine generator shall be classified as Class 2 Class 6 Class 48 Class 96 Insert Classification according to NFPA 110.
- B. Service Load: <1500> kVA.
- C. Power Factor: 0.8, lagging.
- D. Frequency: 60 Hz.
- E. Voltage: 480 -V ac.
- F. Phase: Three-phase, four-wire wye.
- G. Induction Method: Turbocharged.
- H. Governor: Adjustable isochronous, with speed sensing.
- I. Performance: Suitable for loads involving sensitive electronic equipment, adjustable frequency drives, or UPS systems.

1.5 ENGINE

- A. Fuel: Natural gas.
- B. Engine Cooling System: Integral radiator.
- C. Muffler/Silencer: Semicritical type.
- D. Air-Intake Filter: Standard duty.
- E. Starting System: 24-V electric, with negative ground.
 - 1. Cranking Cycle: 60 seconds.
 - 2. Battery: Lead acid; cranking cycle three times without recharging.
 - 3. Battery Charger: Current-limiting, automatic-equalizing and float-charging type.

1.6 GASEOUS FUEL SYSTEM

- A. Natural gas, vapor-withdrawal system.

1.7 CONTROL AND MONITORING

- A. Sequence of Operations: Automatic starting.
 - 1. Minimum run time control set for 30 minutes with emergency-stop switch.
 - 2. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages grouped in a common control and monitoring panel mounted on engine generator.

1.8 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Generator Circuit Breaker: Molded-case, electronic-trip type.
- B. Generator disconnect switch.
- C. Microprocessor-based generator protector.
- D. Ground-fault indication.
- E. Generator: Directly connected to engine shaft, with dripproof enclosure and solid-state voltage regulator.

1.9 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Drive: Shaft directly connected to engine shaft.
- B. Electrical Insulation: Class H or Class F.
- C. Stator-Winding Leads: Twelve-lead alternator.
- D. Range: Limited.
- E. Enclosure: Dripproof.
- F. Instrument Transformers: Mounted within generator enclosure.
- G. Voltage Regulator: Solid state.
 - 1. Adjusting Rheostat on Control and Monitoring Panel: Plus or minus 5 percent adjustment of output-voltage operating band.
 - 2. Maintain voltage within 15 percent on one step, full load.
 - 3. Anti-hunt provision to stabilize voltage.
 - 4. Frequency maintained within 5 percent and stabilized at rated frequency within 2 seconds.
- H. Strip heater.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- J. Subtransient Reactance: 12 percent, maximum.

1.10 OUTDOOR ENGINE GENERATOR ENCLOSURE

- A. Vandal-resistant, sound attenuating, weatherproof steel housing.

1.11 SOURCE QUALITY CONTROL

- A. Testing: Prototype at factory.

1.12 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 263213.16

SECTION 263353 - STATIC UNINTERRUPTIBLE POWER SUPPLY

1.1 QUALITY ASSURANCE

- A. Quality Standard: UL 1778[and NFPA 75 for computer rooms].

1.2 WARRANTY

- A. Materials and Workmanship: Batteries UPS.

1.3 PRODUCTS

- A. Performance Requirements:
 - 1. Load: 50 percent unbalanced continuously.
 - 2. Minimum Duration of Supply: 15 minutes.
 - 3. Input Voltage Tolerance: Plus 10, minus 20 percent from nominal voltage.
 - 4. Overall UPS Efficiency: Equal to or greater than percent at 100 percent load, percent at 75 percent load, and percent at 50 percent load.
 - 5. Maximum Energizing Inrush Current: Six times the full-load current.
 - 6. Maximum AC Output-Voltage Regulation for Loads up to 50 Percent Unbalanced: Plus or minus 2 percent.
 - 7. Output Frequency: 60 Hz, plus or minus 0.5 percent.
 - 8. Limitation of Harmonic Distortion of Input Current to the UPS: THD to 10 percent, maximum.
 - 9. Maximum Harmonic Content of Output-Voltage Waveform: 5 percent rms total and 3 percent rms for any single harmonic, for 100 percent rated nonlinear load current with a load crest factor of 3.0.
 - 10. Minimum Overload Capacity of UPS at Rated Voltage: 125 percent of rated full load for 10 minutes, and 150 percent for 30 seconds in all operating modes.
 - 11. Maximum Output-Voltage Transient Excursions from Rated Value:
 - a. 50 Percent: Plus or minus 5 percent.
 - b. 100 Percent: Plus or minus 5 percent.
 - c. Loss of AC Input Power: Plus or minus 1 percent.
 - d. Restoration of AC Input Power: Plus or minus 1 percent.
 - 12. Input Power Factor: 0.70.
- B. UPS System:
 - 1. Solid-state devices.
 - 2. Surge Suppression:
 - a. Category B Category C TVSS.
 - b. Additional surge protection from low-frequency, high-energy voltage surges.
 - 3. Capacity upgrade capability for future 25 percent increase.
 - 4. Ventilated cabinet.
 - 5. Output Circuit Neutral Bus, Conductor, and Terminal Ampacity: Rated phase current times a multiple of 1.73, minimum.
- C. Components:
 - 1. Rectifier-charger.
 - 2. Inverter: Pulse-width modulated, with sinusoidal output[and bypass phase synchronization window adjustment].
 - 3. Static bypass transfer switch.
 - 4. Battery: Valve-regulated, recombinant, lead-calcium unit.
 - 5. Controls and Indications:
 - a. Quantitative indications with labeled LED.
 - b. Quantitative and basic status condition indications.
 - c. Alarm indications.
 - d. Controls: Inverter on-off, UPS start, battery test, alarm silence/reset, output-voltage adjustment.
 - e. Dry-form "C" contacts.
 - f. Emergency power off switch.
 - 6. Output Isolation Transformer: Shielded unit with low forward transfer impedance up to 3 kHz.
 - 7. Output distribution section for panelboards.
 - 8. Monitoring by remote status and alarm panel.

9. Monitoring by remote computer.
10. Basic Battery Monitoring: Battery ground-fault detector and battery compartment smoke/high-temperature detector.
11. Additional Battery Monitoring: Data transmission to computer electrical power monitoring and control equipment.
12. Battery-cycle warranty monitoring.

1.4 SOURCE QUALITY CONTROL

- A. UPS and battery factory tested.

1.5 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 263353

SECTION 263600 - TRANSFER SWITCHES

1.1 QUALITY ASSURANCE

- A. Quality Standards: NEMA ICS 1, NFPA 99, NFPA 110, and UL 1008.

1.2 PRODUCTS

- A. Performance Requirements:
 - 1. Indicated Current Ratings: For continuous loading and total system transfer.
 - 2. Fault Current Closing and Short-Circuit Ratings: Coordinated with overcurrent protective device(s).
 - a. Short-time withstand capability for three 30 cycles.
 - 3. Transfer Switch and SPD Rating: Service rated.
 - 4. Ground-Fault Protection: Normal bus.
 - 5. Service Disconnecting Means: Externally operated, manual electrically actuated.
 - 6. Neutral Switching for Four-Pole Switches: Neutral pole switched simultaneously with phase poles.
 - 7. Neutral Terminal: Solid. Fully rated.
 - 8. Remote programming for devices.
 - 9. General-purpose Type 1 enclosures.
- B. Contactor-Type Automatic Transfer Switches:
 - 1. Switch Characteristics: Continuous-duty repetitive transfer of full-rated current between active power sources. Double throw; mechanically held in both directions.
 - a. Material: Hard-drawn copper, 98 percent conductivity.
 - b. Lugs: Mechanical type.
 - c. Ground bar.
 - 2. Automatic Switching Arrangement: Delayed transition.
 - 3. Nonautomatic Switching Arrangement: Under-load manual switch operation.
 - 4. Digital communication interface.
 - 5. Automatic transfer-switch controller.
- C. Transfer Switch Accessories:
 - 1. Remote annunciator system to annunciate the following conditions:
 - a. Sources available.
 - b. Switch position.
 - c. Test mode.
 - d. Failure of communication link.
- D. Source Quality Control: Factory test and inspect components, assembled switches, and associated equipment.

1.3 FIELD QUALITY CONTROL

- A. Testing: By Owner-engaged agency.

END OF SECTION 263600

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SECTION 264113 - LIGHTNING PROTECTION FOR STRUCTURES

1.1 QUALITY ASSURANCE

- A. Installer: UL-listed installer, category OWAY or LPI Master Installer.

1.2 PERFORMANCE REQUIREMENTS

- A. Lightning Protection Standard: NFPA 780 UL 96A for Class I Class II buildings.
- B. Components: UL 96.

1.3 COMPONENTS

- A. Roof-Mounting Air Terminals: Copper.
- B. Ground Rods: Copper-clad steel.
- C. Main Conductors: Class I Class II.

1.4 INSTALLATION

- A. Conductors to Be Concealed:
 - 1. System conductors.
 - 2. Down conductors.
 - 3. Interior conductors.
 - 4. Conductors within normal view of exterior locations at grade.
- B. Ground loop.
- C. Ground ring.
- D. Lightning protection components bonded with intermediate-level interconnection loop conductors at 60-foot intervals.

1.5 FIELD QUALITY CONTROL

- A. Inspection: UL Master Label Certificate.

END OF SECTION 264113

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SECTION 264313 - SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

1.1 SUMMARY

- A. Section includes:
 - 1. Type 1 SPDs.
 - 2. Type 2 SPDs.
 - 3. Enclosures.
 - 4. Conductors and cables.

1.2 WARRANTY

- A. Materials and Workmanship Warranty for SPDs: 10 years.

1.3 TYPE 1 SURGE PROTECTIVE DEVICES (SPDs)

- A. Standards: UL 1449, Type 1.
- B. Product Options: Include integral disconnect switch.

1.4 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)

- A. Standards: UL 1449, Type 2.[Comply with UL 1283.]

1.5 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.

1.6 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

1.7 INSTALLATION

- A. Comply with NECA 1.
- B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's written instructions.
- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

1.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections with the assistance of a factory-authorized service representative.

1.9 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's written instructions.

1.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION 264313

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SECTION 265100 – INTERIOR LIGHTING

PART 1 - INTERIOR LIGHTINGINTERIOR LIGHTINGINTERIOR LIGHTINGINTERIOR LIGHTINGGENERAL (Not Applicable)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 265100

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SECTION 265119 - LED INTERIOR LIGHTING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 IgCC:
 - 1. ENERGY STAR Design Lights Consortium certification.

1.2 WARRANTY

- A. Materials and Workmanship for Luminaires: Five Insert number years.

1.3 PRODUCTS

- A. Operating Nominal Voltage: 120 V ac 277 V ac.
- B. Luminaire Types:
 - 1. Cylinder.
 - 2. Downlight.
 - 3. Recessed linear.
 - 4. Strip light.
 - 5. Surface mount, linear.
 - 6. Surface mount, nonlinear.
 - 7. Suspended, linear.
 - 8. Suspended, nonlinear.

1.4 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
- B. Factory-Applied Labels: Comply with UL 1598.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard.
- E. California Title 24 compliant.
- F. Minimum allowable efficacy of 80 lumens per watt.
- G. CRI of minimum 80. CCT of 3500 K.

1.5 MATERIALS

- A. Lighting Diffusers: Tempered Fresnel glass, Prismatic glass, Diffuse glass, Clear glass or Prismatic acrylic.
- B. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear anodized, powder-coat, or painted finish.
- C. Factory-applied labels: Labels shall include the following lamp characteristics:
 - 1. "USE ONLY" and include specific lamp type.
 - 2. Lamp diameter, shape, size, wattage, and coating.
 - 3. CCT and CRI for all luminaires.
- D. Luminaire Support:
 - 1. Single-Stem Hangers: Steel tubing with swivel ball fittings and ceiling canopy.
 - 2. Wires: Soft temper, zinc-coated steel, 12 gage.
 - 3. Rod Hangers: Cadmium-plated, threaded steel rod.
 - 4. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

END OF SECTION 265119

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SECTION 265219 – EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL (Not Applicable)

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 265219

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SECTION 265613 - LIGHTING POLES AND STANDARDS

1.1 WARRANTY

- A. Materials and Workmanship for Poles: 5 years.

1.2 PERFORMANCE REQUIREMENTS

- A. Engineering design by Contractor.
- B. Live Load: Single load of 500 lbf.
- C. Ice Load: Load of 3 lbf/sq. ft..
- D. Wind Load: According to AASHTO LTS-6-M.
 - 1. Basic wind speed for poles exceeding 50 feet is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 50 years.
 - c. Velocity Conversion Factor: 1.0.
 - 2. Basic wind speed for poles 50 feet high or less is 100 mph.
 - a. Wind Importance Factor: 1.0.
 - b. Minimum Design Life: 25 years.
 - c. Velocity Conversion Factor: 1.0.

1.3 PRODUCTS

- A. Steel Poles: Round, straight.
 - 1. Mast Arms: Single-arm type.
 - 2. Brackets for luminaires.
 - 3. Pole-top tenons.
 - 4. Fasteners: Stainless steel.
 - 5. Grounding and bonding lugs.
 - 6. Steps.
 - 7. Handhole.
 - 8. Intermediate handhole and cable support.
 - 9. Cable support grip.
 - 10. Finish: Factory painted Powder coat.
- B. Aluminum Poles: , Round, straight.
 - 1. Mast Arms: Aluminum type.
 - 2. Brackets for luminaires.
 - 3. Pole-top tenons.
 - 4. Grounding and bonding lugs.
 - 5. Fasteners: Stainless steel.
 - 6. Handhole.
 - 7. Finish: Factory painted Powder coat.
- C. Pole Accessories:
 - 1. Duplex receptacle.
 - 2. Base covers.
- D. Lowering systems.
- E. Mounting hardware.

END OF SECTION 265613

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SECTION 265619 - LED EXTERIOR LIGHTING

1.1 SUSTAINABILITY REQUIREMENTS

- A. LEED v4 IgCC:
 - 1. [ENERGY STAR] [Design Lights Consortium] certification.

1.2 WARRANTY

- A. Materials and Workmanship for Luminaires: [Two] <Insert number> years.

1.3 PRODUCTS

- A. CRI of minimum 80. CCT of 4000 K.
- B. L70 lamp life of 50,000 hours.
- C. Operating Voltage: 120 V ac 277 V ac 12 V dc 24 V dc.
- D. In-line Fusing: On the primary for each luminaire Separate in-line fuse for each luminaire.
- E. Luminaire Certification: [ENERGY STAR] [Design Lights Consortium]
- F. Luminaire Types:
 - 1. Area and site.
 - 2. Bollard.
 - 3. Canopy.
 - 4. Decorative post top.

END OF SECTION 265619

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SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall provide all equipment, materials, labor, and services necessary to complete or perfect all parts of the interior pathways systems and to ensure that they comply with the requirements stated or reasonably inferred by the Contract Documents, this Specification, and the Construction Drawings.

1.2 SCOPE OF WORK

- A. This section includes minimum requirements for the following horizontal and backbone communications pathways as they relate to providing interior pathways not already provided by the project:
 - 1. Cable tray
 - 2. Cable supports
 - 3. Sleeves – non-fire-rated wall
 - 4. Sleeves – fire-rated wall
 - 5. Fire stop

1.3 QUALITY ASSURANCE

- A. All equipment installed in communications equipment rooms shall be done in a neat and workmanlike manner.
- B. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Owner's Representative.
- C. Equipment and materials shall be of the quality and manufacturer indicated.
- D. The equipment specified is based on the acceptable manufacturers listed.
- E. Where "other approved equal" is stated, equipment shall be equivalent to that of the equipment specified and shall be subject to approval during the bid process.
- F. Materials and work specified herein shall comply with the latest version of the Montgomery College IT Cabling Standard, as well as the latest version of industry and other related standards below.
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications for Customer Premise.
 - 2. ANSI/TIA-568-C-1, Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA-568-C-2, Balanced Twisted Pair Cabling Components Standard.
 - 4. ANSI/TIA-568-C-3, Optical Fiber Cabling Components Standard.
 - 5. ANSI/TIA-569-C, Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.
 - 7. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 - 8. ANSI/TIA-862-A, Building Automation Systems Cabling Standard.
 - 9. ANSI/TIA-942-A, Telecommunications Infrastructure Standard for Data Centers.
 - 10. ANSI/TIA-1005, Telecommunications Infrastructure for Industrial Premises.
 - 11. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard.
 - 12. ISO/IEC 11801, Generic Cabling for Customer Premises.
 - 13. IEEE 802.3af, Power over Ethernet (PoE) Standard.
 - 14. IEEE 802.3at, Power over Ethernet + (Plus).
 - 15. IEEE 802.3an, Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T.
 - 16. IEEE 802.3ba, Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation.

17. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual.
18. National Electrical Manufacturers Association.
19. National Fire Protection Association (NFPA) 70 – National Electrical Code.
20. Underwriters Laboratory (UL) or equivalent.

1.4 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of (2) years following acceptance by the owner. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a (3) week period will constitute acceptance of the system.

1.5 SUBMITTALS

- A. During the bid process, the Contractor shall submit a detailed bill-of-materials that includes at a minimum the part number, part description, manufacturer, quantity, and units for each product this is included in this specification section.
- B. Prior to purchase and installation of any products that are associated with this bid specification, the Contractor shall submit manufacturers' data sheets (cut sheets) for all proposed equipment in this specification section.
- C. Prior to installation of any ceiling systems, including cable tray, Contractor shall provide coordination drawings. Coordination drawings shall detail the work in the entire area of work, including major elements, components, and systems (communications cable tray, HVAC ducts, conduits, sprinkler system, etc.). Screen captures from building information modeling (BIM) software in addition to the electronic file are acceptable.
- D. Upon completion of the cabling system installation, the Contractor shall submit complete as-built documentation, including showing cable trays and major cabling pathways.
- E. Upon final acceptance of the cabling installation, the Contractor shall furnish to the Owner the extended warranties for the installed cabling products, applications, and workmanship.

PART 2 - PRODUCTS

2.1 CABLE TRAY

- A. Cable tray in hallways and spaces outside of Telecommunications Rooms shall be basket-type tray.
- B. Cable tray inside Telecommunications Rooms shall be ladder rack.
- C. Basket tray shall be a minimum of 18 inches wide and 4 inches deep.
- D. Ladder rack shall be a minimum of 12 inches wide.
- E. If any larger corridor or telecommunications room tray is required based on quantity of cables, the size shall be increased. This shall be brought to the attention of the designers prior to prior to installation.
- F. All cable trays shall include connecting and support hardware to suit installation, including but not limited to runway supports, radius drops, butt-splices, wall angle support brackets, adjustable splice kits, tee splice kits, splice extension clamp kits, vertical bend kits, corner support kits, waterfall support kits, grounding strap kits, etc.
- G. Acceptable Manufacturer:
 1. Chatsworth Products, Inc.
 2. Cablofil

3. WBT
4. Eaton B-Line
5. Other approved equal

2.2 CABLE SUPPORTS

- A. Cable supports shall be used to support cable wherever conduit or cable tray does not provide proper cable support.
- B. Cable supports shall be J-hook type or sling-type supports.
- C. All supports shall be UL listed and comply with NEC and TIA requirements for structured cabling.
- D. J-hooks:
 1. Shall be suitable for plenum air handling spaces.
 2. Shall come in a variety of sizes to accommodate cable bundles.
 3. Shall have vertical bend radius control.
 4. Shall be pre-riveted allowing for attachment to beams, etc.
 5. Shall be non-metallic.
- E. Sling-type:
 1. Shall be suitable for plenum air handling spaces.
 2. Shall be constructed from plastic.
 3. Shall have a static load limit of 100 lbs.
 4. Shall be rated to support Category 6 cabling.
- F. Acceptable Manufacturer:
 1. Caddy
 2. Arlington
 3. Other approved equal

2.3 SLEEVES – NON-FIRE-RATED WALL

- A. Where desired pathway has not penetrated a wall to facilitate cabling between spaces and cable routing path, and the wall is not a fire-rated wall, the Contractor shall provide appropriate sized metallic sleeve to appropriately penetrate the area.
- B. The sleeve shall be sized using generally accepted cabling principles using a 40% fill ratio.

2.4 SLEEVES – FIRE-RATED WALL

- A. Where desired pathway has not penetrated a wall to facilitate cabling between spaces and cable routing path, and the wall is a fire-rated wall, the Contractor shall provide a sleeve that has the intumescent fire stop material as a manufactured part of the sleeve.
- B. Shall be UL listed.
- C. Shall provide ease of cable penetration and re-penetration.
- D. Acceptable Manufacturers:
 1. Hilti Speed Sleeve
 2. STI EZ Path

2.5 FIRE STOP

- A. Fire stop shall be rated to match the rating of the space in which it is used.
- B. Fire stop shall meet the project requirements as detailed in the appropriate architectural specification section.
- C. Acceptable Manufacturers:
 - 1. 3M
 - 2. Hilti
 - 3. Nelson
 - 4. Other approved equal

PART 3 - EXECUTION

3.1 CABLE TRAY

- A. Install cable tray in hallways and outside of Telecommunications Rooms as shown on drawings to appropriately support cables to serving Telecommunications Rooms.
- B. Install cable tray in Telecommunications Rooms on walls and above racks as needed to facilitate routing of cables into racks. Tray in Telecommunications Rooms that is shown on the drawings is for bidding purposes only. The Contractor shall confirm the exact location and quantity of tray prior to its installation.
- C. Particular attention shall be given to coordination of tray with other above ceiling systems (i.e. sprinkler, HVAC, etc.). At all times, tray shall be installed with a minimum of 6 inches of clearance above and 12 inches of clearance to one side. If areas where this is not possible, the Contractor shall bring this to the attention of the Owner prior to installation.
- D. Tray outside of Telecommunications Rooms shall be installed such that it will ensure that no horizontal cable run exceeds 295 feet between the device location and the patch panel location in the serving Telecommunications Room.
- E. No conduit or other ceiling fixtures shall be attached in any way to the cable tray.
- F. Tray shall be installed such that it will accommodate the appropriate installation of horizontal and backbone cables. Particular attention shall be given to cutting of tray and changing direction, especially with 90 degree turns, where appropriate tees and sweeps shall be used.
- G. Tray shall be free of sharp edges. This shall be especially true if tray has to be cut during installation.

3.2 CABLE SUPPORTS

- A. Where tray has not been installed or is not suitable, cable supports shall be used in main hallways, as well as between conduit and tray locations to support all cable.
- B. Wherever cable tray, conduit, or other designated telecommunications cabling pathway is not present, Contractor shall provide cable supports a maximum of 60 inches on center.
- C. Ceiling ties and rods shall not be used to hang cable or cable supports without the approval of the Owner.
- D. Load cable supports as recommended by the manufacturer. Provide cable supports side by side on a common bracket where cable quantities require.
- E. Do not install cables loose above lock-in type, drywall or plaster ceilings.
- F. Cables shall be installed at least 3 inches above the ceiling and shall not touch the ceiling.

3.3 SLEEVES – NON-FIRE-RATED WALL

- A. Appropriately anchor the sleeve on both ends.
- B. Provide an appropriate bushing or other method to ensure that the edge of the sleeve is free of spurs or any sharp edges.
- C. Install a large enough sleeve or a quantity of sleeves that will allow for future installation of cables.
- D. Appropriately fire stop the sleeve after installation.

3.4 SLEEVES – FIRE-RATED WALL

- A. Install sleeve per manufacturer's instructions.
- B. Install an appropriate number of sleeves from the cable tray into each telecommunications room, including a spare.
- C. Install enough sleeves in pathways such that, based on the number of cables installed in that pathway, there remains (1) spare (empty) sleeve.

3.5 FIRE STOP

- A. The Contractor shall fire stop all sleeves, conduit openings, cable tray openings, etc. with an appropriate fire stop material rated for the particular application after the cable installation is complete. This shall include all telecommunications cabling openings, whether they have been used or not.
- B. Installation, testing, and labeling of fire stop locations shall meet the project requirements as detailed in the appropriate architectural specification section.

3.6 AS-BUILT DOCUMENTATION

- A. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation in both hard copy and electronic format (latest version of AutoCAD).
- B. As-built documentation for horizontal cabling shall include floor plan and RCP drawings that indicate major cable pathways, cable locations, labels, etc.

END OF SECTION

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SECTION 271100 - COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall provide all equipment, materials, labor, and services necessary to complete or perfect all parts of the telecommunications rooms and spaces and to ensure that they comply with requirements stated or reasonably inferred by the Contract Documents, this Specification, and the Construction Drawings.

1.2 SCOPE OF WORK

- A. This section includes minimum requirements for the following equipment and related products that are to be installed in the telecommunications rooms:

1. Building entrance terminals
2. 110-type termination blocks
3. Floor-mounted rack
4. Vertical cable manager
5. Floor-mounted cabinet
6. Copper cable patch panels
7. Horizontal cable manager
8. Optical fiber housing
9. Copper patch cords
10. Optical fiber patch cords
11. Grounding wire
12. Fire stop

1.3 QUALITY ASSURANCE

- A. All equipment installed in communications equipment rooms shall be done in a neat and workmanlike manner.
- B. Equipment and materials shall be of the quality and manufacturer indicated.
- C. The equipment specified is based on the acceptable manufacturers listed.
- D. Where "other approved equal" is stated, equipment shall be equivalent to that of the equipment specified and shall be subject to approval during the bid process.
- E. Materials and work specified herein shall comply with the latest version of the Montgomery College IT Cabling Standard, as well as the latest version of industry and other related standards below.
 1. ANSI/TIA-568-C.0, Generic Telecommunications for Customer Premise.
 2. ANSI/TIA-568-C-1, Commercial Building Telecommunications Cabling Standard.
 3. ANSI/TIA-568-C-2, Balanced Twisted Pair Cabling Components Standard.
 4. ANSI/TIA-568-C-3, Optical Fiber Cabling Components Standard.
 5. ANSI/TIA-569-C, Telecommunications Pathways and Spaces.
 6. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.
 7. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 8. ANSI/TIA-862-A, Building Automation Systems Cabling Standard.
 9. ANSI/TIA-942-A, Telecommunications Infrastructure Standard for Data Centers.
 10. ANSI/TIA-1005, Telecommunications Infrastructure for Industrial Premises.
 11. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard.
 12. ISO/IEC 11801, Generic Cabling for Customer Premises.
 13. IEEE 802.3af, Power over Ethernet (PoE) Standard.
 14. IEEE 802.3at, Power over Ethernet + (Plus).

15. IEEE 802.3an, Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T.
16. IEEE 802.3ba, Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation.
17. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual.
18. National Electrical Manufacturers Association.
19. National Fire Protection Association (NFPA) 70 – National Electrical Code.
20. Underwriters Laboratory (UL) or equivalent.

1.4 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of (2) years following acceptance by the owner. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a (3) week period will constitute acceptance of the system.
- B. Contractor shall provide an extended manufacturer's warranty of no less than (25) years for the cabling and associated connectivity products that are part of this specification.

1.5 CERTIFICATIONS

- A. During the bid process, the Contractor shall submit proof (manufacturer's certification) that the installing company is currently an authorized Molex Premise Network System certified installer, that they can provide an extended 25-year warranty, that they are in good standing with the manufacturer, and that they have a minimum of five (5) years of experience on similar cabling systems installations. There should be a molex certified technician on site
- B. During the bid process, the Contractor shall submit proof (manufacturer's certification) that the installing company is currently an authorized Sumitomo FutureFLEX Air-Blown Fiber certified installer, that they can provide an extended 25-year warranty, that they are in good standing with the manufacturer, and that they have a minimum of five (5) years of experience on similar cabling systems installations.
- C. During the bid process, the Contractor shall submit a breakdown of the installation staff, showing that it consists of several BICSI-certified installers.

1.6 SUBMITTALS

- A. During the bid process, the Contractor shall submit a detailed bill-of-materials that includes at a minimum the part number, part description, manufacturer, quantity, and units for each product this is included in this specification section.
- B. Prior to purchase and installation of any products that are associated with this bid specification, the Contractor shall submit manufacturers' data sheets (cut sheets) for all proposed equipment in this specification section.
- C. Upon completion of the cabling system installation, the Contractor shall submit complete cabling test results as detailed later in this specification.
- D. Upon completion of the cabling system installation, the Contractor shall submit complete as-built documentation as detailed later in this specification.
- E. Upon final acceptance of the cabling installation, the Contractor shall furnish to the Owner the extended warranties for the installed cabling products, applications, and workmanship.

PART 2 - PRODUCTS

2.1 BUILDING ENTRANCE TERMINALS

- A. To be used to terminate outside plant backbone copper cables.

- B. Shall be 16 AWG powder-coated steel construction with an industry-standard 110-style connector for both the input and output terminals.
- C. Shall accept 22 AWG - 26 AWG wire.
- D. Shall include multiple external and internal ground lugs.
- E. Shall have a UL-approved standard on all terminals.
- F. Shall be equipped with an internal 26 AWG fuse link.
- G. Shall meet or exceed UL497 primary protection standards.
- H. Shall be populated with 5-pin heavy duty gas tube surge protection modules.
- I. Acceptable Manufacturer:
 - 1. Circa 1880ENA1/NSC-50 or -100 with 3B1E surge protection modules

2.2 110-TYPE TERMINATION BLOCKS

- A. Termination blocks for copper riser cables shall be 110-type IDC style.
- B. 110-type termination blocks shall be rack-mountable and include a means to identify cables per ANSI/TIA/EIA-606.
- C. Contractor shall provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables, including but not limited to:
 - 1. 4-pair connecting clip for horizontal copper cabling.
 - 2. 5-pair connecting clip for backbone copper cabling.
- D. Acceptable Manufacturers:
 - 1. Molex Premise Networks

2.3 FLOOR-MOUNTED RACK

- A. Intended to be used in Telecommunications Rooms and in the LAN Room.
- B. Each floor-mounted rack shall be approximately 19 inches wide by 8 feet high.
- C. The frame shall be steel construction.
- D. The rack shall have #12-24 threaded mounting holes.
- E. The rack shall be 51 RU (rack units) high.
- F. The rack shall be black.
- G. Acceptable Manufacturer:
 - 1. Chatsworth Products, Inc. 55053-715

2.4 VERTICAL CABLE MANAGER

- A. Vertical cable managers shall be provided for the floor-mounted racks.
- B. The vertical managers shall be approximately 8-inches wide and 94-inches high.
- C. Vertical managers shall be double-sided with removable doors.
- D. Vertical managers shall be black.
- E. Vertical cable managers shall be able to appropriately attach to the floor-mounted racks.
- F. Vertical managers shall be the same manufacturer as the floor-mounted rack.
- G. Acceptable Manufacturer:
 - 1. Molex Premise Networks CMA-00084

2.5 FLOOR-MOUNTED CABINET

- A. To be used in the LAN Room only.
- B. The cabinet shall be assembled by the manufacturer and include the following specifics:
 - 1. A frame that is approximately 84 inches high, 31.5 inches wide, and 42 inches deep
 - 2. (2) pairs of mounting rails
 - 3. Perforated front and rear doors, locking
 - 4. (2) vertical managers, "L" shape, 30 inches wide, 4-inch fingers
 - 5. Rack Unit Cage Nuts, #12-24 thread, package of 50
- C. The floor-mounted cabinet and all associated parts shall be black.
- D. Acceptable Manufacturer:
 - 1. Chatsworth Products, Inc. GF-2C520-CB
 - 2. Other approved equal

2.6 COPPER CABLE PATCH PANELS

- A. Patch panels supporting Category 6 copper cables loaded all metal flat panel patch panels that shall support (48) ports of connectivity.
- B. Patch panels shall be 2RU.
- C. Acceptable Manufacturers:
 - 1. Molex Premise Networks PID-00142

2.7 HORIZONTAL CABLE MANAGER

- A. Horizontal cable management shall be provided for all patch panels.
- B. Horizontal cable managers shall be a minimum of 2RU.
- C. Horizontal cable managers shall be cold rolled steel with ring runs.

D. Horizontal cable managers shall allow easy access to patch cords and terminations with standard pass-through holes that incorporate bend radius control.

E. Acceptable Manufacturer:

1. Molex Premise Networks 25.B013G

2.8 OPTICAL FIBER HOUSING

A. Optical fiber housings shall be rack-mountable.

B. Optical fiber housings shall be 4RU (approximately 6.62"H x 17.0"W x 11.8"D).

C. Optical fiber housings shall be able to support a minimum of (288) strands of fiber.

D. Optical fiber housings shall be able to support a minimum of (12) fiber adapter panels (FAP).

E. Optical fiber housings shall include integral cable management and bend radius control for transition to vertical cable managers.

F. Optical fiber housings shall be constructed of steel material with removable molded front and back door.

G. Acceptable Manufacturer:

1. Sumitomo Electric Lightwave

2.9 COPPER PATCH CORDS

A. Contractor shall provide copper patch cords for the telecommunications room end of the cable.

Contractor shall provide copper patch cords for the (offices, classroom, etc)

B. Contractor shall provide copper patch cords for the device end or wireless access points cable.

C. All patch cords shall be 4-pair, factory-terminated, double-ended, 8-position to 8-position, center tuned modular, stranded conductors.

D. Patch cords for Category 6 cables shall be Category 6.

E. Patch cords shall be a variety of different colors. Patch cords for:

1. Data shall be blue
2. Wireless shall be white
3. Security cameras shall be pink
4. Mass notification shall be pink
5. BAS shall be green

F. Acceptable Manufacturers:

1. Molex Premise Networks

2.10 OPTICAL FIBER PATCH CORDS

A. Contractor shall provide optical fiber patch cords for the telecommunications room end of the cable.

B. Both singlemode and multimode optical fiber patch cords are required for this project.

C. Singlemode patch cords supporting data connectivity shall be factory-terminated, double-ended, 2-strand OS2

cordage with SC connectors on each end.

D. Multimode patch cords supporting data connectivity shall be factory-terminated, double-ended, 2-strand 50/125 micron OM4 cordage with SC connectors on each end.

E. Acceptable Manufacturers:

1. Molex Premise Networks

2.11 GROUNDING WIRE

A. Shall be a minimum #6 AWG stranded copper.

B. Shall have green plastic insulation.

2.12 FIRE STOP

A. Contractor shall provide fire stopping protection that shall meet NFPA Life Safety Code #101, 6-2.3.6, "Penetrations and Miscellaneous Openings and Fire Barriers" and the NEC 300.21 "Fire Stopping" regulations and standards.

B. Fire stop shall be the putty type.

C. Fire stop shall be rated to match the rated of the space in which it is used.

D. Acceptable Manufacturers:

1. 3M
2. Hilti
3. Nelson
4. Other approved equal

PART 3 - EXECUTION

3.1 BUILDING ENTRANCE TERMINALS

A. Wall-mount in the main telecommunications room as shown on the drawings.

B. The exact location of the BETs shall be confirmed with the owner or owner's representative prior to their installation.

C. Populate with gas tube surge protection modules.

3.2 110-TYPE TERMINATION BLOCKS

A. Install 110-blocks for copper backbone riser cables adjacent to building entrance terminals on the wall as shown on the drawings.

B. The exact location of the 110-blocks shall be confirmed with the owner or owner's representative prior to their installation.

3.3 FLOOR-MOUNTED RACK

A. Floor-mounted racks shall be installed in each of the (3) telecommunications rooms, as well as in the Cyber Center and Networking Lab LAN Room, as shown on the drawings.

- B. Prior to installation of any racks, the Contractor shall confirm the exact location of the racks to be installed in each location.
- C. The racks shall be appropriately leveled and anchored to the floor.
- D. The racks shall be appropriately grounded.
- E. The racks shall be further supported by the installation of tray per the drawings.
 - 1. Tray shown on the drawings in Telecommunications Rooms supporting racks is for bidding purposes only. The Contractor shall confirm the exact location and quantity of basket tray required prior to its installation.

3.4 VERTICAL CABLE MANAGER

- A. One (1) vertical cable manager shall be installed on each outside portion of the row of floor-mounted racks, as well as between racks, as shown on the drawings.

3.5 FLOOR-MOUNTED CABINET

- A. In the LAN Room only, (1) floor-mounted cabinet shall be installed, as shown on the drawings.
- B. Prior to installation of the cabinet, the Contractor shall confirm the exact location.
- C. The cabinet shall be appropriately leveled.
- D. The cabinet shall be appropriately grounded.
- E. The cabinet shall be further supported by the installation of tray per the drawings.

3.6 COPPER CABLE PATCH PANELS

- A. Patch panels shall be installed in floor-mounted racks for the purposes of terminating all Category 6 horizontal copper cables designated for voice, data, security, and wireless.
- B. The Contractor shall install enough patch panels (and jacks) to provide termination of all data cabling, plus approximately 15% more for growth.
- C. All patch panels shall be appropriately labeled with an owner-accepted labeling scheme.
- D. The location of the patch panels in the racks are shown on the drawings. These shall be confirmed with the Owner prior to their installation. The rack elevations will be done by Montgomery College

3.7 HORIZONTAL CABLE MANAGER

- A. There shall be one (1) horizontal cable manager installed above and below each 48-port patch panel installed in a rack.

3.8 OPTICAL FIBER HOUSING

- A. Install (1) optical fiber housing at the top of each floor-mounted rack as shown on the drawings.
- B. Appropriately label all ports of the housings with an Owner accepted labeling.
- C. Install blank adapter panels in all positions not used at time of installation of fiber terminations.

3.9 COPPER PATCH CORDS

- A. For the telecommunications room end, the Contractor shall provide one (1) patch cord for each wired patch panel port.
- B. For bidding purposes, approximately one-third of the telecommunications room patch cords shall be three (3) feet long, one-third shall be seven (7) feet long, and one-third shall be fifteen (15) feet long. Contractor shall confirm exact lengths before purchasing.
- C. For the wireless access point end of the cable, the Contractor shall provide (2) 1-foot patch cords at each wireless access point.

3.10 OPTICAL FIBER PATCH CORDS

- A. Contractor shall provide (8) singlemode OS2 optical fiber patch cords.
- B. Contractor shall provide (10) multimode OM4 optical fiber patch cords.
- C. For bidding purposes of each type above, half of the optical fiber patch cords shall be three (3) meters long, while half shall be five (5) meters long. Contractor shall confirm exact lengths before purchasing.
- D. Patch cords shall be installed as part of the installation of the data network equipment. Note that optical fiber patch cords shall be installed in the new building, as well as the EACMS building. The appropriate quantity to be installed and associated lengths shall be confirmed with UMES IT prior to purchase and installation.

3.11 GROUNDING AND BONDING

- A. Bond metallic equipment racks, conduits, cable tray, ladder racks, etc. to the provided telecommunications grounding busbar (TGB).
- B. All connectors and clamps shall be mechanical type made of silicon bronze.
- C. Terminals shall be solderless, copper long-barrel NEMA two bolt compression-type.
- D. Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

3.12 FIRE STOP

- A. The installation of fire stop material shall be as recommended by the material manufacturer and backed by formal ASTM E-814 tests.
- B. Plenum air return ceiling penetrations for conduit and cables shall be sealed with a system appropriate for the substrate and level of protection required.

3.13 MISCELLANEOUS REQUIREMENTS

- A. All cables shall be neatly "dressed" in telecommunications racks.

3.14 AS-BUILT DOCUMENTATION

- A. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation in both hard copy and electronic format (latest version of AutoCAD).
- B. Record documentation for equipment rooms shall include plan views of telecom room layouts indicating location of all major equipment that is part of this specification section, as well as elevation drawings indicating rack details (specific port information such as labeling may be shown in tabular format).

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MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

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LEGGETT BUILDING
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- C. Record documentation shall also include operation and maintenance manuals for all components of the system. Manuals shall include Installation and Service manuals and Operating manuals.

END OF SECTION

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SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall provide all equipment, materials, labor, and services necessary to complete or perfect all parts of the backbone cabling system and to ensure that complies with the requirements stated or reasonably inferred by the Contract Documents, this Specification, and the Construction Drawings.

1.2 SCOPE OF WORK

- A. The backbone cabling is that portion of the telecommunications cabling system that connects the main telecommunications room (TR) to the campus backbone, as well as to other TRs within the building. Backbone cabling consists of the actual transmission media, mechanical terminations, splice enclosures, intermediate and main cross-connects, and any patch cords or jumpers used for backbone-to-backbone connection.
- B. This section includes minimum requirements for the following backbone cabling and related products that are to be installed in the building:
 - 1. Outside plant backbone copper cable
 - 2. Outside plant tube cables
 - 3. Outside plant backbone optical fiber cable
 - 4. Backbone copper riser cable
 - 5. Backbone optical fiber riser cable
 - 6. Backbone coaxial riser cable
 - 7. Optical fiber connectors
 - 8. Coaxial cable connectors

1.3 QUALITY ASSURANCE

- A. All equipment installed in communications equipment rooms shall be done in a neat and workmanlike manner.
- B. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Owner's Representative.
- C. Equipment and materials shall be of the quality and manufacturer indicated.
- D. The equipment specified is based on the acceptable manufacturers listed.
- E. Where "other approved equal" is stated, equipment shall be equivalent to that of the equipment specified and shall be subject to approval during the bid process.
- F. Materials and work specified herein shall comply with the latest version of the Montgomery College IT Cabling Standard, as well as the latest version of industry and other related standards below.
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications for Customer Premise.
 - 2. ANSI/TIA-568-C-1, Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA-568-C-2, Balanced Twisted Pair Cabling Components Standard.
 - 4. ANSI/TIA-568-C-3, Optical Fiber Cabling Components Standard.
 - 5. ANSI/TIA-569-C, Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.
 - 7. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
 - 8. ANSI/TIA-862-A, Building Automation Systems Cabling Standard.
 - 9. ANSI/TIA-942-A, Telecommunications Infrastructure Standard for Data Centers.
 - 10. ANSI/TIA-1005, Telecommunications Infrastructure for Industrial Premises.

11. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard.
12. ISO/IEC 11801, Generic Cabling for Customer Premises.
13. IEEE 802.3af, Power over Ethernet (PoE) Standard.
14. IEEE 802.3at, Power over Ethernet + (Plus).
15. IEEE 802.3an, Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T.
16. IEEE 802.3ba, Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation.
17. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual.
18. National Electrical Manufacturers Association.
19. National Fire Protection Association (NFPA) 70 – National Electrical Code.
20. Underwriters Laboratory (UL) or equivalent.

1.4 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of (2) years following acceptance by the owner. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a (3) week period will constitute acceptance of the system.
- B. Contractor shall provide an extended manufacturer's warranty of no less than (25) years for the cabling and associated connectivity products that are part of this specification.

1.5 CERTIFICATIONS

- A. During the bid process, the Contractor shall submit proof (manufacturer's certification) that the installing company is currently an authorized Molex Premise Network System certified installer, that they can provide an extended 25-year warranty, that they are in good standing with the manufacturer, and that they have a minimum of five (5) years of experience on similar cabling systems installations.
- B. During the bid process, the Contractor shall submit proof (manufacturer's certification) that the installing company is currently an authorized Sumitomo FutureFLEX Air-Blown Fiber certified installer, that they can provide an extended 25-year warranty, that they are in good standing with the manufacturer, and that they have a minimum of five (5) years of experience on similar cabling systems installations.
- C. During the bid process, the Contractor shall submit a breakdown of the installation staff, showing that is consists of several BICSI-certified installers.

1.6 SUBMITTALS

- A. During the bid process, the Contractor shall submit a detailed bill-of-materials that includes at a minimum the part number, part description, manufacturer, quantity, and units for each product this is included in this specification section.
- B. Prior to purchase and installation of any products that are associated with this bid specification, the Contractor shall submit manufacturers' data sheets (cut sheets) for all proposed equipment in this specification section.
- C. Upon completion of the cabling system installation, the Contractor shall submit complete cabling test results as detailed later in this specification.
- D. Upon completion of the cabling system installation, the Contractor shall submit complete as-built documentation as detailed later in this specification.
- E. Upon final acceptance of the cabling installation, the Contractor shall furnish to the Owner the extended warranties for the installed cabling products, applications, and workmanship.

PART 2 - PRODUCTS

2.1 OUTSIDE PLANT BACKBONE COPPER CABLE

- A. The Outside Plant (OSP) backbone copper cable shall be shall be Category 5 and be sized as shown on the T-drawings.
- B. The OSP copper cable shall be used in all outside and underground environments.
- C. The cable shall have the following characteristics:
 - 1. 24 AWG solid annealed copper conductors.
 - 2. Core wrap of non-hygroscopic dielectric tape
 - 3. Shield that is electrically continuous 0.008 in (0.20 mm) polymer coated corrugated aluminum tape, applied with an overlap and shield interface is flooded
 - 4. Black, sunlight and weather resistant polyethylene Jacket
 - 5. Characteristic impedance of 100 ohms \pm 15 ohms
 - 6. Nominal Velocity of Propagation of 58%
 - 7. Nominal outside diameter of 1.22 inches
- D. Acceptable Manufacturer:
 - 1. Superior Essex MEGAPIC-NF – 04-104-31

2.2 OUTSIDE PLANT TUBE CABLES

- A. Acceptable Manufacturer:
 - 1. Sumitomo FutureFLEX Air-Blown Fiber

2.3 OUTSIDE PLANT BACKBONE OPTICAL FIBER CABLE

- A. The OSP optical fiber cables shall be specifically designed for use in an air-blown fiber system.
- B. The OSP optical fiber cables shall consist of optical fiber cable sizes as shown on the drawings.
- C. The OSP optical fiber cable shall be singlemode OS2.
- D. Singlemode optical fiber cable shall have a maximum attenuation of 0.5 dB/km at 1310 nm; 0.4 dB/km at 1550 nm.
- E. Acceptable Manufacturer:
 - 1. Sumitomo FutureFLEX Air-Blown Fiber

2.4 BACKBONE COPPER RISER CABLE

- D. Backbone copper riser cable shall be used to connect telecommunications rooms inside the new facility.
- E. Backbone copper riser cable shall be sized as shown on the drawings.
- F. Backbone copper riser cable shall be CMR rated in the riser and CMP rated if cables installed leave the stacked riser system.
- G. Backbone copper riser cable shall have 24 AWG solid bare annealed copper conductors, color coded in accordance with telephone industry standards and shall have the following characteristics:

- | | |
|---|-----------------|
| 1. DC Resistance (Ohms/100 m @ 20° C): | 9.38 |
| 2. Mutual Capacitance (pF/ft @ 1 kHz): | 17 |
| 3. Characteristic Impedance (1.0 – 16.0 MHz): | 100 Ohms +/- 15 |

- H. Conductors shall be twisted to form pairs, and shall be assembled in units, each individually identified by color-coded unit binders.
- I. The outer jacket shall consist of a fire-retardant sheath that meets NEC low flame requirements.
- J. Acceptable Manufacturers:
 - 1. CommScope
 - 2. General Cable
 - 3. Superior Essex
 - 4. Other approved equal

2.5 BACKBONE OPTICAL FIBER RISER CABLE

- A. Backbone optical fiber riser cable shall be used to connect telecommunications rooms inside the new facility.
- B. Backbone optical fiber riser cable shall be both multimode OM4.
- C. Backbone optical fiber riser cable shall be tight buffered designed for installation in plenum, riser, and horizontal environments depending on where it is installed.
- D. Backbone optical fiber riser cable shall have 900 µm buffered fibers surrounded by aramid yarns.
- E. Backbone optical fiber riser cable shall be armored.
- F. Multimode optical fiber cable shall have the number of strands as shown on the drawings and shall have a classification of OM4 with the following characteristics:

1. Bandwidth (Overfilled Launch) 850 nm:	≥ 3500 Mhz.km
2. Bandwidth (Overfilled Launch) 1300 nm:	≥ 500 Mhz.km
3. Effective Modal Bandwidth (EMB) 850 nm:	≥ 4700 Mhz.km
4. Transmission link lengths for 1 Gb/s (SX/LX):	900/550 m
5. Transmission link lengths for 10 Gb/s (SR/LX4):	550*/300 m
6. Transmission link lengths for 40 Gb/s (SR4):	150* m
7. Transmission link lengths for 100 Gb/s (SR10):	150* m
8. Attenuation 850 nm:	3.0 dB/km
9. Attenuation 1300 nm:	1.0 dB/km
10. Attenuation uniformity:	≤ 0.2 dB
11. Numerical Aperture:	0.20 ± 0.02

* with engineered link of maximum 1.0 dB connector insertion loss

- G. Multimode optical fiber cable shall have a maximum attenuation of 3.5 db/km @ 850 nm; 1.5 db/km @ 1300 nm.

- H. Acceptable Manufacturers:

- 1. Sumitomo FutureFLEX Air-Blown Fiber

2.6 BACKBONE COAXIAL RISER CABLE

- A. The backbone coaxial riser cables shall be RG-11/U type, 14 AWG solid .064" bare copper conductor, gas-injected foam HDPE insulation, Duofoil® +tinned copper braid shield (95% coverage), PVC jacket.

B. The backbone coaxial riser cables shall have the following physical characteristics:

1. Center Conductor: 14 AWG solid bare copper
2. Outer Jacket: PVC - Polyvinyl Chloride
3. Shielding: dual shield, Aluminum Foil-Polyester Tape-Aluminum Foil 100% shield coverage, TC - Tinned Copper, 95% coverage

C. The backbone coaxial riser cables shall have the following transmission characteristics:

1. Nominal Impedance: 75 ohms
2. Nominal Capacitance: 16.0 pf/ft.
3. Nominal Velocity of Propagation: 85%
4. Nominal DC Resistance/1000 feet: 2.5 ohms

D. Acceptable Manufacturers:

1. Belden 7731A

2.7 OPTICAL FIBER CONNECTORS

A. The optical fiber connectors for singlemode OS2 and multimode OM4 shall be SC.

B. All optical fiber connectors shall meet ANSI/EIA/TIA-604-3 standards.

C. Multimode OM4 SC connectors shall be aqua.

D. Singlemode OS2 SC connectors shall be blue.

E. The connectors shall be mounted in a rack-mountable fiber housing.

F. The maximum optical attenuation per each mated field installed connector pair shall not exceed 0.75 dB.

G. The total optical attenuation through the cross-connect from any terminated optical fiber to any other terminated fiber shall not exceed 1.5 dB.

1. Multimode fiber shall have a return loss greater than or equal to 20 dB.
2. Single-mode shall have a return loss greater than or equal to 26 dB.
3. The connectors shall sustain a minimum of 500 mating cycles without degrading this performance.

H. Acceptable Manufacturers:

1. Sumitomo

2.8 COAXIAL CABLE CONNECTORS

A. Coaxial connectors shall be self-terminating F-type connectors.

B. Coaxial connectors shall be electric ivory.

C. Acceptable Manufacturers:

1. Molex Premise Networks

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordinate ordering and installation of all equipment with long lead times or having a major impact on work by other trades so as not to delay the job or impact the schedule.
- B. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.
- C. Set all equipment to accurate line and grade, level all equipment and align all equipment components.
- D. Provide all scaffolding, rigging, hoisting and services necessary for erection and delivery of equipment and apparatus furnished into the premises. These items shall be removed from premises when no longer required.
- E. No equipment shall be hidden or covered up prior to inspection by the Owner or Owner's Representative. All work that is determined to be unsatisfactory shall be corrected immediately.
- F. All work shall be installed level and plumb, parallel and perpendicular to other building systems and components.
- G. The Contractor shall fire stop all penetrations made, used or provided for telecommunications installation in all fire-rated walls. Contractor shall also plug all telecommunications conduits in all telecommunications man-holes, and all conduit entries into buildings.
- H. Storage and security of material and equipment shall be the responsibility of the Contractor.
- I. Contractor shall make every effort to conserve wall space.

3.2 BACKBONE CABLES – GENERAL

- A. Attention shall be giving to the phasing of the project and when backbone cables are to be installed as shown on the Telecom Cabling Riser Diagram and on the Phasing drawings.
- B. All cables shall have been manufactured within 12 months of purchase date.
- C. Contractor shall adhere to all manufacturers' requirements regarding pulling tension, allowable lubricants, and bending radius.
- D. Contractor shall be responsible for verifying that pathways are ready for occupancy prior to cable placement.
- E. Contractor shall assume responsibility for any difficulties or damage to the cable during placement.
- F. Pulling tensions shall not exceed those recommended by the cable manufacturer. Use a line tension meter during cable pull to provide accurate measurement of the force exerted on a cable as it is installed.
- G. Cable shall be watched and inspected for sheath defects, as it is payed off the reel. Pulling operation shall be stopped and Owner or Owner's Representative shall be notified if a defect or any other irregularity is found.
- H. Cables shall be of the size and type specified on the drawings.
- I. Cables shall be continuous and without splices.
- J. Contractor shall adhere to all manufacturers' requirements regarding pulling tension and allowable lubricants.
- K. The Contractor shall be responsible for verifying all actual cable distances.
- L. The Contractor shall be responsible for verifying that conduits and raceways are "ready for occupancy" before cable placement.

- M. Placement shall conform to industry standards with regard to anchoring, cable support and separation from other facilities.
- N. Cables and innerduct shall not sag or droop, but should be installed so as to maintain a flat plane with smooth transitions from one level or direction to another.

3.3 OUTSIDE PLANT BACKBONE COPPER CABLE

- A. OSP backbone copper cables shall be installed as shown on the Riser Diagram.
- B. Contractor shall appropriately secure all OSP cables to the telecommunications room backboard within 12 inches of all terminations.
- C. All OSP backbone copper cables shall be appropriately tested, labeled, and documented.

3.4 OUTSIDE PLANT BACKBONE OPTICAL FIBER CABLE

- A. OSP backbone optical fiber cables shall be installed as shown on the Riser Diagram.
- B. On each end, the appropriate connector shall be installed on the OSP backbone optical fiber cables, and then installed in a rack-mounted optical fiber housing.
- C. Contractor shall appropriately secure all OSP cables to the telecommunications room backboard within 12 inches of all terminations.
- D. All OSP backbone optical fiber cables shall be appropriately tested, labeled, and documented.

3.5 BACKBONE COPPER RISER CABLE

- A. Backbone copper riser cables shall be installed as shown on the drawings.
- B. Copper riser cables shall be terminated on wall-mounted 110-type termination blocks.
- C. Contractor shall secure all cables to TR backboard within 12 inches of all terminations.
- D. Cables shall be appropriately supported in the riser. Vertical runs of copper cable shall be secured a minimum of every 48 inches.
- E. Cables shall not be allowed to lie on ceiling or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.
- F. All backbone copper riser cables shall be appropriately tested, labeled, and documented.

3.6 BACKBONE OPTICAL FIBER CABLES

- A. Backbone optical fiber riser cables shall be installed as shown on the drawings.
- B. A service loop of 15' shall be maintained at all cable ends.
- C. Cables shall be appropriately supported in the riser. Vertical runs of fiber optic cable shall be secured a minimum of every 48 inches.
- D. All optical fiber cables shall be terminated with the appropriate connector and then installed in an optical fiber housing.
- E. All backbone optical fiber riser cables shall be tested, labeled, and documented.

3.7 BACKBONE COAXIAL RISER CABLE

- A. Backbone coaxial riser cables shall be installed as shown on the drawings.
- B. Coaxial riser cables shall be terminated with an F-connector installed on the plywood backboard.
- C. Contractor shall secure all cables to TR backboard within 12 inches of all terminations.
- D. Cables shall be appropriately supported in the riser. Vertical runs of copper cable shall be secured a minimum of every 48 inches.
- E. Cables shall not be allowed to lie on ceiling or ceiling support structure. They must be anchored in such a way as to not interfere with other services or space access.
- F. All backbone coaxial riser cables shall be appropriately tested, labeled, and documented.

3.8 OPTICAL FIBER CONNECTORS

- A. Adhere to all manufacturer installation guidelines.
- B. Optical fiber pigtails shall be fusion-spliced to the optical fiber cable.
- C. Connectors shall be installed with less than 0.75 dB of attenuation per mated pair.

3.9 COAXIAL CABLE CONNECTORS

- A. Coaxial connectors shall be installed on coaxial cables per the manufacturer's instructions.

3.10 BACKBONE UTP COPPER CABLE TESTING

- A. One hundred percent of the backbone copper cable pairs shall be tested for opens, shorts, polarity reversals, transpositions, and the presence of AC voltage.
- B. The Contractor shall examine open and shorted pairs to determine if the termination has been done properly. If so, the Contractor shall tag bad pairs at both ends, and make note on the as-built documentation. If the problem is found to be due to termination error, the contractor shall correct the error and retest the pair(s) in question.
- C. If any single copper backbone cable (under one sheath) contains more than one percent (1%) bad pairs, the Contractor shall remove and replace the cable at its expense.

3.11 BACKBONE OPTICAL FIBER CABLE TESTING

- A. Testing procedures shall be in accordance with ANSI/TIA/EIA-568-C and ANSI/TIA/EIA-526.
- B. Inside Optical Fiber Riser cable testing shall be performed using a Power Meter and Light Source.
 - 1. The power meter shall be properly calibrated prior to testing.
 - 2. Ensure that the power meter and light source are set to the same wavelength prior to testing each fiber.
- C. Connectors, adapters, and jumpers shall be properly cleaned prior to testing.
- D. All singlemode optical fibers shall be tested bi-directionally at both 1310 nm and 1550 nm wavelengths.
- E. Contractor shall provide written confirmation of the calibration, with the power meter serial number, to the Owner, if requested. If this documentation is not available upon request, the Contractor shall re-test all optical

fiber cables after documented calibration of the power meter is accomplished.

3.12 BACKBONE COAXIAL CABLE TESTING

- A. Testing procedures shall be in accordance with industry standards for cable television (CATV).
- B. Testing shall be end-to-end, from the RG-11 backbone cable through amplifiers, splitters, etc. through the RG-6 horizontal cable to the connector at the device location.
- C. Testing shall confirm levels at the outlet location to be no less than 0 dB.

3.13 TEST RESULTS

- A. The Contractor shall submit all copper, fiber, and coaxial cable test result data in an electronic format.

3.14 LABELING

- A. All cables and associated termination hardware shall be labeled according to the Owner's labeling standard. Prior to any permanent labeling, the Contractor shall review the labeling scheme with the Owner.
- B. All backbone cables are to be labeled using a machine printed label at each end of the cable at approximately 12 inches of the termination point, and again at approximately 48 inches from the termination point. Handwritten labels shall not be used.
- C. All wiring blocks, connector panels, or other termination points shall be labeled with the cable identifier as well as the pair or conductor identifier.
- D. The labels shall denote, at a minimum, the starting and end points of the cable, as well as a unique cable identifier.
- E. Note all labeling information on the as-built drawings.

3.15 AS-BUILT DOCUMENTATION

- A. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation in both hard copy and electronic format (latest version of AutoCAD).
- B. As-built documentation for backbone cabling shall include telecom room layouts indicating location of riser cables with all appropriate labeling, etc., as well as floor plans and RCPs that indicate major riser pathways.
- C. Documentation shall also include operation and maintenance manuals for all components of the system. Manuals shall include Installation and Service manuals and Operating manuals.

END OF SECTION

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SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall provide all equipment, materials, labor, and services necessary to complete or perfect all parts of the horizontal cabling system and to ensure that it complies with the requirements stated or reasonably inferred by the Contract Documents, this Specification, and the Construction Drawings.

1.2 SCOPE OF WORK

- A. The horizontal cabling is that portion of the telecommunication cabling system that extends from the work area telecommunications outlet to the serving telecommunications room (TR). The horizontal cabling includes the horizontal cables, the mechanically terminated jacks/inserts and the faceplates that the jacks/inserts snap into, in the work area.
- B. This section includes minimum requirements for the following horizontal cabling and related products that are to be installed in the building:
 - 1. Category 6 OSP copper cable
 - 2. Category 6 UTP copper cable
 - 3. Device location jacks
 - 4. Coaxial cable
 - 5. Coaxial cable connectors
 - 6. Standard faceplates
 - 7. Systems furniture faceplates
 - 8. Floor box adapters
 - 9. Wall-phone faceplates
 - 10. Biscuit Boxes
 - 11. Testing equipment
 - 12. Labels

1.3 QUALITY ASSURANCE

- A. All equipment installed in communications equipment rooms shall be done in a neat and workmanlike manner.
- B. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Owner's Representative.
- C. Equipment and materials shall be of the quality and manufacturer indicated.
- D. The equipment specified is based on the acceptable manufacturers listed.
- E. Where "other approved equal" is stated, equipment shall be equivalent to that of the equipment specified and shall be subject to approval during the bid process.
- F. Materials and work specified herein shall comply with the latest version of the Montgomery College IT Cabling Standard, as well as the latest version of industry and other related standards below.
 - 1. ANSI/TIA-568-C.0, Generic Telecommunications for Customer Premise.
 - 2. ANSI/TIA-568-C-1, Commercial Building Telecommunications Cabling Standard.
 - 3. ANSI/TIA-568-C-2, Balanced Twisted Pair Cabling Components Standard.
 - 4. ANSI/TIA-568-C-3, Optical Fiber Cabling Components Standard.
 - 5. ANSI/TIA-569-C, Telecommunications Pathways and Spaces.
 - 6. ANSI/TIA-606-B, Administration Standard for Commercial Telecommunications Infrastructure.

7. ANSI/TIA-607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
8. ANSI/TIA-862-A, Building Automation Systems Cabling Standard.
9. ANSI/TIA-942-A, Telecommunications Infrastructure Standard for Data Centers.
10. ANSI/TIA-1005, Telecommunications Infrastructure for Industrial Premises.
11. ANSI/TIA-1179, Healthcare Facility Telecommunications Infrastructure Standard.
12. ISO/IEC 11801, Generic Cabling for Customer Premises.
13. IEEE 802.3af, Power over Ethernet (PoE) Standard.
14. IEEE 802.3at, Power over Ethernet + (Plus).
15. IEEE 802.3an, Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T.
16. IEEE 802.3ba, Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation.
17. Building Industry Consulting Services International (BICSI) Telecommunications Distribution Methods Manual.
18. National Electrical Manufacturers Association.
19. National Fire Protection Association (NFPA) 70 – National Electrical Code.
20. Underwriters Laboratory (UL) or equivalent.

1.4 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of (2) years following acceptance by the owner. Completion of the installation, in-progress and final inspections, receipt of the test and as-built documentation, and successful performance of the cabling system for a (3) week period will constitute acceptance of the system.
- B. Contractor shall provide an extended manufacturer's warranty of no less than (25) years for the cabling and associated connectivity products that are part of this specification.

1.5 CERTIFICATIONS

- A. During the bid process, the Contractor shall submit proof (manufacturer's certification) that the installing company is currently an authorized Molex Premise Network System certified installer, that they can provide an extended 25-year warranty, that they are in good standing with the manufacturer, and that they have a minimum of five (5) years of experience on similar cabling systems installations.
- B. During the bid process, the Contractor shall submit a breakdown of the installation staff, showing that is consists of several BICSI-certified installers.

1.6 SUBMITTALS

- A. During the bid process, the Contractor shall submit a detailed bill-of-materials that includes at a minimum the part number, part description, manufacturer, quantity, and units for each product this is included in this specification section.
- B. Prior to purchase and installation of any products that are associated with this bid specification, the Contractor shall submit manufacturers' data sheets (cut sheets) for all proposed equipment in this specification section.
- C. Upon completion of the cabling system installation, the Contractor shall submit complete cabling test results as detailed later in this specification.
- D. Upon completion of the cabling system installation, the Contractor shall submit complete as-built documentation as detailed later in this specification.
- E. Upon final acceptance of the cabling installation, the Contractor shall furnish to the Owner the extended warranties for the installed cabling products, applications, and workmanship.

PART 2 - PRODUCTS

2.1 CATEGORY 6 OSP COPPER CABLE

- A. All horizontal cable to devices that are located outside the building (shown on the Telecommunications Cabling Site Plan) shall utilize Category 6 OSP copper cable.
- B. Category 6 OSP cable shall meet the following tested at 250 MHz (dB/100m):
- | | |
|------------------------------------|------|
| 1. Return Loss (RL): | 17.3 |
| 2. Near-End Crosstalk (NEXT): | 34.3 |
| 3. Power Sum NEXT (PSNEXT): | 32.3 |
| 4. Insertion Loss (IL): | 34.4 |
| 5. Attenuation to Crosstalk (ACR): | 1.9 |
- C. Acceptable Manufacturers:
1. Mohawk M57562
 2. Other approved equal

2.2 CATEGORY 6 UTP COPPER CABLE

- A. The horizontal cable for all voice and data systems shall be Category 6, 4-pair, 100-ohm, 23 AWG, unshielded twisted pair (UTP) copper cable.
- B. All horizontal UTP copper cable shall be plenum rated.
- C. Category 6 cables shall meet the following tested at 250 MHz (dB/100m @ 20°C):
- | | |
|---|------|
| 1. Return Loss (RL): | 20.1 |
| 2. Near-End Crosstalk (NEXT): | 43.4 |
| 3. Power Sum NEXT (PSNEXT): | 41.4 |
| 4. Insertion Loss (IL): | 39.9 |
| 5. Attenuation to Crosstalk (ACR): | 10.8 |
| 6. Power Sum ACR (PSACR): | 8.8 |
| 7. Attenuation to Crosstalk Ratio Far-end (ACRF): | 24.8 |
| 8. Power Sum ACRF (PSACRF): | 21.8 |
- D. Category 6 cables shall be different colors based on the system they support:
1. Cables for data shall be blue.
 2. Cables for analog voice shall be white.
 3. Cables for security cameras shall be pink.
 4. Cables for Mass Notification shall be pink.
 5. Cables for BAS shall be green.
- E. Acceptable Manufacturer:
1. Molex Premise Networks CAA-0181P-BL (blue - data); CAA-0181P-02 (white - voice); CAA-0181P-PK (pink - security cameras, MNS); CAA-0181P-GR (green - BAS)

2.3 DEVICE LOCATION JACKS

- A. All device location jacks shall Category 6 shall meet the requirements of the characteristics in the list under the Category 6 cable above.

- B. All device location jacks supporting voice and data connectivity shall be 8P8C modular jacks that snap into user configurable faceplates or biscuit boxes.
- C. The Pin/Pair assignment shall be in accordance with T568B.
- D. Jacks shall be different colors based on the system they support:
 - 1. Category 6 jacks for data shall be blue.
 - 2. Category 6 jacks for analog voice shall be white.
 - 3. Category 6 jacks for security cameras shall be blue.
 - 4. Category 6 jacks for Mass Notification shall be blue.
 - 5. Category 6 jacks for BAS shall be green.
 - 6. Category 6 jacks for wireless access points shall be blue.
- E. Acceptable Manufacturer:
 - 1. Molex Premise Networks Data- KSJ-00018-XX (where XX represents the color)

2.4 COAXIAL CABLES

- A. The coaxial cables installed from a serving telecommunications rooms to a designated device location shall be UL-Listed, low loss, RG-6 cable.
- B. Coax cable shall be plenum rated.
- C. Physical Characteristics:
 - 1. Center Conductor: 18 AWG solid bare copper
 - 2. Dielectric: foam FEP
 - 3. Shielding: Duofoil – aluminum foil-polyester tape-aluminum foil
 - 4. Jacket: Flam arrest
- D. Electrical Specifications:
 - 1. Capacitance: 16.1 pF/ft
 - 2. Characteristic Impedance: 75 ohms +/-3 ohms
 - 3. Nominal Velocity of Propagation: 82%
 - 4. Conductor DC Resistance: 6.4 ohms/1000 ft
- E. Acceptable Manufacturers:
 - 1. Belden 1695A

2.5 COAXIAL CABLE CONNECTORS

- A. Coaxial connectors shall be self-terminating F-type connectors.
- B. Coaxial connectors shall be white.
- C. Acceptable Manufacturers:
 - 1. Molex Premise Networks

2.6 STANDARD FACEPLATES

- A. For general voice and data locations, faceplates shall be single-gang and sized based on the number of jacks

required at the particular device location.

- B. Faceplates shall be white.
- C. Faceplates shall have a designation strip holder.
- D. Faceplates shall be UL listed.
- E. White blanks shall be inserted to cover empty jack locations.
- F. Acceptable Manufacturer:
 - 1. Molex Premise Networks WSY-00018-02 (2-port); WSY-00002-02 (4-port); WSY-00001-02 (6-port); KSJ-00005-02 (blank)

2.7 MODULAR FURNITURE FACEPLATES

- A. For modular furniture locations, jacks shall be installed in a faceplate specific for the furniture.
- B. Modular furniture faceplates shall have a designation strip holder.
- C. Modular furniture faceplates shall be UL listed.
- D. Blanks shall be inserted to cover empty jack locations.
- E. Acceptable Manufacturer:
 - 1. Molex Premise Networks KSJ-00033-XX

2.8 FLOOR BOX ADAPTERS

- A. In areas where cables are installed to floor boxes, the appropriate adapter plate that is manufactured to be used for that device shall be used to terminate Category 6 cables.
- B. The adapter plate shall have the capability to accept the same Category 6 jacks that specified in this project.

2.9 WALL-PHONE FACEPLATES AND JACKS

- A. Wall-phone faceplates shall be provided at each wall-phone location.
- B. To support any wall phones, a wall-phone faceplate be installed with a Category RJ-45 type (8P8C) jack.
- C. Wall-phone faceplates shall have tabs onto which a wall telephone can be appropriately attached.
- D. Acceptable Manufacturer:
 - 1. Molex Premise Networks WSS-00007

2.10 BISCUIT BOXES

- A. For designated cables that support ceiling mounted devices, jacks shall be installed in a biscuit-type box sized based on the number of jacks required at the particular device location.
- B. Biscuit boxes shall be white.
- C. Biscuit boxes shall have a designation strip holder.

- D. Biscuit boxes shall be UL listed.
- E. Blanks shall be inserted to cover empty jack locations.
- F. Acceptable Manufacturer:
 - 1. Molex Premise Networks SSY-00002-02

2.11 TESTING EQUIPMENT

- A. Use an approved testing device for all horizontal cables, including Category 6 copper, coaxial, and optical fiber.
- B. Acceptable Manufacturers:
 - 1. Fluke
 - 2. Other approved equal

2.12 LABELS

- A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.
- B. Shall be pre-printed or laser printed type.
- C. Where used for cable marking, a label with a vinyl substrate and white printing area and a clear "tail" that self laminates the printed area when wrapped around the cable shall be provided. The label color shall be different than that of the cable to which it is attached.
- D. Where insert type labels are used, provide clear plastic cover over label.
- E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18" above all direct buried services, underground conduits and duct-banks.
- F. Acceptable Manufacturers:
 - 1. Ideal
 - 2. Brother P-Touch
 - 3. W.H. Brady
 - 4. Other approved equal

PART 3 - EXECUTION

3.1 HORIZONTAL CABLE INSTALLATION – GENERAL

- A. All horizontal cabling shall be installed per the "T" set of drawings.
- B. All wiring concealed in walls or soffits shall be installed in conduits.
- C. All wiring above ceilings shall be installed in conduit, basket tray, or cable hangers.
- D. If cable tray or conduit is not available, cables above accessible ceilings shall be supported 4 to 5 feet on center from cable hangers attached to the building structure.
- E. The Contractor shall adhere to all ANSI/TIA/EIA and manufacturers' installation instructions for the placement and termination of the cable. This includes without limitation pulling tension, bend radius, jacket stripping, and pair untwisting.

- F. It is the intent that the maximum cable distance between the work-area outlet and the termination in the telecommunications room shall be 90 meters. If any horizontal cables are longer than 90 meters, these shall be brought to the immediate attention of the Owner or Owner's Representative.
- G. Cables shall have no physical defects such as cuts, tears or bulges in the outer jacket. Cables with defects shall be replaced.
- H. The Contractor shall install cable in a neat and workmanlike manner. All cables shall be neatly bundled and tied in rooms. Leave sufficient cable for 90° sweeps at all vertical drops.
- I. At each device location, the cables shall be terminated on the appropriate jack mounted in an appropriate faceplate.
- J. When placing cable, the Contractor shall maintain the following clearances from sources of electro-mechanical interference (EMI).
 - 1. Power cable - 6 inches
 - 2. Fluorescent Lights - 12 inches
 - 3. Transformers - 36 inches
- K. The Contractor shall fire stop all penetrations it makes through fire barriers.

3.2 UTP COPPER CABLE, DEVICE JACKS, AND FACEPLATES

- A. All Category 6 OSP cables shall be used to connect to devices that are outside the building. If these device locations are more than 295 feet from the telecommunications room, PoE extenders shall be used.
- B. Horizontal copper cables shall be routed to the appropriate serving telecommunications room.
- C. All Category 6 OSP cables shall terminate in the telecommunications room on surge protection and extended to rack-mounted 110-type blocks.
- D. All inside Category 6 cables shall be terminated with modular jacks that snap into a faceplate, floor box adapter plate or biscuit box.
- E. In the telecommunications room, inside horizontal Category 6 cables shall be terminated on Category 6 jacks installed in the 48-port patch panels.
- F. Outlet boxes shall be secured to the building with mechanical fasteners. Adhesive fasteners are not allowed.
- G. Any unused openings in the faceplate shall be filled with blank inserts.

3.3 COAXIAL CABLE AND CONNECTORS

- A. Horizontal coaxial cables shall be routed to the appropriate serving telecommunications room.
- B. All coaxial cables shall be terminated with modular connectors and couplers that snap into a faceplate or floor box adapter plate.
- C. All coaxial connections shall be made with solderless connectors using a crimp tool specially designed to prepare the cable for the connectors.

3.4 TESTING PROCEDURES

- A. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions according to the requirements of ANSI/TIA/EIA-568-C.

- B. All pairs of each installed cable shall be verified prior to system acceptance. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors in all cables installed.
- C. All cables shall be tested in accordance with this document, the ANSI/TIA/EIA standards, the manufacturers' procedures, and best industry practice. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

3.5 HORIZONTAL UTP CABLE TESTING

- A. Testing shall conform to current industry standards for performance of 100-ohm Category 6 UTP cable.
- B. Testing shall be accomplished using a UL certified tester capable of performing a full complement of Category 6 tests.
- C. Testing shall be performed after cables have been terminated and permanently labeled. The permanent cable address shall be used for all testing identification.
- D. Any cable failing the prescribed certification testing shall be removed and replaced at the Contractor's expense.
- E. The Contractor shall provide Category 6 permanent link test results on all pairs of cable, including but not limited to cable length, wire map, near-end cross-talk (NEXT), Power Sum NEXT, attenuation to cross-talk ratio (ACR), Power Sum ACR, equal level far-end cross-talk (ELFEXT), Power Sum ELFEXT, and Return Loss.
- F. Results shall be provided in an electronic format.

3.6 HORIZONTAL COAXIAL CABLE TESTING

- A. Testing procedures shall be in accordance with industry standards for cable television (CATV).
- B. Testing shall be end-to-end.
- C. Testing shall confirm levels at the outlet location to be no less than 0 dB.

3.7 TEST RESULTS

- A. The Contractor shall test all cables and submit all horizontal cable test result data in electronic format, with the resulting file formatted with one test result per 8.5-inch x 11-inch page.

3.8 LABELING

- A. All horizontal cables are to be labeled using a machine printed label at each end of the cable at approximately 12 inches of the termination point, and again at approximately 48 inches from the termination point. Handwritten labels shall not be used.
- B. All patch panel ports shall be labeled with the cable identifier.
- C. Labeling schemes shall be confirmed with the Owner prior to any permanent labeling.
- D. Note all labeling information on the as-built drawings.

3.9 AS-BUILT DOCUMENTATION

- A. Contractor shall provide 606A compliant horizontal link records, which, at a minimum, shall include the location of the end-station for each horizontal cable.

- B. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation in both hard copy and electronic format (latest version of AutoCAD).
- C. As-built documentation for horizontal cabling shall include floor plan and RCP drawings that indicate major cable pathways, cable locations, labels, etc.
- D. Documentation shall also include operation and maintenance manuals for all components of the system. Manuals shall include Installation and Service manuals and Operating manuals.

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SECTION 273226 EMERGENCY TELEPHONES

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes the minimum requirements for equipment and installation of Emergency Telephones and associated hardware at Montgomery College. The College currently uses products manufactured by Ramtel.
- B. Scope shall include the installation of concrete bases, anchor bolts, communications and electrical conduits, communications and power cables, emergency telephones, and the connection of telephones to building cable plant.

1.2 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed.
- B. Materials and work specified herein shall comply with the applicable requirements of:
 - 1. Underwriters Laboratory or equivalent
 - 2. Federal Communications Commission
 - 3. National Electric Code (NEC)

1.3 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of two (2) years following acceptance by the owner.
- B. If within two (2) years after the date of substantial completion, any of the work or equipment is found to be defective or not in compliance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor.
- C. The Owner shall give notice to the Contractor of any defects promptly after the discovery of any defective condition.
- D. These obligations shall survive termination of the construction contract.

1.4 SUBMITTALS

- A. Submit manufacturers data sheets for proposed systems, and equipment.
- B. Submit manufacturers instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.
- C. Submit all applicable Material Safety Data Sheets.

- D. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.
- E. Submit detailed shop drawings which include the following information (without limitation):
 - 1. Location of all emergency telephones.
 - 2. Cable types connecting all devices.
 - 3. Mounting details of all devices.
 - 4. Telephone numbers or other address information of each device.
- F. Record documents as described in Part 3.

PART 2 - PRODUCTS

2.1 TELEPHONE

- A. Features:
 - 1. EEPROM nonvolatile memory
 - 2. Automatic Gain Offset
 - 3. Greater Line voltage and Current range
 - 4. No Voice Activity Disconnect
 - 5. Programmable Muted Phone Speaker
 - 6. Password protected remote programmable
 - 7. Custom Silk Screened phone panel
 - 8. Louver Design, Anodized Aluminum Panel
 - 9. PIEZO Switches (Large Red Button Option)
 - 10. Chrome Metal Keypad
 - 11. Surge and Grounding Protection
 - 12. Weather Resistant Vandal Resistant
 - 13. Phone Line Powered
 - 14. Weatherproofed speaker and microphone
 - 15. Tamper resistant screws

16. Condensation Protection (Back Box protects electronics against moisture and condensation)
17. Auto-Redial of Three Additional Numbers, if line busy or no answer.
18. Emergency Override on Call in Progress.
19. Emergency Call in Progress Cannot be terminated.
20. Auto-Answer feature allows for call back and monitoring of area.
21. Voice and location identification signal.
22. ADA Compliant
23. Red" indicator light automatically activated when any button on phone is pressed, and changes to Green" when call is answered.
24. Braille Plaque includes International Phone Symbol.
25. Disconnect Functions:
 - a) Automatic Shut-Off
 - b) Remote Shut Off
 - c) Adjustable Time Out Functions
 - d) No Voice Activity
26. Emergency button external output control.
27. Field Hardware

2.2 COLUMN BASE

A. Physical Specifications:

1. Non-Rusting, Non Magnetic Stainless Steel 0.125 Thick
2. Dimensions: 9 ft. High 11 Square
3. 1 Radius Corners
4. Phone is recessed 2"
5. Pre-wired and assembled
6. Vandal resistant and weatherproof
7. Lettering 4 sides of column
8. Weight: 190 pounds

9. Mounting: 4 5 8 x 16 Anchor Bolts

B. Features:

1. Two High-Powered Blue LED area lights; Combination Constant ON LED and Flashing Strobe constantly illuminated
2. A deep blue polycarbonate Fresnel lens distributes light in a horizontal pattern making the flash bright and visible
3. Strobe flashes (Top Light) when Emergency Call button is pressed, and stops flashing when the called party hangs up
4. LED Phone Panel Light

2.3 WALL-MOUNT

- A. For wall-mounted locations provide a wall mounted enclosure designed specifically to enclose the telephone and designed to match the appearance of the column base units.

B. Features

1. Designed for indoor and outdoor use
2. Includes built in combination constant on High Power LED Light / Strobe
3. LED panel light Illuminates Phone panel
4. Phone panel is recessed by 2"
5. Full clear Wrap Around Lens
6. Lettering on two sides

C. Wall Unit Specs

1. Non-Rusting, Non-magnetic Stainless Steel 0.125 Thick
2. Tamper-resistant
3. Vandal-resistant, and weatherproof
4. Dimensions: 11 x 8 x 38
5. Weight: 65lbs.
6. Mounting: 5 16 x 1-1 2 bolts

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. The locations of the Emergency Telephones are found on the project drawings. The Contractor shall be responsible for conducting a detailed location by location review with the Owner and/or Owner s Representative to finalize the exact locations for mounting.
- B. Current Site Conditions: The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Owner. The Contractor shall not take any corrective action without written permission from the Owner.
- C. Where discrepancies in the construction documents or uncertainties in terms of the intent of the documents exist, contractor shall execute a written Request for Information and forward it to the design team. Contractor shall not be relieved of its obligation under these documents due to its failure to request clarification or additional information in a timely manner.
- D. The contractor shall be responsible for the hook-up to the unit, both power and telephone line.
- E. All installation shall be as described in the manufacturer s installation instructions.
- F. Electrical and telephone line conduits should be run through the foundation and into the center hole of the tower.
- G. To insure proper grounding of all electrical components, the tower mount should be effectively earth grounded from the grounding stud (located across from the lower access panel) with 6 AWG or better insulated, stranded copper wire to the metallic power service raceway (conduit) or an 8 foot or longer corrosion-resistant ground spike. It is the installer's obligation to ensure compliance with all national, regional, and local regulations.

3.2 SYSTEM CONFIGURATION AND SET-UP

- A. The Contractor shall configure and program all Emergency Telephones identified in Section 3.1A above.
- B. The Contractor shall provide, configure and program all diagnostic features with any appropriate peripherals in the Security Command Center.

3.3 PERFORMANCE REQUIREMENTS

- A. General: The Contractor shall perform pre-delivery testing, site testing, and adjustment of the completed system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- B. Contractor's Field Testing: The Contractor shall calibrate and test all equipment, verify operation, place the integrated system in service, and test the integrated system.

- C. Performance Verification Test: The Contractor shall demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown.

3.4 RECORD DOCUMENTATION

- A. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation.
- B. Record documentation shall include:
 - 1. Floor plan drawings indicating device locations and wire routing.
 - 2. Functional block diagrams.
 - 3. Drawings shall be provided in both hard copy and in electronic format. The electronic format shall be the most recent version of AutoCAD.
- C. Record documentation shall also include operation and maintenance manuals for all components of the system. Manuals shall include:
 - 1. Installation and Service manuals.
 - 2. Operating manuals.
 - 3. If not included in the above manuals, the Contractor shall provide:
 - a) Power up and power down procedures.
 - b) Programming procedures.
 - c) Maintenance schedules.
 - d) Diagnostic procedures.

END OF SECTION

SECTION 275319 DISTRIBUTED ANTENNA SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This specification describes technical and performance criteria for deploying a Distributed Antenna System (DAS) throughout the building that is capable of supporting Public Safety Networks (PSN). The DAS components specified in this document include: donor antennas, coverage antennas, coax cable, coax connectors, splitters, combiners, couplers, fiber-optic cable, fiber-optic connectors, and fiber-optic jumpers, bi-directional amplifiers (bda), fiber-optic master unit and fiber-optic remote units and any other devices required to provide a full, complete and functioning system.

1.2 SYSTEM DESCRIPTION

- A. General Requirements:
 - 1. Active DAS system supporting public safety radio systems of:
 - a. Montgomery County, MD
 - 2. Unless otherwise noted, the in-building PSN system shall meet the requirements of NFPA 72-2013.
- B. Radio coverage shall be provided as follows:
 - 1. General building areas shall be provided with 95% floor area coverage.
 - 2. Critical areas such as the emergency command center, fire pump room(s), exit stairs, exit passageways, elevators, elevator lobbies, standpipe cabinets, and sprinkler valve locations shall be included in the required coverage area.
- C. Signal strength shall be -95dBm.
- D. System Frequencies
 - 1. The system shall be capable of transmitting all public safety radio frequencies assigned to the public safety agencies of Montgomery County, Maryland.
- E. Contractor shall state the assumed channel count for the PSN frequency bands in their submittal. Prior to installation, Contractors shall confirm the channel count and frequencies with the AHJ, and shall guarantee coverage for these channels per the criteria stated above.
- F. The DAS shall be capable of upgrade, without additional hardware or software, to allow for changes to system frequencies within the deployed frequency band in order to maintain radio system coverage as originally designed.
- G. FCC Certification All repeaters, transmitters, receivers, and signal boosting equipment shall be certified or otherwise compliant with applicable FCC regulations.
- H. Enclosures All active repeater, transmitter, receiver, battery enclosures, and signal boosting equipment used by the PSN shall be enclosed in locking NEMA type 4 or 4X enclosures. These enclosures shall be painted fire-engine red in color and shall bear the following in bright yellow lettering:
 - 1. Public Safety Radio Reinforcement System
- I. The primary power source will be the building emergency power system which includes an automatic starting, engine-driven generator serving the dedicated branch for the system. Contractor shall provide storage batteries dedicated to the system with at least 12 hours of 100 % system operation.
 - 1. The battery system shall automatically charge in the presence of external power input.

2. The battery system shall be contained in a NEMA 4 or 4x type enclosure.
- J. System Monitoring - The system supporting the DAS shall include a network management system capable of alarm, monitor, configuration and control of all active components. At minimum, this shall include, without limitation:
 1. Fire Alarm The system shall be capable of transmitting automatic supervisory and trouble signals to the building fire alarm system.
 - a. System and signal booster supervisory signals shall include:
 - 1) Antenna Malfunction
 - 2) Signal Booster Failure
 - b. Power supply supervisory signals shall include:
 - 1) Loss of normal AC power
 - 2) Failure of battery charger
 - 3) Low battery capacity, alarming at 70% battery capacity.
 2. Dedicated Panel A dedicated monitoring panel shall be provided within the emergency command center to annunciate the status of all signal boosters. The monitoring panel shall provide visual and labeled indication of the following:
 - a. Normal AC power
 - b. Signal booster trouble
 - c. Loss of normal AC power
 - d. Failure of battery charger
 - e. Low battery capacity, alarming at 70% battery capacity
- K. A permanent sign shall be conspicuously installed in the fire command station or near the main entrance indicating the presence of the DAS amplification system and the radio systems being amplified.

1.3 REFERENCE STANDARDS

- A. All work, including but not limited to: cabling, pathways, support structures, wiring, equipment, installation, workmanship, maintenance and testing shall comply with the latest editions of the National Electrical Code, National Electrical Safety Code, all applicable local rules and regulations, equipment manufacturer's instructions, and the National Electrical Contractor's Association (NECA) Standard of Installation. In case of discrepancy or disagreement between the documents noted above, the Contractor shall satisfy the most stringent requirements.

1.4 ABBREVIATIONS AND ACRONYMS

- A. ACG: Automatic Gain Control
- B. AHJ: Authority Having Jurisdiction
- C. ATP: Acceptance Test Plan
- D. AWS: Advanced Wireless Service
- E. BDA: Bi-Direction Amplifier
- F. BOM: Bill-of-Material

- G. BRS: Broadband Radio Service
- H. BTS: Base Transceiver Station
- I. CDMA: Code Division Multiple Access
- J. C/N: Carrier-to-Noise Ratio
- K. CWDM: Coarse Wave Division Multiplexing
- L. DAS: Distributed Antenna System
- M. DWDM: Dense Wave Division Multiplexing
- N. EBS: Educational Broadband Service
- O. ESMR: Enhanced Specialized Mobile Radio
- P. FCC: Federal Communications Commission
- Q. GUI: Graphical User Interface
- R. iDEN: Integrated Enhanced Digital Network
- S. LMR: Land Mobile Radio
- T. LTE: Long Term Evolution
- U. MIMO: Multiple Input, Multiple Output
- V. MTBF: Mean Time Between Failure
- W. NFPA: National Fire Protection Association
- X. NMS: Network Management System
- Y. OUC: District of Columbia Office of Unified Communications
- Z. PCS: Personal Communications System
- AA. PSN: Public Safety Network (the public safety radio repeater system)
- BB. RoF: Radio-over-Fiber
- CC. RoHS: Restriction of Hazardous Substances
- DD. RSL: Received Signal Level
- EE. SISO: Single-Input, Single-Output
- FF. SMR: Specialized Mobile Radio
- GG. SMS: Short Message Service
- HH. SNIR: Signal-to-Noise Interference Ratio

II. SNMP: Simple Network Management Protocol

JJ. SOW: Statement of Work

KK. VSWR: Voltage Standing Wave Ratio

LL. WSP: Wireless Service Provider

1.5 DEFINITIONS

A. Acceptance: Expressed approval by the customer

B. Active: DAS components that require AC/DC power for operation

C. Carrier Approval: Expressed approval to interconnect to the WSP macro network

D. Cellular Access Unit: The Active device that allows the mobile devices to connect to the DAS network.

E. Channel: A path for an RF transmission between two points

F. Component: A main system element of the DAS

G. Delivered Audio Quality (DAQ): A measure of audio quality over a transmission medium used to quantify the quality of audio heard over a radio system. DAQ levels are defined by the following scale:

1. DAQ 1: Unusable. Speech present but not understandable.

2. DAQ 2: Speech understandable with considerable effort. Requires frequent repetition due to noise or distortion.

3. DAQ 3: Speech understandable with slight effort. Requires occasional repetition due to noise or distortion.

4. DAQ 3.4: Speech understandable without repetition. Some noise or distortion present.

5. DAQ 4: Speech easily understandable. Little noise or distortion.

6. DAQ 5: Perfect. No distortion or noise discernible.

H. Head-End Equipment: The equipment that accepts the RF Source, and then typically attenuates, combines, filters and converts the various RF Source signals before transmitting the RF signals to the Remote Units.

I. Passive: DAS components that do not require AC/DC power for operation

J. Remote Unit: The equipment that receives the RF signals from the Head-End Equipment, and then typically filters, converts and often amplifies the RF signal before transmitting it to the coverage antenna or Cellular Access Unit.

1.6 SAFETY

A. The systems, and all components, shall conform to all applicable code requirements and shall be in conformance with industry standards of operation and practices. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the users to arrange and operate a safe assembly and working environment audience and user personnel.

1.7 QUALITY ASSURANCE

A. Contractor shall fully inform itself of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or materials that the Contractor could have been fully informed of

prior to the bid date.

- B. Manufacturer shall be one who has been continuously engaged in the manufacturer of distributed antenna system equipment for a minimum of three years.
- C. All equipment, where applicable standards have been established, shall be built to the standards of Underwriters Laboratories, Inc., the National Electric Code and the Federal Communications Commission.
- D. Qualifications and Requirements
 - 1. Contractor shall have a minimum of 3-years full-time experience executing DAS work of similar scope and complexity.
 - 2. Contractor shall have deployed a minimum of 10 DAS systems.
 - 3. Contractor must have on staff a Registered Communications Distribution Designer (RCDD®) certified by Building Industry Consulting Service International (BICSI).
 - 4. Contractor shall provide an onsite construction foreman to oversee the installation.
 - 5. Contractor shall provide a project manager to oversee the DAS deployment.
- E. Certifications:
 - 1. The DAS manufacture(s) of the active components shall maintain a formal authorized and certified value-added reseller program, which consists of routine quality audits of the participating value-added resellers. The list of authorized value-added resellers shall be published.
 - 2. Contractor shall be an authorized and certified value-added reseller for the proposed DAS manufacturer of passive and active DAS components.
 - 3. Contractor shall provide manufacturer certification that their personnel have been trained on the passive and active components being installed.
- F. Coordination
 - 1. Coordinate work of this section with requirements of local AHJs, and others as required.
 - 2. Meet with representatives of above organizations and Owner s Representative to exchange information and agree on details of equipment arrangements and installation interfaces.

1.8 SUBMITTALS

- A. Submittal requirements
 - 1. Product Data: Submit manufacturer datasheets for the following components:
 - a. Donor and Coverage Antennas
 - b. Coaxial Cable and Connectors
 - c. Splitters, Combiners and Couplers
 - d. Bi-Directional Amplifiers (BDA)
 - e. Fiber-Optic Master Unit
 - f. Fiber-Optic Remote Units
 - 2. Shop Drawings: Submit the following items:
 - a. RF link budget
 - b. Overlay of system Components on floor plans

- c. Drawings for Donor Antenna and grounding
- d. Heat Map Drawings” which graphically indicate the protected signal coverage pattern overlaid on the building floor plans.
3. Bill-of-Material (BOM) The bill of materials shall include item description, manufacture name and model number, and quantity being provided.
4. Statement of Work (SOW): The SOW shall include a complete description of the technical aspects of the design being submitted.
5. Acceptance Test Plan (ATP): Submit sample ATP
6. Warranty Documents:
 - a. Submit for all manufactured Components specified in this Section.
 - b. Submit Contractor s System Warranty.

1.9 PROJECT RECORD DOCUMENTS

- A. During Construction Contractor shall
 1. Maintain timely and accurate records of actual device locations.
 2. Carefully documents major deviations in work as actually installed.
 3. Include notations reflecting as-built conditions of any additions to or variation from original Drawings.
- B. Drawings: Submit as-built drawings indicating:
 1. Donor antenna, grounding and lighting protection details
 2. Cable routing, splitters, couplers and coverage antenna locations
 3. Active component locations, layout and configuration
 4. Results of all testing and commissioning
- C. Field Reports: Submit sweep-testing results for all cable runs.
- D. Field Reports: Submit OTDR test results for all fiber runs.
- E. Operation and Maintenance Data: Submit hardware and software manuals for all Active Components.
- F. Warranty Documents:
 1. Submit for all manufactured components specified in this Section.
 2. Submit Contractor s System Warranty.
 3. Submit Manufacturer s Extended Warranty

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

- A. Omni-Directional Coverage: Omni-Directional Coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
1. Frequency Band: 698 800 MHz
 2. VSWR: 1.8:1
 3. Gain: 1.5 dBi
 4. Maximum input power:
 5. Impedance: 50
 6. Beamwidth, Horizontal: 360° omnidirectional
 7. Beamwidth, Vertical: 80° nominal
 8. Return Loss: 10.9 dB
 9. Mechanical:
 - a. Connector: 50 N Type Female
 - b. Mounting: Thru-hole ceiling mount
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: KSR195, plenum rated
 10. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
 11. Basis of Design: Equal of Andrew CELLMAX-O-CPUSE
- B. Directional Coverage Antennas: Directional coverage antennas shall feature a multi-band design, accommodating multiple frequency bands in a single small antenna.
1. Band 1:
 - a. Frequency Band: 698 800 MHz
 - b. VSWR: 1.8:1
 - c. Gain: 5.0 dBi 698 800 MHz
 - d. Maximum input power: 50W
 - e. Impedance: 50
 - f. Beamwidth, Horizontal: 110° nominal
 - g. Polarization: Vertical
 - h. Return Loss: 10.9 dB
 1. Band 2:
 - a. Frequency Band: 1710 2700 MHz and 800 960 MHz

- b. VSWR: 1.5:1
 - c. Gain: 5.0 dBi @ 800 960 MHz and 6.0 dBi 2170 2700 MHz and 8.0 dBi 1710 2170 MHz
 - d. Maximum input power:
 - e. Impedance: 50
 - f. Beamwidth, Horizontal: 90° nominal
 - g. Return Loss: 13.9 dB
2. Mechanical:
 - a. Connector: 50 N Type Female
 - b. Mounting: 4-hole wall mounting plate
 - c. Radome material: ABS, UV resistant
 - d. Pigtail cable: RG58, plenum rated
 3. Environmental:
 - a. Application: Indoor
 - b. Operating Temperature: 40 °C to +60 °C (40 °F to +140 °F)
 - c. Relative Humidity: Up to 100%
 4. Basis of Design: Equal of Andrew CELLMAX-D-CPUSE
- B. Splitters, Combiners, Couplers, Coax Jumpers and Connectors:
1. Andrew or equivalent
- C. Fiber-Optic Master Unit: When building size dictates an Active fiber DAS, the Fiber-Optic Master Unit shall convert radio over coax to Radio-Over-Fiber (RoF) for distribution to Fiber-Optic Remote Units.
1. Approved Manufacturers:
 - a. CommScope/Andrew
 - b. Corning/MobileAccess
 - c. TE Connectivity
 - d. SOLiD Technologies
 - e. Other approved equal
- D. Fiber-Optic Remote Units: The Fiber-Optic Remote Unit converts the RoF signal back to radio over coax, as well as provides filtering so that multiple frequency bands can reside over the same passive cable and antenna infrastructure.
1. Approved Manufacturers:
 - a. CommScope/Andrew
 - b. Corning/MobileAccess
 - c. TE Connectivity
 - d. SOLiD Technologies
 - e. Other approved equal

2.2 CABLE

A. ALL cable routed above ceiling spaces shall be plenum rated.

B. Air Dielectric, plenum rated cable:

1. Material Characteristics:

- a. Jacket: halogenated, fire-retardant
- b. Outer Conductor Material: corrugated aluminum or corrugated copper
- c. Inner Conductor Material: copper-clad aluminum wire

2. Electrical Characteristics:

- a. Impedance: 50 2.0
- a. Frequency Band: 1 - 8800 MHz
- b. Peak Power Rating: 40.0 kW

3. Mechanical Characteristics:

- a. Diameter over jacket: .627 in
- b. Minimum bending radius: 5 in
- c. One time minimum bending radius: 3 in

4. Attenuation Characteristics:

Frequency (MHz)	Attenuation (dB/100ft)
150	0.848
450	1.53
800	2.105
2000	3.564

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Approved Manufacturer: Equal of Andrew HL4RP-50A, AL4RPV-50A

C. Foam Dielectric Cable:

1. Material Characteristics:

- a. Jacket: non-halogenated, fire-retardant polyolefin
- b. Outer Conductor Material: corrugated copper
- c. Inner Conductor Material: copper-clad aluminum wire or copper tube

2. Electrical Characteristics:

- a. Impedance: 50 1.0
- b. Frequency band: 1 2" Nominal: 1 - 8800 MHz, 7/8" Nominal: 1 - 5000 MHz
- c. Peak power rating: 40.0 kW

3. Mechanical Characteristics:

- a. Diameter over jacket: 1 2" Nominal: .630 in, 7 8" Nominal: 1.1 in
- b. Minimum bending radius: 1 2" Nominal: 5 in, 7 8" Nominal: 10 in
- c. One time minimum bending radius: 1 2" Nominal: 2 in, 7 8" Nominal: 5 in

4. Attenuation Characteristics: 1 2" Nominal

Frequency (MHz)	Attenuation (dB/100ft)
150	0.815
450	1.447
800	1.968
2000	3.251

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

5. Attenuation Characteristics: 7 8" Nominal:

Frequency (MHz)	Attenuation (dB/100ft)
150	0.417
450	.744
800	1.014
2000	1.683

Standard Conditions: VSWR 1.0, ambient temperature 20 °C (68 °F)

6. Approved Manufacturer: Equal of Andrew LDF4-50A, FXL-540-NHR, FXL-780-NHR.

D. Optical Fiber riser Cables

1. Multimode Fiber:

- a. Shall have a classification of OM3 with a minimum bandwidth of 2000 and 500 MHz km at 850 nm and 1300 nm, respectively.
- b. Shall have a maximum attenuation of 3.5 dB/km at 850 nm.
- c. Shall have a maximum attenuation of 1.5 dB/km at 1300 nm.
- d. Shall have a maximum splice loss 0.3 dB.

2. Singlemode Fiber:

- a. Shall have a classification of OS1 specified for 1310 nm and 1550 nm.
- b. Shall have a core diameter of between 8 and 9 micrometers and a diameter of 125 micrometers.
- c. Shall have a maximum attenuation of 0.5 dB/km for outside plant cable and 1.0 dB/km for inside plant cable at 1310 nm and 1550 nm.
- d. Shall have a maximum splice loss 0.3 dB.

3. Acceptable Manufacturers:

- a. General Cable

2.3 OPTICAL FIBER TERMINATION EQUIPMENT

- A. Panel shelves and wall mount housing shall be used for combination of splicing pigtails, direct connectorization, or PnP cabling. Shelf shall be designed for use as termination shelf only (direct connector termination) or as splice and termination shelf.
- B. Building cabling shall not terminate directly to equipment. Patch panels shall be installed at both the head end and remote locations. Panels shall be sized to match fiber count of cable being installed as well as allow for future expansion (plus 25%).
- C. Solution shall be able to handle the internal termination of Composite copper DC power and optical fiber cable without the use of 3rd party components. Head end components shall be capable of inclusion of power limiting components that meet NEC requirements.

D. Acceptable Manufacturers:

1. Panduit

2.4 FIBER-OPTIC PATCH CORDS

- A. To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below.
- B. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise.
- C. Optical fiber patch cords shall be available with termination types specified by the system manufacturer.
- D. Acceptable Manufacturers:
 1. Panduit

PART 3 - EXECUTION

3.1 GENERAL PROCESS

- A. Conduct System Planning and Design
 1. Contractor shall design the system in accordance with all requirements listed herein.
 2. Contractor shall obtain a separate low-voltage permit to cover the installation of the two-way radio communication enhancement system.
 3. The fire alarm contractor is responsible for the fire alarm permit application, and integration of the radio communications enhancement system into the fire alarm supervisory notification/alarm panel.
- B. Secure Retransmission Approval
 1. Contractor completes a Retransmission Application for each BDA headend in the system design.
 2. Owner submits Retransmission Application(s) and proposed design documentation to AHJ for approval.
- C. Perform System Installation
 1. Contractor proceeds with installation of the approved system in accordance with the project's plan and schedule.
 2. The two-way radio communication enhancement system should not be activated for optimization and testing without prior AHJ approval.
 3. Integration with supervisory notification/alarm panel(s) must be compliant with the requirements of NFPA72-2013 and must be completed prior to fire alarm and two-way radio communication enhancement system testing.
- D. Perform Pre-Commissioning Activation and Optimization
 1. Contractor posts the Provisional Retransmission Authorization at the headend location(s).
 2. The integrator/installer conducts system activation and optimization in coordination with the AHJ.
- E. Perform Fire Alarm/Two-way Radio Communications Enhancement System Testing
 1. Contractor coordinates scheduling of system testing with the fire alarm contractor at the site. Testing

shall include integrator installer staff, fire alarm contractor staff, Fire Marshal s Office staff and other Owner staff.

2. The test participants conduct NFPA72-2013 compliant coverage testing and supervisory notification/alarm panel testing on the scheduled date.
3. The integrator/installer and Owner staff conduct final dense testing at the donor site(s).

F. Submit As-Built Documentation

1. Contractor provides test results and full system as-built documentation in soft copy (e.g., PDF) format.
2. The Final Retransmission Authorization must be posted at all headend location(s).

3.2 SITE SURVEY

- A. Perform a comprehensive site survey before ordering materials and components.
- B. Obtain and record important data such as existing frequencies being used by other applications in the area, future wireless deployments in the area, signal levels, noise levels, possible range and coverage, existing obstructions, future obstructions, etc.

3.3 INSTALLATION

- A. Install materials and equipment in accordance with manufacturer s installation instructions. Refer conflicts between manufacturer s recommendations and Contract Documents to Owner s Representative for resolution.
- B. The Contractor shall adhere to all work and safety requirements while working at the job site.
- C. The Contractor shall have a DAS project foreman on site overseeing the installation.
- D. The Contractor shall have at a minimum one Project Manager on staff overseeing the project. The Project Manager will be responsible for the following:
 1. Developing and maintaining a project plan consistent with the overall milestones of the project.
 2. Overseeing and coordinating the activities of the DAS project, including: initiating and holding weekly project meetings as required, as well as maintaining and distributing meeting minutes.
 3. Act as the point-of-contact interface for all DAS project activities.
 4. Provide weekly status updates regarding work performed, worked scheduled, open items, problems/issues and resolutions.
- E. The Contractor shall be prepared to deploy the DAS in a phased approached as dictated by the building construction and/or work of other trades.
- F. Installation shall be accordance with FCC regulations, EIA/TIA 568-B.1, 568-B.2 and 568-B.3 standards and manufacturer s design and installation guidelines.
- G. Power Separation: Do not place distribution cabling alongside power lines, or share same conduit, channel or sleeve with electrical apparatus.
- H. Bonding and Grounding
 1. Follow active distribution equipment manufacturer s specifications and recommendations for grounding and bonding equipment.
 2. Grounding and Bonding: In accordance with ANSI-J-STD-607-A, NEC, NFPA, and local codes and practices.

3.4 FIELD QUALITY CONTROL

- A. Contractor shall provide facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as required by Contract Documents including, without limitation:
 - 1. Cable plant installation according to standards.
 - 2. Equipment properly grounded and bonded according to manufacturer s recommendations.
 - 3. Verify that cable plant and active equipment are labeled correctly.
 - 4. Cable`s are properly tested for specific category.
 - 5. Cable type is suitable for its environment.

3.5 LABELING

- A. All components and cables shall be labeled to permit easy identification of components and cable connections.
- B. All labeling shall be clear, securely affixed, and consistent on both ends of each installed cable.
- C. All identification information appearing on cables and devices shall correspond to the identifications of said cables and devices appearing on record drawings.

3.6 COMMISSIONING TESTING

- A. Contractor shall perform a commissioning test in accordance with the requirements of Montgomery County, MD to ensure that the coverage meets the minimum coverage requirements of this specification.
- B. Contractor shall coordinate the commissioning test with the Owner as well as Montgomery County.

END OF SECTION

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SECTION 281000 - ACCESS CONTROL

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. This section includes the minimum requirements for equipment and installation of Access Control System hardware at the new Leggett Math and Science Building at Montgomery College.
- B. Contractor shall provide all readers, reader interfaces, access control panels, and all other hardware and software necessary to provide a full, complete and functioning system.
- C. All equipment, software, licenses, etc. shall be compatible with the Lenel On-Guard access control system.
- D. Contractor shall provide all licenses required by any manufacturer in order to provide a fully functioning system.
- E. Contractor shall fully configure the existing system so that it incorporates all of the items included in the construction of the new facility. Contractor shall coordinate with the Owner prior to this configuration to determine naming conventions, access rights, time schedules, and any other parameters available on the system.

1.2 QUALITY ASSURANCE

- A. All equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the Specification shall be subject to the control and approval of the Owner's Representative. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based on the acceptable manufacturers listed.
- B. Materials and work specified herein shall comply with the applicable requirements of:
 - 1. Underwriters Laboratory or equivalent
 - 2. Federal Communications Commission
 - 3. National Electric Code (NEC)

1.3 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of two (2) years following acceptance by the owner.
- B. If within two (2) years after the date of substantial completion, any of the work or equipment is found to be defective or not in compliance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor.
- C. The Owner shall give notice to the Contractor of any defects promptly after the discovery of any defective condition.
- D. These obligations shall survive termination of the construction contract.

1.4 SUBMITTALS

- A. Submit manufacturers data sheets for proposed systems, and equipment.
- B. Submit manufacturers instructions for storage, handling, protection, examination, preparation, operation, and installation of all products. Include any application conditions or limitations of use stipulated by any product testing agency.
- C. Submit all applicable Material Safety Data Sheets.
- D. Submit a detailed bill-of-materials listing all manufacturers, part numbers, and quantities that the Bidder proposes to use in this project.
- E. Submit detailed shop drawings which include the following information (without limitation):
 - 1. Location of all access control devices.
 - 2. Cable types connecting all devices.
 - 3. Mounting details of all devices.
 - 4. The layout of all equipment fields and/or equipment racks.
 - 5. Schematic drawings showing the interconnection of all devices.
- F. Record documents as described in Part 3.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. **Materials and Equipment:** Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place. Equipment shall conform to UL 294 and UL 1076.
- B. **Enclosures:** System enclosures shall be metallic.
 - 1. **Interior Terminal Device:** All terminal devices to be used in an interior environment shall be housed in an enclosure that provides protection against dust, falling dirt, and dripping non-corrosive liquids.
 - 2. **Exterior Terminal Device:** All terminal devices to be used in an exterior environment shall be housed in an enclosure that provides protection against conditions as specified under UL 294 performance requirements for outdoor use equipment, and shall be undamaged by the formation of ice on the enclosure.
 - 3. **Interior Electronics:** All system electronics to be used in an interior environment shall be housed in enclosures meeting the requirements of NEMA 250 Type 12.
 - 4. **Exterior Electronics:** All system electronics to be used in an exterior environment shall be housed in enclosures meeting the requirements of NEMA 250 Type 4. Enclosures exposed to direct sunlight shall be finished with white polyester powder coating; and shall be equipped with a sunshield finished to match the enclosure. Sunshield shall be mounted to protect the top of the

enclosure from direct sun and shall extend at least 1-inch beyond the edges of the enclosure on all sides.

5. Hazardous Environment Equipment: All system electronics to be used in a hazardous environment shall be housed in enclosures which meets the requirements of paragraph "Hazardous Environment."
- C. Tamper Provisions: Enclosures, cabinets, housings, boxes, and fittings of every description having hinged doors or removable covers, and which contain circuits or connections of the ACS equipment or power supplies, shall be provided with cover operated, corrosion resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. Tamper switches shall be mechanically mounted to maximize the defeat time when enclosure covers are opened or removed
- D. Locks and Key-Lock-Operated Switches: All locks required to be installed on system enclosures for maintenance purposes shall be UL listed, round-key type, with three dual, one mushroom, and three plain pin tumblers or conventional key type lock having a combination of five cylinder pin and five-point three position side bar. The locks shall be so arranged that the key can only be withdrawn when in the locked position. All maintenance locks shall be keyed alike and only two keys shall be furnished for all of these locks.
- E. System Component Design: ACS components shall be designed for continuous operation. All electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Circuitry shall not be so densely placed as to impede maintenance
- F. Product Safety: ACS components shall conform to applicable rules and requirements of NFPA 70 and UL 294. ACS components, shall be equipped with instruction plates including warnings and cautions, describing physical safety, and special or important procedures to be followed in operating and servicing ACS equipment.
- G. Special Test Equipment: The Contractor shall provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.
- H. The Contractor shall furnish the ACS complete and ready for operation. The ACS shall operate in a continuous interrogation, control, and response mode.

2.2 FIELD HARDWARE

- A. Intelligent controller
 1. The family of intelligent controllers and peripheral interface devices must provide an open architecture family of products that enables a choice of host software system vendor without replacement of hardware.
 2. The Linux based intelligent controller must provide decision making, event reporting and database storage as a hardware platform. Supports up to 64 doors with peripheral interface devices.
 3. The intelligent controller must communicate with the host via on-board 10BaseT/100BaseTX Ethernet port and support TLS encryption as a minimum security implementation.
 4. The intelligent controller must be capable of elaborate processes and procedures without host intervention. Once configured, the intelligent controller must function independently of the host, and must be capable of controlling access, managing alarms, interfacing with an array of

hardware devices, all while providing the decision-making oversight that each system configuration requires.

5. The controller must provide a fault-tolerant host communication setup in order to efficiently manage a large network of access control panels in any system design.
6. The intelligent controller must provide centralized biometric template management and support a wide range of reader technologies, including OSDP, Wiegand, magnetic stripe and biometric.
7. Controller must support, as a minimum the following open standards, PSIA Area Control, SNMPv3/v2c, OSDP and OSDP SC.
8. The controller must utilize a cryptographic module, like OpenSSL FIPS Object Module RE, that is validated to FIPS 140-2 thus providing a certified implementation of TLS.
9. Connectivity: Connectivity: 10/100 Ethernet. Optional alternate 10/100 Ethernet (using USB/Ethernet converter)
10. Security:
 - a) Host/Controller connection protected by TLS 1.2/1.1 or AES-256/128
 - b) Controller/IO Expansion connection protected by AES
 - c) Generate and load custom peer certificates for TLS
 - d) Port based network access control using 802.1X
 - e) Crypto memory chip
 - f) FIPS 140-2 user of OpenSSL
 - g) HTTPS protection for installer web pages
 - h) Secure cookies
 - i) SNMPv3/v2c
 - j) DIP switch toggle sets 5 minute time to disable webpage access
 - k) Disable default login credentials
 - l) Authorized IP address filtering
 - m) IP Client Proxy
 - n) Bulk erase controller and periphery devices during replacement
 - o) Strong password enforcement
11. Access Control:
 - a) 600,000 Cardholder capacity
 - b) 50,000 Transaction buffer

- c) If/Then Macro capability
 - d) Adjustable cardholder capacity
 - e) Supports up to 1024 inputs and 1024 outputs
12. Card Formats:
- a) 16 card formats per active reader, 8 per offline reader
 - b) Entire card number reported on invalid read
 - c) 19 digit (64-bit) User ID and 15 digit PIN numbers maximum
 - d) PIV, CAC, TWIC card compatible
 - e) 255 Access Levels per cardholder
 - f) Activation/Deactivation Date or Date & Times
13. Card Reader Functions (supported via peripheral interface devices)
- a) Multiple card format support by reader
 - b) Paired reader support
 - c) Alternate reader support
 - d) Elevator support
 - e) Turnstile support
 - f) Biometric device support
 - g) Open Supervised Device Protocol (OSDP) and OSDP SC compliant
 - h) Occupancy count
 - i) Support of multi-occupancy rules
 - j) Anti-passback support
 - 1) Area-based, reader-based, or time based
 - 2) Nested area, hard, soft, or timed forgiveness
 - k) Supports host-based approval rules
 - l) Keypad support with programmable user commands, card input
 - m) Shunt relay support
 - n) Strike follower relay support
 - o) Threat level and Operating Modes

- p) Host controlled OSDP reader passthrough
- 14. Database Functions
 - a) Encrypted database
 - b) Configurable card database
 - c) Supports up to nineteen (19) digital card numbers
 - d) Supports pin codes up to fifteen (15) digits
 - e) Programmable card activation and deactivation times and dates
 - f) Card issue code up to 32 bits, ADA and VIP flags; PIV (75 bits); Smart Card (200 bits)
 - g) Ability to track people and objects
- 15. Intrusion Alarm Functions
 - a) Supports entry delays and exit delays
 - b) Area monitoring
 - c) Standard alarm masking
 - d) Provides control and alarm processing from the keypad
- 16. Supported Integrations
 - a) Regional I/O shares I/O status
 - b) Wireless locks
 - c) Map Power Supply Alarms and Events using PSIA
 - d) Reader firmware and configuration download
 - e) Supports up to 1024 inputs and 1024 outputs
- 17. System Functions
 - a) Relay count activations
 - b) Interoperability with older host software using Legacy Mode feature
 - c) Synchronize time using NTP

2.3 READER INTERFACE

- A. The reader interface shall be a single card reader interface panel dedicated to individual door oversight and provide of all the I/O needed for controlling a single door. Each reader interface shall connect one card

reader, two general-purpose input monitor points and two control relays for access control and security monitoring to an intelligent controller.

B. Features:

1. AES 128/256 bit data encryption
2. HSPD-12/FIPS201 compliant
3. UL 294 recognized, CE compliant, FCC, RoHS
4. Supports OSDP, OSDP Secure Channel, FICAM government profiles, keypads, biometric readers, Wiegand, clock and data, magnetic stripe, F/2F and supervised F/2F reader technologies
5. RS-485 host connectivity
6. Serial I/O

2.4 CARD READER

- A. Provides highly adaptable and secure high frequency access control solution
- B. Support for Open Supervised Device Protocol (OSDP) for secure, bidirectional communication.
- C. Transmit Frequency 13.56 MHz & 125 kHz
- D. 13.56 MHz Card Compatibility: Secure Identity Object SIO on iCLASS Seos, iCLASS SE SR, MIFARE DESFire EV1 and MIFARE Classic,--ISO14443A (MIFARE) CSN, ISO14443B CSN, ISO15693 CSN, - MIFARE Classic and MIFARE DESFire
- E. 125 kHz Card Compatibility HID Prox4, AWID4, Indala, EM41024

2.5 FIELD HARDWARE POWER SUPPLIES

- A. Power Supplies for field hardware shall be designed specifically for the equipment installed. These power supplies shall be regulated, with battery back-up. All power supplies shall be housed in locked enclosures that also allow mounting space for the ISC, ICM, SRI, or other device/panel required.

2.6 WIRE AND CABLE

- A. General: The Contractor shall provide all wire and cable. All wiring shall meet NFPA 70 standards.
- B. Terminal Device Wiring: All device wiring shall meet the requirements of the manufacturer of the device.
- C. Class 2 Low Energy Conductors: The conductor sizes specified for digital functions shall take precedence over any requirements for Class 2 low energy signal circuit conductors specified elsewhere.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all system components in accordance with the manufacturer's instructions, and shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from affecting system operation.
- B. Installation and configuration programming shall be accomplished by Lenel On-Guard certified personnel.
- C. Current Site Conditions: The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Owner. The Contractor shall not take any corrective action without written permission from the Owner.
- D. Where discrepancies in the construction documents or uncertainties in terms of the intent of the documents exist, contractor shall execute a written Request for Information and forward it to the design team. Contractor shall not be relieved of its obligation under these documents due to its failure to request clarification or additional information in a timely manner.
- E. Panels
 - 1. The Control Panel, the Door Reader Modules, expansion boards, and power supplies are to be installed in appropriately sized lockable metal enclosures. The enclosures shall be labeled with the type of component, and the devices served by that component.
 - 2. Contractor to make all required network connections. Any required IP address shall be provided to the contractor by the College for programming of the Network connection.
 - 3. All cable connections to be standard direct cable connections.
- F. Field Devices
 - 1. Card Readers to be mounted as shown on the construction drawings.
 - 2. If any Bosch 160 motion detectors are installed, contractor shall wire and make operational the sounder included in the device.
- G. System Programming
 - 1. All programming shall be provided by Lenel On-Guard certified programmer.
 - 2. Contractor shall meet with appropriate College personnel to establish the base system programming required for the ACS.
 - 3. Contractor shall document these requirements for review, comment, and approval by the Owner and the Design Team.
 - 4. Upon approval of the configuration requirements, contractor shall configure the systems as documented.

3.2 SYSTEM STARTUP

- A. The Contractor shall not apply power to the ACS until after:
1. ACS equipment items have been set up in accordance with manufacturer's instructions.
 2. A visual inspection of the ACS has been conducted to insure that defective equipment items have not been installed and that there are no loose connections.
 3. System wiring has been tested and verified as correctly connected as indicated.
 4. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
 5. Power supplies to be connected to the ACS have been verified as the correct voltage, phasing, and frequency as indicated.
 6. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 PERFORMANCE REQUIREMENTS

- A. General: The Contractor shall perform pre-delivery testing, site testing, and adjustment of the completed ACS. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
- B. Contractor's Field Testing: The Contractor shall calibrate and test all equipment, verify operation, place the integrated system in service, and test the integrated system.
- C. Performance Verification Test: The Contractor shall demonstrate that the completed ACS complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown.

3.4 RECORD DOCUMENTATION

- A. Prior to final acceptance of the work, the Contractor shall submit two (2) sets of record documentation.
- B. Record documentation shall include:
1. Floor plan drawings indicating device locations and wire routing.
 2. Functional block diagrams.
 3. List of all IP addresses utilized along with the device to which each address is assigned.
 4. Drawings shall be provided in both hard copy and in electronic format. The electronic format shall be the most recent version of AutoCAD.
- C. Record documentation shall also include operation and maintenance manuals for all components of the system. Manuals shall include:
1. Installation and Service manuals.

2. Operating manuals.
3. If not included in the above manuals, the Contractor shall provide:
 - a) Power up and power down procedures.
 - b) Programming procedures.
 - c) Maintenance schedules.
 - d) Diagnostic procedures.

END OF SECTION

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

1.1 SUMMARY

- A. System Description: Noncoded, UL-certified FM Global-placarded addressable system with automatic sensitivity control of certain smoke detectors and with multiplexed signal transmission.

1.2 QUALITY ASSURANCE

- A. Quality Standard: NFPA 72.
- B. Installer Qualifications: Certified by NICET as fire-alarm Level II Level III Level IV technician.

1.3 SYSTEMS OPERATIONAL DESCRIPTION

- A. Signal initiation from:
 - 1. Manual stations.
 - 2. Heat detectors.
 - 3. Flame detectors.
 - 4. Smoke detectors.
 - 5. Duct smoke detectors.
 - 6. Air-sampling smoke-detection system (VESDA).
 - 7. Carbon monoxide detectors.
 - 8. Combustible gas detectors.
 - 9. Automatic sprinkler system water flow.
 - 10. Preaction system.
 - 11. Fire-extinguishing system operation.
 - 12. Fire standpipe system.
 - 13. Dry system pressure flow switch.
 - 14. Fire pump running.
 - 15. Insert alarm-initiating devices and systems.
- B. Signal initiates the following actions:
 - 1. Continuously operate alarm notification appliances, including voice evacuation notices.
 - 2. Identify alarm at the fire-alarm control unit and remote annunciators.
 - 3. Transmit an alarm signal to the remote alarm receiving station.
 - 4. Unlock electric door locks in designated egress paths.
 - 5. Release fire and smoke doors held open by magnetic door holders.
 - 6. Activate voice/alarm communication system.
 - 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 - 8. Activate smoke-control system at firefighters' smoke-control system panel.
 - 9. Activate stairwell and elevator shaft pressurization systems.
 - 10. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 - 11. Activate preaction system.
 - 12. Recall elevators.
 - 13. Activate elevator power shunt trip.
 - 14. Activate emergency lighting control.
 - 15. Activate emergency shutoffs for gas and fuel supplies.
 - 16. Record events in the system memory.
 - 17. Record events by the system printer.
 - 18. Indicate device in alarm on the graphic annunciator.
 - 19. <Insert signal-initiating actions>.
- C. Supervisory signal initiation by:
 - 1. Valve supervisory switch.
 - 2. High- or low-air-pressure switch of a dry-pipe sprinkler system.
 - 3. Alert and Action signals of air-sampling detector system.
 - 4. Elevator shunt-trip supervision.
 - 5. Fire pump running.
 - 6. Fire-pump loss of power.
 - 7. Fire-pump power phase reversal.
 - 8. Independent fire-detection and -suppression systems.

9. User disabling of zones or individual devices.
 10. Loss of communication with any panel on the network.
 11. <Insert supervisory signal-initiating devices and actions>.
- D. Trouble signal initiation by:
1. Open circuits, shorts, and grounds, in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 4. Loss of primary power at fire-alarm control unit.
 5. Ground or a single break in fire-alarm control unit internal circuits.
 6. Abnormal ac voltage at fire-alarm control unit.
 7. Break in standby battery circuitry.
 8. Failure of battery charging.
 9. Abnormal position of any switch at the fire-alarm control unit or annunciator.
 10. Voice signal amplifier failure.
 11. Hose cabinet door open.
 12. <Insert trouble signal-initiating devices and actions>.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliances and annunciate at fire-alarm control unit[and remote annunciators]. Record the event on system printer.

1.4 PRODUCTS

- A. Fire-Alarm Control Unit: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, addressable initiation device circuits, and addressable control circuits.
1. Alphanumeric liquid-crystal display with one two three line(s) of 40 80 characters and system controls and keypad.
 2. Initiating Device, Notification Appliance, and Signaling-Line Circuits:
 - a. Pathway Class Designations: Class A Class B Class C Class D Class E.
 - b. Pathway Survivability: Level 0 Level 1.
- B. Stairwell [and elevator shaft]pressurization.
- C. Smoke-alarm verification.
- D. Manual Fire-Alarm Boxes: Single Double action.
- E. System Smoke Detectors: Base mounted, four two-wire type, self-restoring, with integral visual-indicating light and remote controllability from fire-alarm control unit.
- F. Projected beam smoke detectors.
- G. Nonsystem single-station [duct]smoke detectors.
- H. Heat Detectors: Combination type Fixed-temperature type Continuous linear heat-detector system.
- I. Carbon monoxide detector.
- J. Multicriteria detectors.
- K. Air-sampling smoke detector.
- L. Elevator recall initiated by elevator lobby, elevator machine room, or elevator hoistway detectors.
- M. Preaction system.
- N. Notification Appliances:
1. Audible appliances.
 2. Electric-vibrating-polarized type, 24-V dc horns.
 3. Xenon strobe lights.
 4. Flush -mounted voice/tone speakers.
 5. Exit marking audible notification appliance.
- O. Firefighters' telephones.
- P. Firefighters' smoke-control system.

- Q. Magnetic Door Holders: Wall- or floor-mounted units; 24-V ac or dc 120-V ac.
- R. Graphic annunciator.
- S. Remote annunciator.
- T. Addressable Interface Device: Microelectronic monitor module with integral relay to initiate elevator recall shut down power Insert functions.
- U. Digital alarm Radio alarm transmitter.
- V. System printer.
- W. Welded wire mesh device guards.
- X. Network communications for fire-alarm system interconnection and for connection to building automation system.
- Y. Maintenance Service: 12 months' full maintenance.
- Z. Software Service Agreement: Two years.

END OF SECTION 284621.11

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SECTION 321216 - ASPHALT PAVING

1.1 SUSTAINABILITY REQUIREMENTS

A. **LEED v4:**

1. Recycled content.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements: **In accordance with the standards and specifications of Maryland State Highway Administration.**

1.3 MATERIALS

A. Asphalt Materials:

1. Asphalt Binder: **AASHTO M 320**, performance graded.
2. Asphalt Cement: **In accordance with the standards and specifications of Maryland State Highway Administration.**
3. Tack Coat: **In accordance with the standards and specifications of Maryland State Highway Administration.**

B. Auxiliary Materials:

1. Herbicide.

- C. Asphalt Mixes: **Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by Maryland State Highway Administration and complying with the following requirements.**

1. Base Course: **9.5mm Superpave.**
2. Surface Course: **19mm Superpave.**

1.4 INSTALLATION

- A. Cold Milling: **2 inches.**

- B. Patching Hot-Mix Asphalt Pavement: **Base mix with surface layer.**

- C. Patching Portland Cement Concrete Pavement with Hot-Mix Asphalt:

1. Cracked slabs broken and rolled.
2. Rocking slabs stabilized with pumped asphalt.
3. Badly cracked pavement excavated and **partially filled with base mix, and covered with surface layer.**

- D. Repairs to Existing Pavements: **Leveling course.**

- E. Hot-Mix Asphalt Paving:

1. Subgrade proof rolled.
2. Herbicide applied.

MONTGOMERY COLLEGE PROJECT # FP16-077
MONTGOMERY COLLEGE BUILDING #319
MHEC PROJECT #CC-01-MC16-458
SMITHGROUP #12543.000

MONTGOMERY COLLEGE
LEGGETT BUILDING
ISSUED FOR DESIGN DEVELOPMENT
27 SEPTEMBER 2019

3. **Prime coat over unbound-aggregate base course.**
4. Base Course: 9.5mm Superpave.
5. Surface Course: 19mm Superpave.

1.5 FIELD QUALITY CONTROL

- A. Testing Agency: **Contractor** engaged.

END OF SECTION 321216

SECTION 321313 - CONCRETE PAVING

1.1 QUALITY ASSURANCE

- A. Mockups to demonstrate surface finish, texture, and color; curing; and standard of workmanship.

1.2 SUSTAINABILITY REQUIREMENTS

- A. **LEED v4:**
 - 1. Solar reflectance index.
 - 2. Recycled content.
 - 3. Regional materials.

1.3 PRODUCTS

- A. Concrete, General: **ACI 301**.
- B. Reinforcement:
 - 1. Welded-Wire Reinforcement: **Plain** steel.
 - 2. Reinforcing Bars: **Deformed** steel.
 - 3. Steel bar mats.
 - 4. Joint Dowel Bars: **Plain** steel.
- C. Concrete:
 - 1. Portland Cement Replacement: Use fly ash, slag cement, and silica fume to reduce portland cement by 40 percent.
 - 2. Portland Cement: **White**.
 - 3. Normal-weight aggregate.
 - 4. Air-entraining admixture.
 - 5. Compressive Strength: **4500 psi and 3500 psi** at 28 days.
- D. Detectable Warnings: **Blockouts in concrete for detectable paving units**.

1.4 FINISHING AND CURING

- A. Finishes: **Medium-to-fine-textured broom**.
- B. Cure concrete by **moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these**.

1.5 FIELD QUALITY CONTROL

- A. Testing: By **Contractor-engaged agency**.

END OF SECTION 321313

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SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

1.1 JOINT SEALANTS

A. Joints within concrete paving.

1. Location: **Expansion and isolation joints.**
2. Sealant:
 - a. Single component, nonsag, silicone,
 - b. Single component, self-leveling, silicone
 - c. Multicomponent, nonsag, urethane
 - d. Single component, pourable, urethane
 - e. Multicomponent, pourable, urethane
 - f. Hot applied, single component.
3. Color: **Manufacturer's standard.**

B. Joints within concrete paving and between concrete and asphalt paving.

1. Location: **Joints between concrete and asphalt paving, and Joints between concrete curbs and asphalt paving.**
2. Sealant: **Hot applied, single component.**
3. Color: **Manufacturer's standard.**

1.2 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: **Round backer rods for cold- and hot-applied joint sealants.**

END OF SECTION 321373

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SECTION 321713 - PARKING BUMPERS

1.1 SUMMARY

- A. **Concrete** wheel stops.

1.2 SUSTAINABILITY REQUIREMENTS

- A. **LEED v4:**
 - 1. Recycled content.

1.3 INSTALLATION

- A. Wheel stops anchored with galvanized-steel hardware.

END OF SECTION 321713

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SECTION 321723 - PAVEMENT MARKINGS

1.1 QUALITY ASSURANCE

- A. Regulatory Requirements: **In accordance with the Standards and Specifications of the Maryland State Highway Administration.**

1.2 MATERIALS

- A. Pavement-Marking Paint: **Alkyd**, latex or thermoplastic type.

1.3 INSTALLATION

- A. Paving aged **30** days before marking.
- B. Graphic symbols and lettering made with stencils.

END OF SECTION 321723

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SECTION 321726 - TACTILE WARNING SURFACING

1.1 QUALITY ASSURANCE

- A. Accessibility Requirements: **The U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities.**

1.2 SUSTAINABILITY REQUIREMENTS

A. **LEED v4:**

1. Recycled content.
2. Regional materials.

1.3 MATERIALS

- A. Detectable Warning Concrete Unit Pavers: Solid paving units, made from normal-weight concrete.

1. Shapes and Sizes:

- a. Face Size: Nominal **12 by 12 inches.**

- B. Setting Bed: **Aggregate.**

END OF SECTION 321726

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SECTION 323116 - WELDED WIRE FENCES AND GATES

PART 1 - GENERAL

1.1 PERFORMANCE REQUIREMENTS

- A. Wind Loading: ASCE/SEI 7.
- B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms.

1.2 QUALITY ASSURANCE

- A. Mockups.

1.3 METALLIC-COATED-STEEL WIRE FENCES

- A. Fence Fabric: Electro-forged welded steel panel.
 - 1. Spacing of Vertical Wires: 2-3 8"
 - 2. Spacing of Horizontal Wires: 5-3 16"
- B. Posts: Rectangular tubes 2-3 16" x 1-5 8" formed from metallic-coated steel sheet or steel sheet that is hot-dip galvanized after fabrication.
- C. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.
- D. Finish: Powder coating. Color: Black (Manufacturer's standard).

1.4 GATES

- A. Horizontal-Slide Gate Configuration: Double leaf.
 - 1. Cantilever style gate with matching fence fabric panels.

1.5 INSTALLATION

- A. Post Setting: In concrete.
- B. Grounding and Bonding: NFPA 780.

1.6 FIELD QUALITY CONTROL

- A. Grounding-Resistance Testing: Engage a qualified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Products specified herein are components of the "MFR Gate System", and produced by MFR Manufacturing Corp, Inc. Aurora, IL 60506, Tel: 815-472-9154, Fax: 815-552-3315, Website: www.mfrcorp.com
- B. Grigliato A 8 Ht. Fencing System with Cantilever Gate

END OF SECTION

SECTION 329113 - SOIL PREPARATION

1.1 PRECONSTRUCTION TESTING

- A. Preconstruction testing of existing, on-site soil] by Contractor's testing agency.

1.2 SUSTAINABILITY REQUIREMENTS

- A. LEED v4:
 - 1. Regional materials.

1.3 MATERIALS

- A. Planting soils produced by modifying the following soil sources:
 - 1. Existing, On-Site Surface Soil Stockpiled On-Site: 1 type(s) of planting soil.
 - 2. Manufactured Soil: 2 type(s) of planting soil.

1.4 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavate soil to a depth of 6 inches and stockpile until amended.
- B. Remove large over 3" and deleterious materials.

1.5 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. Till or rip subgrade to depth of 18 inches.
- B. Spread unamended soil to depth specified on soils plan and amend in place.
- C. Compact each lift of planting soil.

1.6 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE

- A. Till or rip subgrade to depth of 18 inches.
- B. Spread planting soil to depth specified on soils plan.
- C. Compact each lift of planting soil.

1.7 BLENDING PLANTING SOIL IN PLACE

- A. Till unamended, existing soil to depth of 8 inches.
- B. Apply amendments and blend.

- C. Compact blended planting soil.

1.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor engaged.

END OF SECTION

SECTION 329200- TURF AND GRASSES

PART 1 - GENERAL

1.1 SUMMARY

- A. Sodded turf.

1.2 QUALITY ASSURANCE

- A. Installer's Personnel Certifications: Certified Turfgrass Professional, CTP.
- B. Soil analysis of each un-amended soil type.

1.3 MAINTENANCE SERVICE

- A. Turf: 60 days from date of Substantial Completion

1.4 MATERIALS

- A. Turfgrass Sod: Turf Type Tall Fescue and Kentucky Bluegrass blend.
- B. Planting Soils: see 329113 Soil Preparation.
- C. Fertilizers.

END OF SECTION

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SECTION 329300 - PLANTS

1.1 QUALITY ASSURANCE

- A. Installer's Personnel Certifications: Certified Landscape Technician, CLT-Exterior.
- B. Soil analysis of each un-amended soil type.

1.2 WARRANTY

- A. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
- B. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.

1.3 MAINTENANCE SERVICE

- A. Trees and Shrubs: 12 months.
- B. Ground Cover and Other Plants: 12 months.

1.4 MATERIALS

- A. Plants, General: Nursery-grown and complying with ANSI Z60.1.
- B. Annuals and Biennials: Healthy and acclimated to outdoor conditions.
- C. Planting Soils: Existing, native surface topsoil with duff layer retained or Imported manufactured soil, amended with inorganic and organic soil amendments and fertilizers in specified quantities.
- D. Lightweight On-Structure Intensive Planting Media: Modified Intensive planting media formulated for the Mid-Atlantic Region. 24-48" depth for Intensive areas; 12" depth for roof meadow areas.
- E. Mulches: Shredded hardwood.
- F. Weed-Control Barriers: Non-woven fabric.
- G. Pesticides: Registered and approved by EPA pre-emergent and post-emergent herbicides.
- H. Tree Stabilization at Grade: Root-ball stabilization hardwood stakes—see planting details.
- I. Planter drainage gravel and filter fabric.

1.5 INSTALLATION

- A. Planting Soil Depth: 12 inches-48"
- B. Mechanized tree spade planting of designated trees.
- C. Pruning.

- D. Ground Cover and Plant Planting: Space ground cover and plants other than trees, shrubs, and vines as indicated in plant list in even rows with triangular spacing.

- E. Mulching:
 - 1. Trees in Turf Areas: Organic mulch ring of 2-inch thickness with 12-inch radius.
 - 2. Planting Areas: 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area.

END OF SECTION

