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IN128 JAMES T. MORRIS ARENA – ADDENDUM-02

RATIO PROJECT	23112. IUI ATHLETICS AND CONVOCATION CENTER
DATE	February 03, 2025
SUBJECT	Addendum 02

SPECIFICATIONS

- SECTION 003132 – GEOTECHNICAL DATA

Insert Section 003132 Geotechnical Data and Geotechnical Report into the Project Manual.

- SECTION 004113 – BID FORM

Replace existing bid form with attached.

- SECTION 012300 – ALTERNATES

Insert Section 012300 Alternates into the Project Manual.

- SECTION 055900 – EXPANDED METAL WALL STRUCTURE

Insert Section 055900 Expanded Metal Wall Structure into the Project Manual.

- SECTION 074213.13 – FORMED METAL WALL PANELS

Delete Section 074213.13 Formed Metal Wall Panels from the Project Manual.

- SECTION 074213.19 – INSULATED METAL WALL PANELS

Insert Section 07213.19 Insulated Metal Wall Panels into the Project Manual.

- SECTION 074800 – RAINSCREEN ATTACHMENT SYSTEM

Insert Section 074800 Rainscreen Attachment System into the Project Manual.

- SECTION 084423 – STRUCTURAL SEALANT GLAZED CURATIN WALLS

Insert item 2.2.A.4 as follows:
“4. Tubelite Architectural Framing Systems.”

- SECTION 092400 – CEMENT PLASTERING

Insert Section 092400 Cement Plastering into the Project Manual.

- SECTION 092900 – GYSUM BOARD

Insert item 1.1.A.3 as follows:
“3. Impact resistant board.”
Insert item 1.1.A.4 as follows:

“4. Partition gap closure.”
Delete item 1.2.A.7
Delete item 1.2.A.8
Delete item 1.2.A.17
Insert item 1.2.A.18 as follows:
“18. Partition gap closure.”
Insert item 2.5.C.7 as follows:
“7. Coordinate with metal stud framing for minimum thickness required by manufacturer.”
Insert paragraph 2.5.D as follows:
“D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.
1. Core: 5/8 inch (15.9 mm), Type X.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds [Level 2] [Level 3] requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds [Level 1] [Level 2] [Level 3] requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds [Level 1] [Level 2] [Level 3] requirements.
5. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds [Level 1] [Level 2] [Level 3] requirements according to test in Annex A1.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
8. Coordinate with metal stud framing for minimum thickness required by manufacturer.”
Insert item 2.6.B.3 as follows:
“3. Application: Shower walls or steam room walls.”
Insert paragraph 2.7.C as follows:
“C. Partition Gap Closure: Accessory for partitions meeting exterior wall vertical aluminum window mullions: Two- piece, adjustable aluminum extrusion profile, with manufacturer provided adhesive strips and partition extruded aluminum end caps.
1. Basis of Design Product: Gordon Inc Product Name: “Mullion Mate” Adjustable Partition Closure. An adjustable, spring-loaded 2 inch wide partition closure that provide trim between window and partition walls.
2. Aluminum partition closures shall be pre-assembled and spring loaded to provide a tight fit for vertical junctures of partitions and window walls. Mullion Mate is finished to match mullions in a spray applied water-borne cross-linked baked acrylic finish or Acrylic-Polyester hybrid powder coat paint finish or custom paints or anodized finish. They are sound tested to a 38 STC rating with optional acoustical batts for sound attenuation.
3. Performance Requirements:
a. Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable.
b. Aluminum extrusions: 6063-T5 temper, tensile strength 31 KSI (ASTM B 221, ASTM B 221 M).
c. Extrusion Lengths: Lengths up to 10', splicing vertical closures is not allowable.
d. Surface Finish: Acrylic-Polyester hybrid powder coat paint finish custom colors to match color of the adjacent aluminum window extrusion, as approved by the Architect from range samples provided by the Contractor.
e. Insulation and Sound Attenuation: Mullion closures fitted with mineral wool batt insulation by Thermafiber Inc. or Roxul, Inc.

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f. Filler Insulation Density: Not less than 4 lb/cu.ft. nominal density filling entire cavity of mullions when fitted in final set position.
g. Flame Spread: Maximum flame-spread and smoke-developed indexes of 25 and 50 respectively.
h. Sound Rating: not less than STC 38.
i. Closure Gasket to Partition: Manufacturer's standard extrusion Gordons, Inc. "Final Form Series 911" to finish partition ends.
j. Compressible Fittings: UV resistant neoprene closure gaskets on both sides of vertical closures, adhesively attached, profile fitting depth, forming a tight-fitting, light-proof, durable closure.
4. Contractor shall follow the installation guidelines for closures as recommended by the manufacturer and as indicated on the Drawings."
Insert item 3.3.A.4 as follows:
"4. Impact-Resistant Type: As indicated on Drawings."

- <u>SECTION 093000 – TILING</u>

Delete paragraph 2.3.B in its entirety.
Insert item 2.4.B.2 as follows:
"2. Application: Shower walls."

- <u>SECTION 093015 – GAUGED PORCELAIN TILE PANELS</u>

Insert Section 093015 Gauged Porcelain Tile Panels into the Project Manual.

- <u>SECTION 095113 – ACOUSTICAL PANEL CEILINGS</u>

Delete paragraph 2.3.D in its entirety.
Delete paragraph 2.3.E
Delete paragraph 2.3.F in its entirety.

- <u>SECTION 096723 – RESINOUS FLOORING</u>

Modify item 1.2.A.1 as follows:
"1. Cementitious urethane resinous flooring systems."
Delete item 2.3.A.1.a
Delete item 2.3.A.1.c
Delete item 2.3.A.1.f
Delete item 2.3.A.1.g
Modify paragraph 2.3.B as follows:
"B. Basis of Design: Duraflex, Poly-Crete SLB, or approved equivalent by listed manufacturers."
Modify item 2.3.G.1 as follows:
"1. Resin: Cementitious Urethane with natural quartz aggregate."
Modify paragraph 2.3.H as follows:
"H. Topcoats: Sealing "
Modify item 2.3.H.1 as follows:
"1. Basis of Design: DuraGlaze Novolac"
Delete item 2.3.H.6
Modify item 2.3.H.8 as follows:
"8. Grit: Natural Quartz."
Modify item 3.2.D.1 as follows:
"1. Integral Cove Base: 4 inches high with stainless steel termination angle."

- <u>SECTION 097723 – FABRIC WRAPPED PANELS</u>

Delete Section 097723 Fabric Wrapped Panels from the Project Manual.

- <u>SECTION 098433 – SOUND ABSORBING WALL UNITS</u>

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Delete Section 098433 Sound Absorbing Wall Units from the Project Manual.

- SECTION 099713 – STRETCHED-FABRIC WALL SYSTEMS

Insert Section 099713 Stretched Fabric Wall Systems into the Project Manual.

- SECTION 102400 – ARCHITECTURAL ROOF SCREENS

Delete Section 102400 Architectural Roof Screens from the Project Manual.

- SECTION 102600 – WALL AND DOOR PROTECTION

Delete item 1.2.A.2
Delete item 1.3.D.2
Delete item 1.7.A.2
Delete Article 2.4 ABUSE RESISTANT WALL COVERINGS in its entirety.
Delete paragraph 2.5.A
Delete paragraph 2.5.B
Delete paragraph 3.3.C

- SECTION 116623 – GYMNASIUM EQUIPMENT

Insert Section 116623 Gymnasium Equipment into the Project Manual.

- SECTION 126100 – FIXED AUDIENCE SEATING

Modify item 1.2.A.1 as follows:
"1. Riser mounting."
Insert item 1.2.A.2 as follows:
"2. Upholstered chairs."
Insert item 1.4.E.5 as follows:
"5. Upholstery Fabric: Full with long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric."
Modify item 1.7.A.2.c as follows:
"c. Electrical Components: One years."
Modify item 1.7.A.2.d as follows:
"d. Plastic, and Paint Components: Five years. "
Insert paragraph 2.2.A as follows:
"A. Fire-Test-Response Characteristics of Upholstered Chairs:
1. Fabric and Padding:
a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.
b. Padding: Comply with California Technical Bulletin 117-2000."
Modify paragraph 2.3.B as follows:
"B. Chair Mounting Standards: Riser attached of the following material:"
Modify paragraph 2.3.C as follows:
"C. Chair Mounting Beam: Steel horizontal beam mounted on riser-attached steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths."
Modify paragraph 2.3.D as follows:
"D. Fabric Upholstered Chairs: "
Modify item 2.3.D.1 as follows:
"1. Back:"
Insert item 2.3.D.1.a as follows:
"a. Padding Thickness: 2 inches."
Insert item 2.3.D.1.b as follows:
"b. Outer Back Surface: Polyethylene, with fasteners."
Insert item 2.3.D.1.c as follows:
"c. Top Corners: Rounded."

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Modify item 2.3.D.2 as follows:
"2. Seats: Seats shall be padded and upholstered on their top surface with an engineered polymer seat foundation. Seats shall self-rise to a uniform position when unoccupied. Two part top and bottom construction and as follows:"
Insert item 2.3.D.2.a as follows:
"a. Top Padding Thickness: Minimum 3 inches at front and rear edges."
Insert item 2.3.D.2.b as follows:
"b. Seat Bottom: Engineered polymer, strengthened by deep internal ribs and gussets, completely enclosing the self-rising hinge mechanism. "
Insert item 2.3.D.3 as follows:
"3. Fabric: As selected by Architect from manufacturer's full range."
Modify paragraph 2.3.G as follows:
"G. Back Pitch: Fixed "
Delete item 2.3.G.2
Modify paragraph 2.3.L as follows:
"L. LED Aisle Light: In quantity and arrangement per Drawings EL-102A through EL-102D and of the type indicated on Drawing E-008."
Modify item 2.3.L.1 as follows:
"1. Mounting: Top center of polypropylene aisle panels to provide illumination of the aisle panel and adjacent floor and/or steps."
Insert paragraph 2.3.M as follows:
"M. Cup Holders: Provide chair mounted plastic cup holders unless seating layout doesn't allow or railing impedes use of cup holder. Attach to back of chair assembly with concealed hardware."
Insert paragraph 2.3.N as follows:
"N. Accessible Seating:
1. Designated on the seating layout drawings and designed to allow an individual to transfer from a wheelchair to the chair. Equip aisle standard with an armrest capable of lifting to a position parallel with the support column, opening sideways access to the seat. Equip aisle standards with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards."
Insert Article 2.4 UPHOLSTERED CHAIRS as follows:
"2.4 UPHOLSTERED CHAIRS
A. Description: Upholstered seating.
B. Ergonomic lumbar support.
C. Width: 21 inches.
D. Enclosed Back.
E. Fabric: As selected by Architect from manufacturer's full range."
Insert Article 2.5 BENCH SEATING WITH BACKRESTS as follows:
"2.5 BENCH SEATING WITH BACKRESTS
A. Provide bench seating with back rests where indicated on cast-in-place concrete.
B. Seat Systems:
1. Provide plastic modular 18 inch individual seats in 12 inch deep models. Seating to be scuff resistant injection molded high density polyethylene plastic.
2. Seat heights shall be maintained at a minimum of 16 ¾ inches.
3. Color: As selected by Architect from Manufacturer's full range.
C. Fold-Down Backrests.
1. Provide molded contoured back rests, manually fold and store on the deck without the need for removal. Injection molded plastic backrest attached to a clear anodize d aluminum rail, using concealed fasteners."
Insert paragraph 2.6.B as follows:

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“B. Fabric: Manufacturer's standard 100 percent polyolefin with flame-retardant treatment if required to meet performance requirements.
1. Weight: 18 oz./linear yd..
2. Color and Pattern: As selected by Architect from manufacturer's full range.”
Insert paragraph 2.6.C as follows:
“C. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.”
Insert paragraph 2.7.B as follows:
“B. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.”
Insert paragraph 2.7.C as follows:
“C. Upholstered Chairs: Fabricate as follows:
1. Two-Part Upholstered Back: Padded cushion glued to a curved steel plywood or molded-plastic inner panel and covered with easily replaceable fabric; with curved steel or molded-plastic outer back shell that fully encloses upholstery edges.”
Insert paragraph 3.4.F as follows:
“F. Replace upholstery fabric damaged during installation or work of other trades.”

- <u>SECTION 126600 – TELESCOPING STANDS</u>

Revise Item 1.2.A.1 as follows:
“1. Telescoping stands with upholstered folding chairs and bench seating.”
Insert item 1.3.B.1 as follows:
“1. Uniformly Distributed Live Load: Not less than 100 lbs per sq. ft. of gross horizontal projection.”
Insert item 1.3.B.2 as follows:
“2. Seat Boards and Footrest: Live Load of not less than 120 lbs per linear ft.”
Insert item 1.3.B3 as follows:
“3. Sway Force: 24 lbs per linear ft. parallel to the seats and 10 lbs per linear ft perpendicular to the seats. Sway forces not to be considered simultaneously applied.”
Insert item 1.3.B.4 as follows:
“4. Handrails shall be designed and constructed for:
a. A concentrated load of 200 lbs. (890 N) applied at any point and in any direction.
b. A uniform load of 50 lbs. per ft. (730 N/m) applied in any direction. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.”
Insert item 1.3.B.5 as follows:
“5. Guards shall be designed and constructed for:

a. A concentrated load of 200 lbs. (890 N/m) applied at any point and in any direction along the top railing member and; a uniform load of 50 lbs. per ft. (730 N/m) applied horizontally at the required guardrail height and simultaneous uniform load of 100 lbs. per ft. (1460 N/m) applied vertically downward at the top of the guardrail. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.”

Insert Item 1.3.C. as follows:
“C. Fire-Test-Response Characteristics of Upholstered Chairs:
1. Fabric and Padding:
a. Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.

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b. Padding: Comply with California Technical Bulletin 117-2000."
Insert Item 1.4.E.4. as follows:
"4. Upholstery Fabric: Full with long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric."
Insert Article 1.8 REFERENCE STANDARDS as follows:
"1.8 REFERENCE STANDARDS
A. American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI) and Aluminum Association (AA) design criteria shall be the basis for calculation of member sizes and connections.
B. Wood members shall be designed in accordance with National Forest Products Association, (NFOPA), and National Design Specification for Wood Construction."
Insert paragraph 2.3.B as follows:
"B. Back Rest for Bench Seating: Folding backrests permanently attached to bench units.
1. Material: Molded plastic with contour support surface in color matching seat.
2. Operation: Semi-Automatic with foot release lever.
3. Location: Where indicated on Drawings."

Insert paragraph 2.3.C as follows:
"C. Platform Chairs: Beam mounted.
1. Upholstered Seats: Cantilevered, self-centering, automatic three-quarters lift with over center retracting feature. Coordinate aesthetic with seating for fixed seating specified in Section 126100 "Fixed Audience Seating".
a. Upholstery shall be a complete self-retaining unit, welded to the seat and back surfaces using a hot plate welding technique.
2. Height: Minimum of 16-3/4 inches.
3. Backs: Textured one-piece gas-assist injection molded pigmented polypropylene shells; withstand evenly distributed front or rear static load of 450 lbs.
4. Armrests: Injection molded plastic, attached to the support structure with concealed fasteners. Include manufacturer's standard cup holders.
5. Color and Fabric: As selected by Architect from Manufacturer's full range to match fixed audience seating.
6. Chair Beam: Shall be constructed of extruded aluminum with polymer end caps and serve as the focal attachment and shall in turn transmit all forces to the beam support.
7. Beam support: Shall be cast steel support arms. Closed seam steel tube standards are unacceptable. Top of support arms shall be designed to capture and secure the beam in place. Support arms articulate from manual assist or semi-automatic operating mechanism."
Modify paragraph 2.3.D as follows:
"D. Deck: .3/4 inch Panelam surface."
Insert item 2.3.D.2 as follows:
"2. Nosing: One piece, formed 14 gage steel with a minimum of G-60 pre-galvanized finish."
Modify paragraph 2.3.F as follows:
"F. Safety Rails: Structural steel with cable infill, finished with manufacturer's standard powder coat system."
Insert item 2.3.F.7 as follows:
"7. Basis of Design: Irwin VersaDeck Cable Rail."

- SECTION 220800 COMMISSIONING OF PLUMBING
  - Insert section into project manual.
- SECTION 230800 COMMISSIONING OF HVAC
  - Insert section into project manual.
- SECTION 230514 ”VARIABLE-FREQUENCY DRIVES FOR HVAC EQUIPMENT”:
    - Remove in its entirety.
- SECTION 230901 ”CIC BUILDING AUTOMATION”:
    - Add subparagraph 2.1 B. as follows:
      - All equipment provided by Siemens will be shipped to the Mechanical Contractor, Sheet Metal Contractor, or Controls Installation Contractors’ shop for installation, wiring and/or tubing. The Mechanical Contractor, Sheet Metal Contractor, or Controls Installation Contractor shall receive, handle, and store all material to be installed under this contract; then transport the materials to the job site. The Mechanical Contractor, Sheet Metal Contractor, or Controls Installation Contractor shall be responsible for verification of quantity received. Any discrepancies shall be reported in writing to Siemens Building Technologies, Inc. within 48 hours of delivery.
    - Add subparagraph 2.1 C. as follows:
      - All variable-frequency motor controllers/drives (VFD) on Project shall be furnished, installed, and wired by Division 26.
- SECTION 232116 ”HYDRONIC PIPING SPECIALTIES”:
    - Add subparagraph 2.2 1 d as follows:
      - Grundfos CBS, Inc.
    - Add subparagraph 2.3 C 1 g as follows:
      - Grundfos CBS, Inc.
- SECTION 232123 ”HYDRONIC PUMPS”:
    - Add subparagraph 2.2 A 5 as follows:
      - 5. Grundfos CBS, Inc.
    - Add subparagraph 2.3 A 5 as follows:
      - 5. Grundfos CBS, Inc.
- SECTION 233300 “HVAC DUCT ACCESSORIES”:
    - Remove subparagraph 1.2 A 4.
    - Add subparagraph 2.3 E 4 and 2.3 E 5 as follows:
      - 4. Pottorff.
      - 5. Greenheck.
    - Remove subparagraph 2.4 in its entirety. 2.5 now becomes 2.4, etc.
    - Add subparagraph 2.4 A 5 and 2.4 A 6 as follows:
      - 5. Pottorff.
      - 6. Greenheck.
    - Add subparagraph 2.5 A 5 and 2.5 A 6 as follows:
      - 5. VAW Systems.
      - 6. Price Industries.
    - Remove subparagraph 3.1 G.
- SECTION 233400 “HVAC FANS”:
    - Add subparagraph 2.6 as follows:

    2.6 RELIEF/RETURN AIR FAN ARRAYS
    - Manufacturers:
      - Greenheck.
      - Loren Cook Company.
      - Mainstream Corp.
      - Penn Barry.

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        - Twin City.
        - York.
    - Stacked Array Fan System: Singular product with supportive and connective framing with material matching fan housing.

- SECTION 233439 ”HIGH-VOLUME, LOW SPEED FANS”:
    - Add subparagraph 2.2 A 4 and 2.2 A 5 as follows:
        - 4. SkyBlade.
        - 5. Greenheck.
- SECTION 233713.13 “AIR DIFFUSERS”:
    - Replace subparagraph 2.1 A 5 as follows:
        - 5. Metalaire.
    - Replace subparagraph 2.2 A 5 as follows:
        - 5. Metalaire
    - Replace subparagraph 2.3 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.4 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 1.1 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.5 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.6 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.7 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.8 A 5 as follows:
        - 5. Metalaire
    - Add subparagraph 2.10 A 5 as follows:
        - 5. Metalaire
- SECTION 233713.23 “REGISTERS AND GRILLES”:
    - Specification Section Add subparagraph 2.1 A 1 e as follows:
        - e. Metalaire.
    - Replace subparagraph 2.1 B 1 e as follows:
        - e. Metalaire
    - Replace subparagraph 2.2 A 1 e as follows:
        - e. Metalaire

- SECTION 233723 “HVAC GRAVITY VENTILATORS”:
    - Add subparagraph 2.2 A 4 as follows:
        - 4. ACME.
- SECTION 235700 ”HEAT EXCHANGERS FOR HVAC”:
    - Specification Section
    - Add subparagraph 2.2 A 2 and 2.2 A 3 as follows:
        - 2. Grundfos CBS, Inc.
        - 3. Taco
- SECTION 238219 “FAN COIL UNITS”:
    - Add subparagraph 2.2 A 8 as follows:
        - 8. Krueger.
- SECTION 238245 “CHILLED BEAMS”:
    - Add subparagraph 2.2 A 7 as follows:
        - 7. Krueger.
    - Remove subparagraph 2.4 G.

- SECTION 260800 COMMISSIONING OF ELECTRICAL
    - Insert section into project manual.

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- SECTION 262923 “VARIABLE-FREQUENCY MOTOR CONTROLLERS”:
    - Replace subparagraph 2.1 to as follows:

        2.10 MANUFACTURERS
        - ABB.
        - Allen Bradley.
        - Danfoss.
- SECTION 280800 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY
    - Insert section into project manual.
- ENERGY PERFORMANCE ASSESSMENT
    - Insert energy model report into the project manual as supplemental information
- SECTION 334200 – STORMWATER PUMPING STATIONS
    - Insert section into project manual.

DRAWINGS

GENERAL

- G-002 – SHEET INDEX AND PROJECT LOCATION
    - Add sheets C405-406, C416, C605-606, and C621 to the index.
- G-006 – LIFE SAFETY PLANS
    - A3: Revise steel fire protection notes, see drawing.
- G-007 – LIFE SAFETY PLANS
    - Revise fire protection wall ratings as shown.

CIVIL

- C111 - Demolition Plan
    - Revised pavement, curb, and sidewalk removal extents for installation of water service.
- C200 - Overall Site Plan
    - Revised proposed pavement, curb, and sidewalk limits near southwest corner of the project site
- C210 - Road Plan and Profile
    - Renamed Profile Grade Line “PR-A”.
    - Revised vertical curve geometry
- C300 - Overall Grading Plan
    - Reissue Sheet
- C301 - Grading Plan
    - Fine grading tweaks and coordination
    - Revised grading near southwest corner of the site for water service
    - Revised enlargement limits
- C302 - Grading Plan
    - Fine grading tweaks and coordination
    - Revised enlargement limits
- C303 – Grading Plan Enlargements
    - Revised detailed grading within enlargements for coordination
- C304 - Grading Plan Enlargements
    - Revised detailed grading within enlargements for coordination

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- C400 – Overall Utility Plan
    - Reissue Sheet
- C401 – Utility Plan
    - Storm revisions
    - Revised enlargement
- C402 – Utility Plan
    - Reissue sheet
- C403 – Utility Enlargements
    - Revised enlargements #1 and #3
- C404 – Structure Data Tables
    - Revised Storm Structure Data Table
    - Added clarification to Stormwater Pump Station Specification Table
- C405 & C406 – Duct Bank Crossing
    - Added Duct Bank Crossing Sheets
- C413 – Storm Sewer Plan & Profiles
    - Revised Storm 06 Profile
- C414 – Storm Sewer Plan & Profiles
    - Revised Storm 08 Profile
- C416 – Storm Sewer Plan & Profiles
    - Reissue Sheet
- C420 – Sanitary Sewer Plan & Profile
    - Reissue sheet for CEG Review Comments
- C601 - C605 – Site Details
    - Reissue Sheets
- C606 – Site Details
    - Added Sheet for additional pump details
- C620 – Sanitary Sewer Details
    - Added CEG Detail
- C621 – Sanitary Sewer Details
    - Added CEG Detail
- C622 – Sanitary Sewer Details
    - Reissue

<u>STRUCTURAL</u>

- S-101B – EVENT LEVEL FOUNDATION PLAN – UNIT B
    - Noted footing box out north of loading dock for storm water pump station.
- S-101SB – EVENT LEVEL SLAB PLAN – UNIT B
    - Noted embedded angle at overhead door.
- S-102B – CONCOURSE LEVEL PLAN – UNIT B
    - Adjusted location of foundation wall at NE entry to match architecture.
- S-102C – CONCOURSE LEVEL PLAN – UNIT C
    - Adjusted location of foundation wall at SE entry to match architecture.
- S-103C – UPPER LEVEL PLAN – UNIT C
    - Added angle along grid K to support storefront.
- S-103D – UPPER LEVEL PLAN – UNIT D
    - Added angle along grid K to support storefront.

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- S-105B – HIGH ROOF PLAN – UNIT B
    - Adjusted big fan support locations to match mechanical.
- S-105C – HIGH ROOF PLAN – UNIT C
    - Adjusted big fan support locations to match mechanical.
- S-110 – ENLARGED FOUNDATION PLANS
    - Plan 1 – Noted footing box out for sanitary sewer.
- S-391 – TYPICAL PRECAST SECTIONS AND DETAILS
    - Section 2 – Updated seating anchorage zone to match architecture.
- S-570 – CLADDING BACKUP ELEVATIONS
    - Added notes on tube steel backup for Insulated Metal Panels (IMP).
    - Elevation 7 – Added tube over basement clearstory window.
- S-571 – CLADDING BACKUP ELEVATIONS
    - Added notes on tube steel backup for Insulated Metal Panels (IMP).
    - Elevation 7 and 8 – Adjusted elevation of cladding steel.
- S-577 – CLADDING BACKUP CONNECTION DETAILS
    - Section 6 – Added section for angle along grid K to support storefront.
    - Section 7 – Added detail showing steel backup at IMP.
    - 8, 9, 10, 11 – Added structural requirements for mockup.

<u>ARCHITECTURE</u>

- A-101A- EVENT FLOOR PLAN – AREA A
    - Clarified Location of impact resistant gyp in CIRCULATION 002B
- A-101B – EVENT FLOOR PLAN – AREA B
    - Added lockers in Staff Break 064.
    - Added wall type S1FA.A in FS Commissary Kitchen 063
- A-101D- EVENT FLOOR PLAN – AREA D
    - Clarified Location of impact resistant gyp in CIRCULATION 002B
- A-102A – CONCOURSE FLOOR PLAN – AREA A
    - A1:Remove keynotes for 078123 as shown. Add annotation as shown. Add counter in ticketing area. Add/revise dimensions as shown.
- A-102C – CONCOURSE FLOOR PLAN – AREA C
    - A1: Add notes as shown.
    - Wall shifted in in room 108B
- A-102D – CONCOURSE FLOOR PLAN – AREA D
    - Remove keynotes for 078123 as shown. Add annotation as shown. Revise dimensions as shown.
- A-103A – CONCOURSE FLOOR PLAN – AREA A
    - A1: Add keynote 072119 as shown. Add callouts for access panels. Add air plenum notes as shown.
- A-103C – UPPER FLOOR PLAN – AREA C
    - Revised dimensions of offices PO 201H, 201G, 201D, 201E, & 201F. Added Storage 115L & Door 115L
    - Added plan details
- A-103D – UPPER FLOOR PLAN – AREA D
    - Removed wall at column grid K
    - Added plan details
- A-104A – LOW ROOF PLAN – AREA A
    - A1: Add outside air plenum notes as shown.

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- A-104D – LOW ROOF PLAN – AREA D
  - A1: Revise size of louver. Add dimension as shown.
- A-133A– UPPER FLOOR REFLECTED CEILING PLAN – AREA A
  - Added callout and locations for speaker trim detail
  - Added missing dimensions
- A-133B– UPPER FLOOR REFLECTED CEILING PLAN – AREA B
  - Added callout and locations for speaker trim detail
- A-133C– UPPER FLOOR REFLECTED CEILING PLAN – AREA C
  - Added callout and locations for speaker trim detail
  - Revised dimensions of Ceiling Element in Break Room
  - Revised ceiling layout for rearranged offices
- A-133D– UPPER FLOOR REFLECTED CEILING PLAN – AREA D
  - Added callout and locations for speaker trim detail
  - Revised dimensions of Ceiling Element in Break Room
- A-151A- EVENT FLOOR FINISH PLAN – AREA A
  - Removed WP-01 from Circulation 002B
  - Removed CTB-01 from finish tags in locker rooms – wall tile installs to the floor, no base.
- A-151C- EVENT FLOOR FINISH PLAN – AREA C
  - Changed PC-01 to SC-01 for flooring in Fan Room 054
- A-151D- EVENT FLOOR FINISH PLAN – AREA D
  - Removed CTB-01 from finish tags in locker rooms – wall tile installs to the floor, no base.
- A-153C- UPPER FLOOR FINISH PLAN – AREA C
  - Created finish tag for new Storage room 115L
- A-201 – EXTERIOR ELEVATIONS
  - A1: Add building signage and callout C1/A-325
  - D1: Add callout B1/A-203. Revise louver size as shown.
- A-202 – EXTERIOR ELEVATIONS
  - A1: Add callout D3/A-630
- A-203 – EXTERIOR ELEVATIONS
  - Issue details B1 and C1 for exterior building signage
- A-321 – WALL SECTIONS
  - A4: Notes and keynotes for outside air plenum construction revised, see drawing.
- A-322 – WALL SECTIONS
  - A4: Detail callout revised.
  - B7: Detail callout revised.
- A-323 – WALL SECTIONS
  - A1: Waterproof lines revised.
- A-325 – WALL SECTIONS
  - A1: Add keynote for spray applied fireproofing.
  - A3: Add counter and callout A4/A-358.
  - A5: Add callout A7/A-358, add keynotes, add dimensions as shown.
- A-351 – EXTERIOR DETAILS
  - A4: Dimension revised.
  - C6: Metal stud walls and gypsum walls behind insulated metal wall panel added.
  - D6: Metal stud walls and gypsum walls behind insulated metal wall panel added.
- A-352 – EXTERIOR DETAILS
  - A4: Reissued.
  - A6: Dimension revised.
  - F3: Dimension revised.

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- A-353 – EXTERIOR DETAILS
  - C6: Reissued.
  - C8: Reissued.
  - E6: Reissued.
  - F1: Dimension added.
- A-354 – EXTERIOR DETAILS
  - A1: Notes added.
- A-355 – EXTERIOR DETAILS
  - F1: Reissued.
- A-356 – EXTERIOR DETAILS
  - F3: Dimensions revised.
- A-357 – EXTERIOR DETAILS
  - A1: Reissued.
  - A4: Waterproof membrane added.
  - C1: Detail deleted.
  - C6: Waterproof membrane added.
  - D3: Beam moved down.
  - F1: Reissued.
- A-358 – EXTERIOR DETAILS
  - A4: Issue new detail
  - A7: Issue new detail
- A-370 – EXTERIOR 3D DIAGRAMS
  - A1: Add elevation tags as shown
- A-411 – ENLARGED RESTROOM PLANS
  - Enlarged view to show JAN closet 102A in enlarged plan F1.
  - Added tags for janitor closet shelf & mop & broom holder.
  - Corrected note in lavatory elevations for sink apron to be powdercoat white metal finish and clarifying the sink, counter, and apron as provided by the sink manufacturer (Splashlab).
  - Updated equipment schedule 01D & 02B with corrected descriptions & product numbers.
- A-412 – ENLARGED RESTROOM PLANS
  - Added tags for janitor closet shelf & mop & broom holder.
  - Corrected note in lavatory elevations for sink apron to be powdercoat white metal finish and clarifying the sink, counter, and apron as provided by the sink manufacturer (Splashlab).
  - Updated equipment schedule 01D & 02B with corrected descriptions & product numbers.
- A-413 - ENLARGED RESTROOM PLANS
  - Added tags for janitor closet shelf & mop & broom holder.
  - Corrected note in lavatory elevations for sink apron to be powdercoat white metal finish and clarifying the sink, counter, and apron as provided by the sink manufacturer (Splashlab).
  - Updated equipment schedule 01D & 02B with corrected descriptions & product numbers.
  - Added notes to enlarged plan and elevation for restroom 205
- A-421 - STAIR AND ELEVATOR PLANS AND SECTIONS
  - A1: Add cane rail.
  - A3: Add cane rail.
- A-426 – MONUMENTAL STAIR SECTIONS & DETAILS
  - Included details at landings in view E1 Perf metal stair
  - Updated notes in south stair upper and concourse enlarged plans
- A-501 – INTERIOR ELEVATIONS

- A1: Add keynotes and notes. Updated ticketing window in vestibule view A1 Concourse west.

- A-502 – INTERIOR ELEVATIONS
  - Removed note for AWP-01 and updated wth proper keynote for crash pad specifications section in E1 and E4.
  - A1: Added notes to A1 showing sprinkler line installation. Add keynote 078123 as shown.
- A-503 - INTERIOR ELEVATIONS
  - Added E3 elevation onto sheet
  - Updated note for metal frame in elevation D5 Conference 115B
  - Added clarifying notes for Fry Reglet reveal type in elevation C4.
- A-521 - INTERIOR DETAILS
  - Updated frame detail A6 for conference room AV wall
- A-522 - INTERIOR DETAILS
  - Added note for blocking / stud pack at videowall A2 detail.
- A-523 – INTERIOR DETAILS
  - Updated A6 vanity trough sink details
- A-524 – FINISH DETAILS
  - Added details E4, D3, D4, D6, C3, C4, B3, B4, B6, B7, B5
  - Updated details B1, C6, E1
- A-531 – CEILING DETAILS
  - Updated speaker trim detail A3
- A-630 – LOUVER ELEVATIONS
  - D3: Issue new louver elevation
  - E6: Revise louver size
- A-650 – FINISH & EQUIPMENT SCHEDULE
  - Corrected comments to show equipment as OFCI, owner furnished contractor installed
  - Removed AWP-01, WP-01 from finish schedule
  - Updated specification details for WDV-01, EPB-01, RB-01, CT-02, EP-01, RF-01, WD-01, WDF-01, and WO-01
  - Added product numbers for ACT ceilings
- A-901 – BOWL CONFIGURATION PLANS
  - Add dimensions to A3, C1, C3, F6 as shown.
- A-902 – DIMENSIONED SEATING BOWL PLAN
  - A1: Railings added. Notes and Dimensions for aisle width. Add enlarged plan callout A5/A-904.
  - A7: Dimensions revised.
  - E7: Reissued.
  - G1: Reissued.
- A-904: DIMENSIONED PRACTICE GYM PLAN
  - A5: Issue new enlarged overbuild plan
- A-910 – ENLARGED SEATING BOWL SECTIONS
  - C1: Note Added.
  - C4: Note Added.
- A-911 – RAIL DETAILS
  - A7: Revise end rail to a horizontal steel cable design by telescopic manufacturer.
  - C2: Revise rail to a horizontal steel cable design by telescopic manufacturer. See drawing.

<u>PLUMBING & FIRE PROTECTION</u>

Fire Protection

- FP-201A – EVENT LEVEL – AREA A
    - Keynote 211320 added.
    - Keynote 211319 added.
- FP-201D – EVENT LEVEL – AREA D
    - Keynote 211320 added.

Plumbing

- P-200A – UNDERFLOOR – AREA A
    - Refer to revised SPD piping.
- P-200B – UNDERFLOOR – AREA B
    - Refer to addition of multiple FS-3.
- P-201A – EVENT LEVEL – AREA A
    - Refer to revised SPD, ST, and GW piping.
- P-201B – EVENT LEVEL – AREA B
    - Refer to revised and additional DCW piping.
    - Refer to addition of multiple FS-3.
- P-202A – MAIN CONCOURSE LEVEL – AREA A
    - Refer to addition of multiple FS-3.
    - Refer to revised ST and Vent piping.
    - Refer to addition of WCO-1.
- P-202D – MAIN CONCOURSE LEVEL – AREA D
    - Refer to addition of multiple FS-3.
- P-203A – UPPER LEVEL – AREA A
    - Refer to revised ST and V piping.
- P-204 – ROOF – OVERALL PLAN
    - Refer to revised V piping.
- P-304 – SANITARY RISER DIAGRAM EVENT LEVEL II
    - Refer to revised SPD piping.
- P-306 – SANITARY RISER DIAGRAM EVENT AND CONCOURSE LEVEL
    - Refer to addition of multiple FS-3.
- P-307 – SANITARY RISER DIAGRAM CONCOURSE AND UPPER LEVEL I
    - Detail 2: Refer to revised SAN and V piping.
    - Detail 2: Refer to addition of WCO-1.
- P-309 – SANITARY RISER DIAGRAM CONCOURSE LEVEL CONCESSIONS
    - Detail 1: Refer to revised GW piping.
    - Detail 1: Refer to addition of multiple FS-3.
    - Detail 2: Refer to addition of multiple FS-3.
- P-402 – ENLARGED PLUMBING PLANS I
    - Detail 1: Refer to revised ST, SAN, and V piping.
    - Detail 2: Refer to revised ST and GW piping.
- P-405 – ENLARGED PLUMBING PLANS IV
    - Detail 2: Refer to addition of multiple FS-3
    - Detail 2: Refer to revised and additional DCW piping. Additional keynote 221129 added.
- P-406 – ENLARGED PLUMBING PLANS V

- Detail 1: Refer to revised ST and V piping.
  - Detail 1: Refer to addition of WCO-1.
- P-601 – PLUMBING FIXTURE
  - FS-3 added to plumbing fixture schedules.
  - TD-1 updated.
  - TD-2 updated.
- P-602 – PLUMBING EQUIPMENT
  - Refer to updated SE-1 selection.

MECHANICAL

- M-002 - “CHW DIAGRAM”:
  - Changed the fire-smoke dampers to fire dampers. Changed sheet note 1 to callout FDs instead of FSDs.
  - Updated airflow for the exhaust grille in the janitors closet and the supply diffusers in the bathroom.
- M-102D - “CONCOURSE FLOOR PLAN – AREA D - HVAC”:
  - Updated airflows for the exhaust grille in the kitchen/concessions area, supply diffuser in the bathroom, and the supply grille in the storage closet.
  - Updated outside air airflow being supplied to the kitchen/concessions area from OAVAV 01-02.
  - Changed layout of exhaust ductwork to accommodate architectural changes to the bathroom.
  - Changed the fire-smoke dampers to fire dampers. Changed sheet note 2 to callout FDs instead of FSDs.
- M-103 - “UPPER FLOOR PLAN – OVERALL - HVAC”:
  - Changed HVLS layout in the AUX gym.
- M-103A - “UPPER FLOOR PLAN – AREA A - HVAC”:
  - Updated airflows for supply diffusers and slots serving the concourse/seating.
- M-103B - “UPPER FLOOR PLAN – AREA B - HVAC”:
  - Updated airflows for supply diffusers and slots serving the concourse/seating.
  - Updated HVLS layout in the Aux gym. Added tag for new HVLS fan.
- M-103C - “UPPER FLOOR PLAN – AREA C - HVAC”:
  - Updated airflows for supply diffusers and slots serving the concourse/seating.
  - Updated HVLS layout in the Aux gym. Added tag for new HVLS fan.
  - Added duct mounted temperature and humidity sensors to the OA ductwork serving AHU 00-01. Added sheet note 7 for clarity on placement and purpose of the sensors.
  - Updated chilled beam and ductwork layout for architectural changes to the tenant office.
- M-103D - “UPPER FLOOR PLAN – AREA D - HVAC”:
  - Updated airflows for supply diffusers and slots serving the concourse/seating.
- M-201B - “EVENT FLOOR PLAN – AREA B - PIPING”:
  - Changed size of piping riser.
- M-201C - “EVENT FLOOR PLAN – AREA C - PIPING”:
  - Removed HHW piping from AHU 00-01.
- M-202A - “CONCOURSE FLOOR PLAN – AREA A - PIPING”:

  - Removed baseboard radiators and associated piping from the north wall.
- M-202B - “CONCOURSE FLOOR PLAN – AREA B - PIPING”:
  - Removed baseboard radiators and associated piping from the north wall.
  - Changed size of piping riser.
- M-202C - “UPPER FLOOR PLAN – AREA C - PIPING”:
  - Rerouted piping to chilled beam CB 01-11.
- M-202D - “UPPER FLOOR PLAN – AREA D - PIPING”:
  - Rerouted piping to chilled beam CB 01-11.
- M-203A - “UPPER FLOOR PLAN – AREA A - PIPING”:
  - Updated tag and size of baseboard heater.
- M-203C - “UPPER FLOOR PLAN – AREA C - PIPING”:
  - Updated chilled beam and piping layout for architectural changes to the tenant office.
- M-401A - “ENLARGED PLAN - HX/CHW 068A”:
  - Changed fire-smoke dampers to fire dampers.
  - Added duct mounted temperature and humidity sensors to the OA ductwork serving AHU 00-03. Added sheet note 12 for clarity on placement and purpose of the sensors.
  - Modified note 5 to clarify routing intent.
- M-401B - “EVENT LEVEL ENLARGED PLAN - DOAS, AHU, LAUNDRY ROOMS”:
  - Removed water recirculation pumps from AHU 00-03.
  - Removed HHW piping from AHU 00-02.
- M-402 - “ENLARGED PLANS - PRACTICE GYM”:
  - Removed fire dampers from ductwork penetrating the mechanical room wall.
- M-403 - “ENLARGED PLAN - FAN ROOM 209”:
  - Added duct mounted temperature and humidity sensors to the OA and RA ductwork serving AHU 02-01. Added sheet note 13 for clarity on placement and purpose of the sensors.
  - Added differential pressure sensors to the HHW and CHW piping risers and sheet note 14 for clarity.
  - Removed water recirculation pumps from AHU 02-01.
  - Added tag for duct silencer DS-04.
- M-404 - “ENLARGED PLAN - FAN ROOM 210”:
  - Added duct mounted temperature and humidity sensors to the OA and RA ductwork serving AHU 02-02. Added sheet note 113 for clarity on placement and purpose of the sensors.
  - Removed water recirculation pumps from AHU 02-02 and rerouted piping to unit.
- M-405 - “ENLARGED PLAN - EVENT TEAM LOCKERS”:
  - Changed supply airflows in MBB nutrition, MBB showers, WBB showers, storage 022A, WVB showers, storage 026A.
  - Updated tag for the exhaust slots to include length of the slot.
- M-406 - “ENLARGED PLAN - EVENT COACH/VISITOR LOCKERS”:
  - Changed supply airflows in visitor showers, visitor lockers, home coach lockers, home coach nutrition, and storage 012.
  - Updated exhaust airflow in visitor lockers.
  - Updated tag for the exhaust slots to include length of the slot.

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- Tagged duct.
- Added tag for wire mesh screen on transfer boot in the home coach nutrition. Tagged ceiling return.

- M-407 - “ENLARGED PLAN - MECHANICAL ROOM 208”:
  - Added duct mounted temperature and humidity sensors to the OA and REA ductwork serving AHU 02-03. Added sheet note 8 for clarity on placement and purpose of the sensors.
  - Changed fire damper to fire-smoke damper for REA ductwork serving AHU 02-03.
  - Changed fire-smoke damper to fire damper for OA ductwork serving make-up air to the SW kitchen.
  - Removed water recirculation pumps from AHU 02-03 and rerouted piping to unit.
- M-501 - “MECHANICAL DETAILS - AHU”:
  - Updated AHU cutsheets.
- M-502 - “MECHANICAL DETAILS - AHU”:
  - Updated AHU cutsheets.
- M-602 - “MECHANICAL SCHEDULES – AHU”:
  - Removed water recirculating pump schedule.
  - Included schedule data for sound attenuator DS 02-09.
  - Updated supply fan schedule for final ESP values.
  - Updated AHU heating coil schedule.
  - Updated AHU cooling coil schedule for AHU 02-03.
  - Updated supply airflow of AHU 02-03.
- M-603 - “MECHANICAL SCHEDULES – UH & FTR”:
  - Updated the equipment tag, flow rate, and length of FTR CR2-15.
- M-604 - “MECHANICAL SCHEDULES – VAV”:
  - Updated airflows for EAVAVs in the EAVAV schedule.
- M-605 - “MECHANICAL SCHEDULES – FAN”:
  - Updated HVLS schedule for new AUX gym HVLS layout.
- M-607 - “MECHANICAL SCHEDULES - ACTIVE CHILLED BEAMS”:
  - Updated CB schedule.
- M-703 - “MECHANICAL CONTROLS – AHU-00-01”:
  - Removed re-heat coil from diagram and removed associated language from the sequence of operation.
  - Updated points table.
  - Changed the supply air temperature where freeze protection measures engage from 40F to 35F.
- M-704 - “MECHANICAL CONTROLS – AHU-00-02”:
  - Removed pre-heat coil from diagram and removed associated language from the sequence of operation.
  - Updated points table.
  - Changed the supply air temperature where freeze protection measures engage from 40F to 35F.
- M-705 - “MECHANICAL CONTROLS – AHU-00-03”:
  - Added a HHW bypass valve.
  - Removed Coil recirculation pumps
  - Changed the initial, high, and low temperature of the heating supply air.
  - Updated Freeze protection logic.
  - Updated points table.

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- M-706 - “MECHANICAL CONTROLS – AHU-01-01”:
    - Changed the supply air temperature where freeze protection measures engage from 40F to 35F.
- M-707 - “MECHANICAL CONTROLS – AHU-02-01”:
    - Added a HHW bypass valve.
    - Removed Coil recirculation pumps
    - Updated Freeze protection logic.
    - Updated points table.
- M-708 - “MECHANICAL CONTROLS – AHU-02-02”:
    - Added a HHW bypass valve.
    - Removed Coil recirculation pumps
    - Updated Freeze protection logic.
    - Updated points table.
- M-709 - “MECHANICAL CONTROLS – AHU-02-03”:
    - Added a HHW bypass valve.
    - Removed Coil recirculation pumps
    - Updated Freeze protection logic.
    - Updated points table.
- M-710 - “MECHANICAL CONTROLS – CHW PUMPS”:
    - Added area leak detection sensor.
- M-711 - “MECHANICAL CONTROLS – HHW AND STEAM PLANT”:
    - Added area leak detection sensor.
- M-713 - “MECHANICAL CONTROLS – FANS”:
    - Added diagram for transfer fan control.
- M-714 - “MECHANICAL CONTROLS – CHILLED BEAM SYSTEM”:
    - Added area leak detection sensor.

<u>ELECTRICAL & FIRE ALARM</u>

- E-003 - ELECTRICAL GENERAL NOTES AND ABBREVIATIONS:
    - Added branch circuit voltage drop table.
- E-009 - ELECTRICAL CONNECTION SCHEDULES:
    - Updated connection to AHU 02-03
    - Removed Coil recirculation pumps (qty 8)
- E-501 - ONE-LINE DIAGRAMS
    - Added 100% rating to MSB main circuit breaker
    - Added connecting cones to splices in existing manholes
- E-502 - ONE-LINE DIAGRAMS
    - Removed panel ULSHD2
- E-609 - LIGHTING CONTROL RISER DIAGRAM
    - Updated lighting control diagram clarifying scope of architectural lighting control systems and sports lighting control system.
- EL-101A - EVENT FLOOR PLAN – AREA A – LIGHTING LAYOUT
    - Updated lighting in green room
    - Added branch circuit voltage drop note
- EL-101B - EVENT FLOOR PLAN – AREA B – LIGHTING LAYOUT
    - Added branch circuit voltage drop note
- EL-101C - EVENT FLOOR PLAN – AREA C – LIGHTING LAYOUT
    - Added branch circuit voltage drop note
- EL-101D - EVENT FLOOR PLAN – AREA D – LIGHTING LAYOUT
    - Added branch circuit voltage drop note

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- EL-102A - CONCOURSE FLOOR PLAN - AREA A – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-102B - CONCOURSE FLOOR PLAN - AREA B – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-102C - CONCOURSE FLOOR PLAN - AREA C – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-102D - CONCOURSE FLOOR PLAN - AREA D – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-103A - UPPER FLOOR PLAN - AREA A – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-103B - UPPER FLOOR PLAN - AREA B – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-103C - UPPER FLOOR PLAN - AREA C – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting layout 201
  - Revised lighting fixture circuiting
- EL-103D - UPPER FLOOR PLAN - AREA D – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
  - Revised lighting fixture circuiting
- EL-104A - LOW ROOF FLOOR PLAN - AREA A – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
- EL-104B - LOW ROOF FLOOR PLAN - AREA B – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
- EL-104C - LOW ROOF FLOOR PLAN - AREA C – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
- EL-104D - LOW ROOF FLOOR PLAN - AREA D – LIGHTING LAYOUT
  - Added branch circuit voltage drop note
- EP-101A - EVENT FLOOR PLAN – AREA A – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
  - Removed recirculating pumps
- EP-101B - EVENT FLOOR PLAN – AREA B – POWER
  - Added branch circuit voltage drop note
  - Removed disconnect switch
- EP-101C - EVENT FLOOR PLAN – AREA C – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
  - Coordinated receptacle locations
- EP-101D - EVENT FLOOR PLAN – AREA D – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
  - Coordinated receptacle locations
- EP-102A - CONCOURSE FLOOR PLAN – AREA A – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers

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- EP-102B - CONCOURSE FLOOR PLAN – AREA B – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
- EP-102C - CONCOURSE FLOOR PLAN – AREA C – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
- EP-102D - CONCOURSE FLOOR PLAN – AREA D – POWER
  - Added branch circuit voltage drop note
  - Added connections to paper towel dispensers
- EP-103A - UPPER FLOOR PLAN- AREA A - POWER
  - Added branch circuit voltage drop note
  - Removed coil recirculation pumps
  - Added circuiting for heat trace
- EP-103B - UPPER FLOOR PLAN- AREA B - POWER
  - Added branch circuit voltage drop note
  - Removed coil recirculation pumps
  - Added circuiting for heat trace
- EP-103C - UPPER FLOOR PLAN- AREA C - POWER
  - Added branch circuit voltage drop note
  - Changed device location 201
  - Added circuiting for heat trace
- EP-103D - UPPER FLOOR PLAN- AREA D - POWER
  - Added branch circuit voltage drop note
  - Added circuiting for heat trace
- EP-401 - ENLARGED - POWER
  - Removed panel ULSHD2
  - Added branch circuit voltage drop note
- EP-404 - ENLARGED - POWER
  - Revised device locations 047
  - Added branch circuit voltage drop note
- EP-602 - PANEL SCHEDULES
  - Removed circuit breaker for panel ULSHD2
- EP-610 - PANEL SCHEDULES
  - Revised circuit breaker for AHU 02-03
- EP-611 - PANEL SCHEDULES
  - Removed panel ULSHD2

- FA-101A - EVENT FLOOR PLAN – AREA A – FIRE ALARM:
  - REMOVE 2 duct detectors and 2 output modules associated with 2 fire/smoke dampers (also removed) in 068.
  - REVISE HVAC unit identification in 068.
  - REVISE keynotes #5.
  - REMOVE keynote #4.
  - REMOVE 2 duct detectors associated with HVAC supply air fan shutdown.
  - Refer to reissued sheet dated 1/31/2025.
- FA-101C - EVENT FLOOR PLAN – AREA C – FIRE ALARM:
  - REVISE fire alarm notification device location in room 044.
  - REVISE fire alarm notification device location in room 046.
  - REVISE fire alarm detection device locations in hall 002D.
  - REVISE HVAC unit identification in 054.

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- REVISE keynote #3.
- Refer to reissued sheet dated 1/31/2025.

- FA-101D - EVENT FLOOR PLAN – AREA D – FIRE ALARM:
  - REVISE fire alarm notification device location in room 026.
  - REVISE fire alarm notification device installation from wall to ceiling mounted in room 002C.
  - REVISE fire alarm detection device locations in hall 002D.
  - REVISE door hold-open device location in hall 002D.
  - Refer to reissued sheet dated 1/31/2025.
- FA-102A - CONCOURSE FLOOR PLAN – AREA A – FIRE ALARM:
  - REVISE fire alarm notification device location in 115F.
  - REVISE fire alarm notification device candela rating 115F.
  - REVISE fire alarm notification device candela rating and location in 115F.
  - Refer to reissued sheet dated 1/31/2025.
- FA-102B - CONCOURSE FLOOR PLAN – AREA B – FIRE ALARM:
  - REVISE fire alarm notification device location in 115F.
  - ADD fire alarm notification device in 115F.
  - REVISE fire alarm notification device candela rating 116.
  - REVISE fire alarm notification device candela rating 122.
  - REVISE fire alarm notification device locations and add keynotes #5, #6 and #7 in 115.
  - Refer to reissued sheet dated 1/31/2025.
- FA-102C - CONCOURSE FLOOR PLAN – AREA C – FIRE ALARM:
  - REVISE fire alarm notification device locations and add keynotes #6, #7 and #8 in 115.
  - REVISE fire alarm notification device candela rating 111.
  - ADD fire alarm notification device in 115F.
  - REVISE fire alarm notification device candela rating in 115F.
  - REVISE fire alarm notification device location and candela rating in 115F.
  - REVISE fire alarm notification device location and candela rating in 108.
  - REVISE fire alarm notification device candela rating in unidentified hall.
  - REVISE fire alarm notification device type to be audible/visual in 115F.
  - REVISE HVAC unit identification in 115G.
  - REVISE keynote #4.
  - Refer to reissued sheet dated 1/31/2025.
- FA-102D - CONCOURSE FLOOR PLAN – AREA D – FIRE ALARM:
  - REVISE fire alarm notification device candela rating 108.
  - REVISE fire alarm notification device location and candela rating 115F.
  - ADD fire alarm notification device in 115F.
  - REVISE fire alarm notification device location in unidentified hall.
  - ADD fire alarm notification device in unidentified hall.
  - REVISE fire alarm notification device installation from wall to ceiling in 115F.
  - Refer to reissued sheet dated 1/31/2025.
- FA-103A - UPPER FLOOR PLAN – AREA A – FIRE ALARM:

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- REMOVE duct detector, output module and keynote #3 associated with fire/smoke damper (also removed) in 209.
  - REVISE HVAC unit identification in 209.
  - REVISE keynote #2.
  - REMOVE duct detector associated with HVAC supply air fan shutdown.
  - Refer to reissued sheet dated 1/31/2025.
- FA-103B - UPPER FLOOR PLAN – AREA B – FIRE ALARM:
  - REMOVE duct detector, output module and keynote #3 associated with fire/smoke damper (also removed) in 210.
  - REVISE HVAC unit identification in 210.
  - REVISE keynote #2.
  - REMOVE duct detector associated with HVAC supply air fan shutdown.
  - Refer to reissued sheet dated 1/31/2025.
- FA-103C - UPPER FLOOR PLAN – AREA C – FIRE ALARM:
  - REVISE fire alarm notification device location in 201.
  - REVISE fire alarm smoke detector location to 115L.
  - Refer to reissued sheet dated 1/31/2025.
- FA-103D - UPPER FLOOR PLAN – AREA D – FIRE ALARM:
  - REVISE HVAC unit identification in 208.
  - REVISE keynote #2.
  - ADD duct detector, output module and associated keynote #3 for new fire/smoke dampers in 208.
  - Refer to reissued sheet dated 1/31/2025.

AV

- AV-132C – CONCOURSE RELFECTED CEILING PLAN – AREA C
  - Adjust location of conference room speakers
- AV-132D – CONCOURSE RELFECTED CEILING PLAN – AREA C
  - Adjust location of conference room speakers
- AV-133A – UPPER CONCOURSE RELFECTED CEILING PLAN – AREA C
  - Location of loudspeaker adjusted
- AV-133B – UPPER CONCOURSE RELFECTED CEILING PLAN – AREA C
  - Location of loudspeaker adjusted
- AV-133C – UPPER CONCOURSE RELFECTED CEILING PLAN – AREA C
  - PTZ conduit routing path noted
  - Location of loudspeaker adjusted
- AV-133D – UPPER CONCOURSE RELFECTED CEILING PLAN – AREA C
  - Location of loudspeaker adjusted
- AV-201 – AV ELEVATIONS
  - Wireless microphone antenna mounting height adjusted
- AV-202 – AV ELEVATIONS
  - Assisted Listening Antenna Elevation Added
- AV-402 – AV ENLAGED PLANS
  - Antennas relocated to backside of desks

ATTACHMENTS

PROJECT MANUAL

- SECTION 003132 – GEOTECHNICAL DATA
- ATTACHMENT: GEOTECHNICAL REPORT BY ATLAS
- SECTION 004113 – BID FORM
- SECTION 012300 – ALTERNATES
- SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS
- SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS ATTACHMENT
- SECTION 055900 – EXPANDED METAL WALL STRUCTURE
- SECTION 074213.13 – FORMED METAL WALL PANELS
- SECTION 074213.19 – INSULATED METAL WALL PANELS
- SECTION 074800 – RAINSCREEN ATTACHMENT SYSTEM
- SECTION 084423 – STRUCTURAL SEALANT GLAZED CURATIN WALLS
- SECTION 092400 – CEMENT PLASTERING
- SECTION 092900 – GYSUM BOARD
- SECTION 093000 – TILING
- SECTION 093015 – GAUGED PORCELAIN TILE PANELS
- SECTION 095113 – ACOUSTICAL PANEL CEILINGS
- SECTION 096723 – RESINOUS FLOORING
- SECTION 097723 – FABRIC WRAPPED PANELS
- SECTION 098433 – SOUND ABSORBING WALL UNITS
- SECTION 099713 – STRETCHED-FABRIC WALL SYSTEMS
- SECTION 102400 – ARCHITECTURAL ROOF SCREENS
- SECTION 102600 – WALL AND DOOR PROTECTION
- SECTION 116623 – GYMNASIUM EQUIPMENT
- SECTION 126100 – FIXED AUDIENCE SEATING
- SECTION 126600 – TELESCOPING STANDS
- SECTION 220800 COMMISSIONING OF PLUMBING
- SECTION 230800 COMMISSIONING OF HVAC
- SECTION 260800 COMMISSIONING OF ELECTRICAL
- SECTION 280800 COMMISSIONING OF ELECTRONIC SAFETY AND SECURITY
- ENERGY PERFORMANCE ASSESSMENT: “IN128 – JAMES T. MORRIS ARENA - 100% CD ENERGY PERFORMANCE ASSESSMENT”
- SECTION 334200 – STORMWATER PUMPING STATIONS

DRAWINGS

- G-002 – SHEET INDEX AND PROJECT LOCATION
- G-006 – LIFE SAFETY PLANS
- G-007 – LIFE SAFETY PLANS

- C111 - Demolition Plan
- C200 - Overall Site Plan
- C210 - Road Plan and Profile
- C300 - Overall Grading Plan
- C301 - Grading Plan
- C302 - Grading Plan
- C303 – Grading Plan Enlargements
- C304 - Grading Plan Enlargements
- C400 – Overall Utility Plan
- C401 – Utility Plan

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- C402 – Utility Plan
- C403 – Utility Enlargements
- C404 – Structure Data Tables
- C405 & C406 – Duct Bank Crossing
- C413 – Storm Sewer Plan & Profiles
- C414 – Storm Sewer Plan & Profiles
- C416 – Storm Sewer Plan & Profiles
- C420 – Sanitary Sewer Plan & Profile
- C601 - C605 – Site Details
- C606 – Site Details
- C620 – Sanitary Sewer Details
- C621 – Sanitary Sewer Details
- C622 – Sanitary Sewer Details

- S-101B – EVENT LEVEL FOUNDATION PLAN – UNIT B
- S-101SB – EVENT LEVEL SLAB PLAN – UNIT B
- S-102B – CONCOURSE LEVEL PLAN – UNIT B
- S-102C – CONCOURSE LEVEL PLAN – UNIT C
- S-103C – UPPER LEVEL PLAN – UNIT C
- S-103D – UPPER LEVEL PLAN – UNIT D
- S-105B – HIGH ROOF PLAN – UNIT B
- S-105C – HIGH ROOF PLAN – UNIT C
- S-110 – ENLARGED FOUNDATION PLANS
- S-391 – TYPICAL PRECAST SECTIONS AND DETAILS
- S-570 – CLADDING BACKUP ELEVATIONS
- S-571 – CLADDING BACKUP ELEVATIONS
- S-577 – CLADDING BACKUP CONNECTION DETAILS

- A-101A – EVENT FLOOR PLAN – AREA A
- A-101B – EVENT FLOOR PLAN – AREA B
- A-101D – EVENT FLOOR PLAN – AREA D
- A-102A – CONCOURSE FLOOR PLAN – AREA A
- A-102C – CONCOURSE FLOOR PLAN – AREA C
- A-102D – CONCOURSE FLOOR PLAN – AREA D
- A-103A – UPPER FLOOR PLAN – AREA A
- A-103C – UPPER FLOOR PLAN – AREA C
- A-103D – UPPER FLOOR PLAN – AREA D
- A-104A – LOW ROOF PLAN – AREA A
- A-104D – LOW ROOF PLAN – AREA D
- A-133A – UPPER FLOOR REFLECTED CEILING PLAN – AREA A
- A-133B – UPPER FLOOR REFLECTED CEILING PLAN – AREA B
- A-133C – UPPER FLOOR REFLECTED CEILING PLAN – AREA C
- A-133D – UPPER FLOOR REFLECTED CEILING PLAN – AREA D
- A-151A – EVENT FLOOR FINISH PLAN – AREA A
- A-151C – EVENT FLOOR FINISH PLAN – AREA C
- A-151D – EVENT FLOOR FINISH PLAN – AREA D
- A-153C – UPPER FLOOR FINISH PLAN – AREA C
- A-201 – EXTERIOR ELEVATIONS
- A-202 – EXTERIOR ELEVATIONS
- A-203 – EXTERIOR ELEVATIONS
- A-321 – WALL SECTIONS

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- A-322 – WALL SECTIONS
- A-323 – WALL SECTIONS
- A-325 – WALL SECTIONS
- A-351 – EXTERIOR DETAILS
- A-352 – EXTERIOR DETAILS
- A-353 – EXTERIOR DETAILS
- A-354 – EXTERIOR DETAILS
- A-355 – EXTERIOR DETAILS
- A-356 – EXTERIOR DETAILS
- A-357 – EXTERIOR DETAILS
- A-358 – EXTERIOR DETAILS
- A-370 – EXTERIOR 3D DIAGRAMS
- A-411 – ENLARGED RESTROOM PLANS
- A-412 – ENLARGED RESTROOM PLANS
- A-413 – ENLARGED RESTROOM PLANS
- A-421 – STAIR AND ELEVATOR PLANS AND SECTIONS
- A-426 – MONUMENTAL STAIR SECTIONS & DETAILS
- A-501 – INTERIOR ELEVATIONS
- A-502 – INTERIOR ELEVATIONS
- A-503 – INTERIOR ELEVATIONS
- A-521 – INTERIOR DETAILS
- A-522 – INTERIOR DETAILS
- A-523 – INTERIOR DETAILS
- A-524 – FINISH DETAILS
- A-531 – CEILING DETAILS
- A-630 – LOUVER ELEVATIONS
- A-650 – FINISH & EQUIPMENT SCHEDULE
- A-901 – BOWL CONFIGURATION PLANS
- A-902 – DIMENSIONED SEATING BOWL PLAN
- A-904: DIMENSIONED PRACTICE GYM PLAN
- A-910 – ENLARGED SEATING BOWL SECTIONS
- A-911 – RAIL DETAILS

- FP-201A – EVENT LEVEL – AREA A
- FP-201D – EVENT LEVEL – AREA D

- P-200A – UNDERFLOOR – AREA A
- P-200B – UNDERFLOOR – AREA B
- P-201A – EVENT LEVEL – AREA A
- P-201B – EVENT LEVEL – AREA B
- P-202A – MAIN CONCOURSE LEVEL – AREA A
- P-202D – MAIN CONCOURSE LEVEL – AREA D
- P-203A – UPPER LEVEL – AREA A
- P-204 – ROOF – OVERALL PLAN
- P-304 – SANITARY RISER DIAGRAM EVENT LEVEL II
- P-306 – SANITARY RISER DIAGRAM EVENT AND CONCOURSE LEVEL
- P-307 – SANITARY RISER DIAGRAM CONCOURSE AND UPPER LEVEL I
- P-309 – SANITARY RISER DIAGRAM CONCOURSE LEVEL CONCESSIONS
- P-402 – ENLARGED PLUMBING PLANS I

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- P-405 – ENLARGED PLUMBING PLANS IV
- P-406 – ENLARGED PLUMBING PLANS V
- P-601 – PLUMBING FIXTURE
- P-602 – PLUMBING EQUIPMENT

- M-002 - “CHW DIAGRAM”:
- M-102D - “CONCOURSE FLOOR PLAN – AREA D - HVAC”:
- M-103 - “UPPER FLOOR PLAN – OVERALL - HVAC”:
- M-103A - “UPPER FLOOR PLAN – AREA A - HVAC”:
- M-103B - “UPPER FLOOR PLAN – AREA B - HVAC”:
- M-103C - “UPPER FLOOR PLAN – AREA C - HVAC”:
- M-103D - “UPPER FLOOR PLAN – AREA D - HVAC”:
- M-201B - “EVENT FLOOR PLAN – AREA B - PIPING”:
- M-201C - “EVENT FLOOR PLAN – AREA C - PIPING”:
- M-202A - “CONCOURSE FLOOR PLAN – AREA A - PIPING”:
- M-202B - “CONCOURSE FLOOR PLAN – AREA B - PIPING”:
- M-202C - “UPPER FLOOR PLAN – AREA C - PIPING”:
- M-202D - “UPPER FLOOR PLAN – AREA D - PIPING”:
- M-203A - “UPPER FLOOR PLAN – AREA A - PIPING”:
- M-203C - “UPPER FLOOR PLAN – AREA C - PIPING”:
- M-401A - “ENLARGED PLAN - HX/CHW 068A”:
- M-401B - “EVENT LEVEL ENLARGED PLAN - DOAS, AHU, LAUNDRY ROOMS”:
- M-402 - “ENLARGED PLANS - PRACTICE GYM”:
- M-403 - “ENLARGED PLAN - FAN ROOM 209”:
- M-404 - “ENLARGED PLAN - FAN ROOM 210”:
- M-405 - “ENLARGED PLAN - EVENT TEAM LOCKERS”:
- M-406 - “ENLARGED PLAN - EVENT COACH/VISITOR LOCKERS”:
- M-407 - “ENLARGED PLAN - MECHANICAL ROOM 208”:
- M-501 - “MECHANICAL DETAILS - AHU”:
- M-502 - “MECHANICAL DETAILS - AHU”:
- M-602 - “MECHANICAL SCHEDULES – AHU”:
- M-603 - “MECHANICAL SCHEDULES – UH & FTR”:
- M-604 - “MECHANICAL SCHEDULES – VAV”:
- M-605 - “MECHANICAL SCHEDULES – FAN”:
- M-607 - “MECHANICAL SCHEDULES - ACTIVE CHILLED BEAMS”:
- M-703 - “MECHANICAL CONTROLS – AHU-00-01”:
- M-704 - “MECHANICAL CONTROLS – AHU-00-02”:
- M-705 - “MECHANICAL CONTROLS – AHU-00-03”:
- M-706 - “MECHANICAL CONTROLS – AHU-01-01”:
- M-707 - “MECHANICAL CONTROLS – AHU-02-01”:
- M-708 - “MECHANICAL CONTROLS – AHU-02-02”:
- M-709 - “MECHANICAL CONTROLS – AHU-02-03”:
- M-710 - “MECHANICAL CONTROLS – CHW PUMPS”:
- M-711 - “MECHANICAL CONTROLS – HHW AND STEAM PLANT”:
- M-713 - “MECHANICAL CONTROLS – FANS”:
- M-714 - “MECHANICAL CONTROLS – CHILLED BEAM SYSTEM”:

- E-003 - ELECTRICAL GENERAL NOTES AND ABBREVIATIONS:
- E-009 - ELECTRICAL CONNECTION SCHEDULES:

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- E-501 - ONE-LINE DIAGRAMS
- E-502 - ONE-LINE DIAGRAMS
- E-609 - LIGHTING CONTROL RISER DIAGRAM
- EL-101A - EVENT FLOOR PLAN – AREA A – LIGHTING LAYOUT
- EL-101B - EVENT FLOOR PLAN – AREA B – LIGHTING LAYOUT
- EL-101C - EVENT FLOOR PLAN – AREA C – LIGHTING LAYOUT
- EL-101D - EVENT FLOOR PLAN – AREA D – LIGHTING LAYOUT
- EL-102A - CONCOURSE FLOOR PLAN - AREA A – LIGHTING LAYOUT
- EL-102B - CONCOURSE FLOOR PLAN - AREA B – LIGHTING LAYOUT
- EL-102C - CONCOURSE FLOOR PLAN - AREA C – LIGHTING LAYOUT
- EL-102D - CONCOURSE FLOOR PLAN - AREA D – LIGHTING LAYOUT
- EL-103A - UPPER FLOOR PLAN - AREA A – LIGHTING LAYOUT
- EL-103B - UPPER FLOOR PLAN - AREA B – LIGHTING LAYOUT
- EL-103C - UPPER FLOOR PLAN - AREA C – LIGHTING LAYOUT
- EL-103D - UPPER FLOOR PLAN - AREA D – LIGHTING LAYOUT
- EL-104A - LOW ROOF FLOOR PLAN - AREA A – LIGHTING LAYOUT
- EL-104B - LOW ROOF FLOOR PLAN - AREA B – LIGHTING LAYOUT
- EL-104C - LOW ROOF FLOOR PLAN - AREA C – LIGHTING LAYOUT
- EL-104D - LOW ROOF FLOOR PLAN - AREA D – LIGHTING LAYOUT
- EP-101A - EVENT FLOOR PLAN – AREA A – POWER
- EP-101B - EVENT FLOOR PLAN – AREA B – POWER
- EP-101C - EVENT FLOOR PLAN – AREA C – POWER
- EP-101D - EVENT FLOOR PLAN – AREA D – POWER
- EP-102A - CONCOURSE FLOOR PLAN – AREA A – POWER
- EP-102B - CONCOURSE FLOOR PLAN – AREA B – POWER
- EP-102C - CONCOURSE FLOOR PLAN – AREA C – POWER
- EP-102D - CONCOURSE FLOOR PLAN – AREA D – POWER
- EP-103A - UPPER FLOOR PLAN- AREA A - POWER
- EP-103B - UPPER FLOOR PLAN- AREA B - POWER
- EP-103C - UPPER FLOOR PLAN- AREA C - POWER
- EP-103D - UPPER FLOOR PLAN- AREA D - POWER
- EP-401 - ENLARGED - POWER
- EP-404 - ENLARGED - POWER
- EP-602 - PANEL SCHEDULES
- EP-610 - PANEL SCHEDULES
- EP-611 - PANEL SCHEDULES

- FA-101A - EVENT FLOOR PLAN – AREA A – FIRE ALARM:
- FA-101C - EVENT FLOOR PLAN – AREA C – FIRE ALARM:
- FA-101D - EVENT FLOOR PLAN – AREA D – FIRE ALARM:
- FA-102A - CONCOURSE FLOOR PLAN – AREA A – FIRE ALARM:
- FA-102B - CONCOURSE FLOOR PLAN – AREA B – FIRE ALARM:
- FA-102C - CONCOURSE FLOOR PLAN – AREA C – FIRE ALARM:
- FA-102D - CONCOURSE FLOOR PLAN – AREA D – FIRE ALARM:
- FA-103A - UPPER FLOOR PLAN – AREA A – FIRE ALARM:
- FA-103B - UPPER FLOOR PLAN – AREA B – FIRE ALARM:
- FA-103C - UPPER FLOOR PLAN – AREA C – FIRE ALARM:
- FA-103D - UPPER FLOOR PLAN – AREA D – FIRE ALARM:

- AV-132C – CONCOURSE RELFECTED CEILING PLAN – AREA C
- AV-132D – CONCOURSE RELFECTED CEILING PLAN – AREA C

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- AV-133C – UPPER CONCOURSE RELFECTED CEILING PLAN – AREA C
- AV-201 – AV ELEVATIONS
- AV-202 – AV ELEVATIONS
- AV-402 – AV ENLAGED PLANS

<u>SUPPLEMENTAL INFORMATION</u>

- BIDDER RFI LOG: “25-02-03_ADDENDUM 02_JTM ARENA_RFI LOG_RESPONSES”

Respectfully submitted,

Kevin Stewart, AIA

CC: File 23112.

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DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, prepared by Atlas Technical Consultants, LLC., dated July 9, 2024, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

END OF DOCUMENT 003132

GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED ARENA AND CONVOCATION CENTER
INDIANA UNIVERSITY – INDIANAPOLIS
OHIO STREET AND BLACKFORD STREET
INDIANAPOLIS, INDIANA

ATLAS PROJECT NO. 170GC01791

JULY 9, 2024

PREPARED FOR:

INDIANA UNIVERSITY
OFFICE OF THE VICE PRESIDENT FOR CAPITAL PLANNING AND FACILITIES
2901 EAST DISCOVERY PARKWAY
BLOOMINGTON, IN 47408

ATTENTION: MR. BRETT HATCHETT
SENIOR ASSOCIATE UNIVERSITY ARCHITECT

ATLAS

Atlas Technical Consultants LLC

7988 Centerpoint Dr.
Suite 100
Indianapolis, IN 46256

Phone **317 849 4990**

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July 9, 2024

Mr. Brett Hatchett
Senior Associate University Architect
Indiana University
Office of the Vice President for Capital Planning and Facilities
2901 East Discovery Parkway
Bloomington, IN 47408

Re: **Geotechnical Engineering Investigation**
Proposed Arena and Convocation Center
Indiana University – Indianapolis
Ohio Street and Blackford Street
Indianapolis, Indiana
Atlas Project No. 170GC01791

Dear Mr. Hatchett:

Submitted herewith is the report of the geotechnical engineering investigation performed by Atlas Technical Consultants LLC (Atlas) for the referenced project. This study was authorized in accordance with Atlas Proposal No. 24-02640-Revised dated April 17, 2024 and Indiana University Purchase Order No. PO0836147 dated May 30, 2024.

This report contains the results of the field and laboratory testing program, an engineering interpretation of this data with respect to the available project characteristics and recommendations to aid design and construction of the foundations and other earth-connected phases of this project. We wish to remind you that we will store the samples for 30 days after which time they will be discarded unless you request otherwise.

We appreciate the opportunity to be of service to you on this project. If we can be of any further assistance, or if you have any questions regarding this report, please do not hesitate to contact either of the undersigned.

Sincerely,

ROY D. MCILWAINE
No. PE11200315
REGISTERED
STATE OF
INDIANA
PROFESSIONAL ENGINEER

David McIlwaine, P.E.
Senior Project Engineer

Thomas J. Struewing, P.E.
Principal Engineer

Table of Contents

Appendix

1 PURPOSE AND SCOPE

The purpose of this study was to assess the general subsurface conditions at the project site by drilling 17 soil test borings and 48 soundings and to evaluate the subsurface data with respect to foundation concept and design for the proposed arena and convocation center on the Indiana University – Indianapolis campus. Also included is an evaluation of the site with respect to potential construction problems and recommendations dealing with quality control during construction.

2 PROJECT CHARACTERISTICS

Indiana University – Indianapolis (IU-I) is planning for the construction of a new arena and convocation center to be located southwest of the intersection of Ohio Street and Blackford Street on the IU-I campus in downtown Indianapolis, Indiana. The general location of the project site is shown on the Vicinity Map (Figure 1 in the Appendix), which is taken from the 1984 U.S.G.S. Indianapolis West Quadrangle map that was made prior to the current level of development in the area surrounding the project site as well as prior to the demolition of the former Indianapolis Tennis Center. The existing project site is a relatively flat, vacant, grass-covered lot. The project site was formerly occupied by the Indianapolis Tennis Center, with the former tennis center arena facility being located in the east half of the currently proposed project area. Based upon information provided, it is estimated that the former tennis center grandstand structures foundations were approximately 10 ft to 12 ft below the existing grade, and it is reported that some, or all, of the former foundations may still partially be in-place. The current grade at the site is estimated to be at about El 704 to El 705 except for the far southeast corner of the site where the ground surface rises to about El 711.

The proposed project will include an approximately 4,500 seat arena and convocation center that will consist of three levels: Court Level, Main Concourse Level and Terrace Level. The Court Level finish floor will reportedly be at about El 688 to 695 (the finish floor elevations have not been determined at this time). The Main Concourse Level area will be coincident with Court Level area, except that there will be a small entrance area on the west side and a practice court area on the east side that will not be over the court level (i.e., slab-on-grade floors will be constructed for these east and west building extensions). The Main Concourse Level finish floor will reportedly be at about El 707 to El 714 (the finish floor elevations have not been determined at this time), or approximately 19 ft above the finish floor elevation of the Court Level. The proposed structure will have a footprint area of approximately 88,000 sq.ft.

Based on provided topographic mapping, the existing ground surface in the area of the proposed structure varies from approximately El 704 to El 706. Therefore, it is estimated that as much as about 10 ft of grade-raise fill will be required to establish the finish grade in the proposed “at-grade” structure areas (i.e., those areas that do not include a Court Level). It is also our understanding that the finish of the Court Level is as much as approximately 18 ft below the existing ground surface.

The maximum column, wall and floor slab loads for the proposed structure will reportedly be about 500 kips/column, 10 kips/lin.ft and 250 lbs/sq.ft, respectively. The foundations for both the Court Level and the Main Concourse Level will nominally bear approximately 3 ft below the respective finish floor elevation. No unusual loading conditions or settlement restrictions have been specified.

A new driveway with parking areas and sidewalks will be located west of the proposed arena structure. An underground storm water detention chamber is being considered in the project area west of the proposed arena structure below the new pavements. The general arrangement of the project site as well as the “as-drilled” soil test borings and soundings are shown on the Boring Plan (Figure 2 in the Appendix).

3 GENERAL SUBSURFACE CONDITIONS

The general subsurface conditions were investigated by drilling seventeen test borings to depths of 10 ft to 40 ft at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). In addition to the test borings, forty-eight soundings were drilled in the vicinity of the former Indianapolis Tennis Center grandstand areas that were formerly located in the east portion of the proposed project site. The soundings were drilled to determine if obstructions potentially exist, such as former foundations, floor slabs, etc. that could remain in-place.

The subsurface conditions disclosed by the field investigation are summarized in Section 3.2. Detailed descriptions of the subsurface conditions encountered in each test boring are presented on the “Test Boring Logs” in the Appendix. The letters in parentheses following the soil descriptions are the soil classifications in general accordance with the Unified Soil Classification System (ASTM D2488 “Standard Practice for Description and Identification of Soils by Visual-Manual Procedures”). It should be noted that the stratification lines shown on the test boring logs represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths.

3.1 Regional and Site Geology

The City of Indianapolis is located near the western boundary of the Indiana Physiographic unit known as the New Castle Till Plains and Drainageways, which is part of the Central Till Plain Region. This unit is typified by nearly flat to gently rolling terrain that is dissected by generally southwest trending valleys. Natural Indianapolis surface features result from the most recent glaciation (i.e., Wisconsinan age), which is believed to have crossed Indiana approximately 20,000 years ago. While most of the Indianapolis area is covered by a relatively thick layer of glacial till, major valleys such as those of White River and Fall Creek were formed by meltwater flows during glacial recession. Glacial outwash deposits within these meltwater valleys, which generally coincide with current stream channels but are much wider, are predominately granular soils consisting of sands and gravels, sometimes overlying cobbles and boulders.

The project site is located approximately 1,000 ft northeast of White River. The majority of the natural unconsolidated deposits in the immediate vicinity of the site consist of glacial outwash sand and gravel that was deposited by glacial meltwaters. The outwash is often covered by a thin layer of primarily cohesive alluvium and interrupted by layers of glacial till that vary in thickness and appear to be somewhat random in occurrence. Geologic mapping indicates that the upper bedrock in this area is limestone that was deposited on the order of about 400,000 years ago during the Devonian Age. Published geologic mapping indicates that the bedrock surface underlying downtown Indianapolis varies from about El 590 to El 640. The current surface topography within the project site is the result of urban development.

The only mapped fault underlying Marion County is the Fortville Fault, which trends approximately northeast to southwest in the eastern part of the county. This is a high angle dip-slip fault of post-Mississippian and pre-Pleistocene age that cuts the upper bedrock surface but does not extend into the overlying glacial till. There have been no recorded earthquakes associated with the Fortville Fault. Any ground shaking in Indianapolis from earthquakes would likely result from fault movement within with the New Madrid seismic zone, which is located in southeast Missouri, or the Wabash Valley fault system located in southeast Illinois and southwest Indiana. No significant earthquake activity is expected from any of the other faults located in Indiana. There is virtually no probability of “liquefaction” (a phenomenon whereby ground shaking causes a severe loss of soil strength) of the soil at the project site under any reasonably anticipated ground shaking event.

3.2 Subsurface Soil Conditions

The test borings typically revealed about 3 inches to 6 inches of topsoil at the existing ground surface. Underlying the topsoil, the test borings revealed miscellaneous, uncontrolled fill materials that include silty clay, sandy silty clay, silty sand and/or sand with varying amounts of sand and gravel to depths of approximately 6.0 ft to 18.5 ft below the existing ground surface. Boring B-13 revealed slightly moist sand fill with gravel to a depth of only 3.5 ft. Much of the miscellaneous uncontrolled fill materials contain various types of unnatural materials such as bricks, concrete, asphalt and crushed limestone fragments as well as cinders and roots in some cases.

Underlying the fill materials described above, some test borings revealed layers of very soft to very stiff silty clay (CL), sandy silty clay (CL) and/or clay (CH) with various amounts of sand and gravel to depths of about 8 ft to 16 ft below the existing ground surface. Underlying the miscellaneous uncontrolled fill materials or the natural cohesive soils, the test borings generally revealed medium dense to dense sand (SW-SM, SP-SM, SP-SC, SP) and/or silty sand (SM) with varying amounts of silt and gravel to the boring termination depths ranging from 10 ft to 40 ft below the ground surface.

The qualitative density of the natural glacial outwash sand and gravel soils was typically determined to be medium dense to dense based on the standard penetration test results. However, several test borings encountered zones of looser sand, such as in Borings B-1, B-5, B-8, B-15 and B-16 to depths of 13.5 ft to 18.5 ft, below the existing ground surface. The qualitative strengths or consistencies of the cohesive soils and the qualitative densities of the granular soils as described above and on the test boring logs were estimated based on the results of the standard penetration test (ASTM D1586) and based on the definitions as described on the Field Classification System for Soil Exploration contained in the Appendix of this report.

Due to the urban location of the project site and past generations of development, large obstructions and various types of debris, rubble and remnants from previous structures are often encountered within miscellaneous uncontrolled fill materials such as those encountered in the upper 6.0 ft to 18.5 ft of the test borings. It is possible that remnants from previous structures (such as basements, foundations, slabs, utilities, etc.) may exist at various locations at the site, especially in the east portion of the project area where the former Indianapolis Tennis Center was located, some of which may extend deeper than the miscellaneous fill depths encountered in the test borings. See Table 3 in Section 4.2 for locations and depths of potential obstructions that were revealed by the soundings.

Our experience indicates that cobbles and boulders are often present within the White River glacial outwash sand and gravel that underlie this site. Therefore, it is important to understand that cobbles and boulders may be encountered at various depths and locations at this site.

3.3 Ground Water

Ground water level observations were made during the drilling operations by noting the depth of free ground water on the drilling tools during drilling operations. Free ground water was encountered in the test borings at depths ranging from about 28.0 ft to 33.5 ft below the existing ground surface, with free ground water typically encountered in the test borings in a range of about El 676 to El 677.

Short-term ground water level readings made in relatively clean granular glacial outwash soils are generally considered to be a reliable indication of the ground water level at the time the test borings are drilled. However, fluctuations in the level of the ground water should be expected due to variations in rainfall, pumping from the aquifer, the flow level in nearby White River and Fall Creek and other factors not evident at the time of this study. Furthermore, ground water levels reported in test borings drilled for multiple nearby project sites (i.e., NCAA headquarters facility, former Indianapolis Tennis Center facility, adjacent parking garage structure, etc.) by Atlas (formerly ATC/ATEC) typically revealed ground water levels ranging from about El 677 to El 681 at various locations and times from the 1970s to 2010s. Although the ground water level at the time of this investigation was generally at or below about El 677, higher ground water levels should be expected at other times. Based upon prior investigations at this site and surrounding sites, ground water levels in the range of about El 679 to El 682 appear to be more common.

It is not possible to accurately predict future ground water levels with complete certainty; however, it is reasonable and prudent to expect that ground water levels above the levels measured during this investigation will occur in the future and within the life-span of the facility. Based upon our experience, as well as data generated from other studies in the White River and Fall Creek outwash terraces in downtown Indianapolis, it does not appear likely that the ground water level would rise above about El 688 during the life of the facility. Although a higher ground water level due to rare or unforeseen events, or a combination of rare events (e.g., an extended period of heavy or above normal rainfall, cessation of pumping from the aquifer in nearby wells, extended periods of flooding of Fall Creek and White River, etc.) cannot be ruled out with complete certainty, it appears that a ground water level higher than about El 688, although possible, is unlikely during the life of this structure. Furthermore, it is unlikely that such an event would occur rapidly, but rather would occur over an extended period of time, allowing emergency measures to be taken, if necessary.

4 DESIGN RECOMMENDATIONS

The following design recommendations have been developed on the basis of the previously described project characteristics (Section 2) and subsurface conditions (Section 3). If there are any changes in the project criteria, including the proposed structure location, loading conditions, the lowest finish floor elevation, structure type, etc., a review should be made by this office.

The design recommendations presented herein are based upon the assumption that continuous field observations, testing and evaluations of all of the soil related aspects of the project as described in Sections 4 and 5 of this report will be performed by a representative of Atlas during construction to confirm that the earth related elements of the project are compatible and consistent with the conditions upon which the design recommendations are based. The careful and thorough field testing and observations of the soil related aspects of the project are a critical and essential component of the design recommendations.

4.1 Seismic Parameters

Based on geologic mapping and the results of the test borings, it is our opinion that the subsurface conditions at this site meet the criteria for Site Class C based on Section 1613.3.2 of the 2012 International Building Code (Chapter 20 of ASCE 7-10 “Minimum Design Loads for Buildings and Other Structures”). The recommended seismic design parameters are summarized in the following table:

Table 1 – Recommended Seismic Design Parameters

Seismic Design Parameter	Recommended Class/Value
Seismic Site Class*	C
Site Modified Peak Ground Acceleration, PGA_M	0.09g
Design Spectral Response Acceleration at Short Periods, S_{DS}**	0.13g
Design Spectral Response Acceleration at 1-Second Period, S_{D1}**	0.10g

*Based upon Chapter 20 of ASCE 7-10 “Minimum Design Loads for Buildings and Other Structures”
**Based upon Section 1613 of the 2012 International Building Code

There is virtually no probability of “liquefaction” (a phenomenon whereby ground shaking causes a severe loss of soil strength) of the soil at the project site under any reasonably anticipated ground shaking event.

4.2 General Foundation Concepts

Based upon the results of the test borings that were drilled for this project, it is evident that materials that are not suitable for reliable support of conventional spread footings for the proposed arena and convocation center structure underlie the entire project site. The unsuitable materials consist of miscellaneous, uncontrolled fill, rubble or debris, remnants from previous structures and facilities (e.g., underground utilities, etc.), weak natural cohesive soils and in some cases looser natural granular soils. These unsuitable materials were typically encountered in the test borings to depths ranging from approximately 6.0 ft to 18.5 ft below the existing ground surface, which corresponds to estimated bottom of unsuitable materials mostly ranging from approximately El 699 to El 685. The test borings that were drilled in the area of the proposed arena and convocation center structure generally revealed unsuitable materials to depths ranging from about 11.0 to 18.5 ft, which corresponds to estimated bottom of unsuitable materials mostly ranging from approximately El 693 to El 685. It is important to note that it is possible that miscellaneous, uncontrolled fill, rubble and debris, remnants from previous structures and facilities, cohesive soils or looser granular soils may extend deeper at some isolated locations on the project site since this condition has been encountered on other similar urban project sites in and near downtown Indianapolis. The natural, medium dense to dense glacial outwash sand and gravel soils that were typically encountered underlying the unsuitable materials described above (i.e., below the miscellaneous uncontrolled fill materials, remnants of previous construction, natural cohesive soils and/or looser granular soils) are judged to be suitable for the reliable support of conventional spread footings in conjunction with the anticipated loading conditions and expected settlement tolerances for the proposed building.

Table 2 summarizes the approximate depths and the estimated approximate elevations at which soils that are judged to be suitable for support of the spread footings were encountered in the test borings drilled at this project site. Due to the urban location and the previous generations of urban development of the project site, it is possible that miscellaneous uncontrolled fill materials and remnants from previous structures (e.g., walls, floors, basements, pits, wells, vaults, tanks, footings, utilities, etc.) may extend deeper at some isolated locations since such cases have been encountered in the past on other similar project sites in downtown Indianapolis.

Table 2 – Estimated Suitable Bearing Soil Depths and Elevations

Boring No.	Estimated Ground Surface Elevation*	Estimated Depth to Suitable Bearing Soils, ft	Estimated Elevation at Top of Suitable Bearing Soils*
B-1	705	13.5	691
B-2	705	16.0	689
B-3	705	13.5	691
B-4	705	18.5	686
B-5	705	18.5	686
B-6	705	13.5	691
B-7	704	11.0	693
B-8	704	16.0	688
B-9	705	16.0	689
B-10	705	18.5	686
B-11	704	18.5	685
B-12	705	16.0	689
B-13	706	NA	NA
B-14	706	NA	NA
B-15	705	16.0	689
B-16	705	13.5	691
B-17	705	NA	NA

*Ground surface elevations estimated from topographic map provided by American Structurepoint, Inc.
NA – Suitable bearing soils were not revealed within the planned depth of the test boring.

The natural, medium dense to very dense, glacial outwash sand and gravel soils that were typically encountered beneath the unsuitable materials are generally judged to be suitable for support of conventional spread footings. As noted above, it will be necessary to remove all existing miscellaneous uncontrolled fill materials, remnants from previous structures or utilities, all cohesive soils, and any isolated zones or pockets of looser natural sand beneath the spread footings to expose the natural, medium dense to very dense glacial outwash sand and gravel soils.

In addition to the conventional test borings that were drilled for this project, 48 “soundings” were drilled in the approximate locations of the three former Indianapolis Tennis Center grandstand areas (see Boring Plan, Figure 2 in the Appendix). These soundings were drilled without sampling in an attempt to determine if any apparent obstructions that may be former foundations or slabs remain in-place at the sounding locations. The soundings were drilled to a maximum depth of 15 ft, unless an obstruction that resulted in refusal of the augers was encountered.

Auger-refusal is defined herein as the depth at which a conventional test drill rig cannot advance the hollow-stem-augers used for the soundings. It is important to understand that auger-refusal is not necessarily coincident with the apparent obstruction surface since the augers can possibly penetrate into an obstruction. Table 3 summarizes the depths and elevations at which auger-refusal was encountered in those soundings where auger-refusal, and thus an apparent obstruction, was encountered.

Table 3 – Estimated Locations, Depths and Elevations for Auger-Refusal on Apparent Obstruction within former Indianapolis Tennis Center Grandstand Areas

Sounding No.	Estimated Ground Surface Elevation*	Estimated Depth to Apparent Obstruction, ft	Estimated Elevation at Top of Apparent Obstruction*
S-1	704	5.5	698
S-20	705	5.0	700
S-31	705	5.0	700
S-32	705	4.5	700
S-38	705	2.0	703
S-39	705	5.0	700
S-42	706	8.0	698
S-43	705	13.0	692

*Ground surface elevations estimated from topographic map provided by American Structurepoint, Inc.

Since auger-refusal was encountered in 8 of the 48 soundings (auger-refusal was not encountered in any of the 17 test borings drilled at this site), it should be expected that obstructions will be encountered at various locations throughout the site. Where obstructions were encountered, they were generally well above the Court Level, except at S-43, and thus will be removed as part of the mass excavation for the Court Level. However, it is likely that obstructions will need to be removed deeper at some isolated locations.

If the Court Level floor is established above about El 688, which will result in spread footings nominally bearing above about El 685, undercutting of unsuitable materials will be required at many of the spread footing locations (dependent upon where the Court Level floor elevation is established) in order for the spread footings to bear on soils that are judged to be suitable for reliable support of the proposed structure. It is also possible that undercutting of unsuitable materials may be required deeper than El 685 at isolated locations even with the spread footings bearing at about El 685. The actual undercutting depths required to completely remove unsuitable materials from beneath spread footings shall be based upon careful observations, evaluations, and testing at the time of construction. Furthermore, suitable bearing soils are significantly deeper than the nominal spread footing bearing elevations for the areas of the structure where the Main Concourse Level is the lowest floor level and are not above the Court Level area (e.g., the west entry area and the east gymnasium area).

Depending upon the Court Level floor elevation that is yet to be determined, it may be possible to undercut all unsuitable materials at the spread footing locations and to replace the unsuitable materials with well-compacted engineered fill that is placed and compacted as described in Section 5.3. However, if the Court Level floor is to be established as high as El 695, which results in spread footings nominally bearing at about El 692, significant undercutting of unsuitable materials and replacement with engineered fill will be required at most, if not all, spread footing locations, unless other ground improvement measures or "intermediate foundation systems" are utilized that eliminate the need for removal and replacement of the unsuitable materials. In the areas where the Main Concourse Level is the lowest floor level (no Court Level below), undercutting and replacement of unsuitable materials does not appear to be feasible and special ground improvement measures or “intermediate foundation systems” will be required in these areas. Alternatively, auger-cast piles can be used for support of the proposed structure.

It is recommended that only well-graded granular material that contains no more than 10 percent material finer than the No. 200 sieve, such as Indiana Department of Transportation (INDOT) No. 53 crushed limestone, be used to backfill the undercut excavations for spread footings. The lateral dimensions at the bases of the undercut excavations beneath spread footings that are backfilled with compacted engineered fill materials must be enlarged 1 ft in each direction for each 2 feet of undercut depth below the design base of the footing, as depicted in Figure 4 in the Appendix, if compacted engineered fill material will be used to re-establish the nominal spread footing bearing elevation. The well-graded granular backfill materials should be placed and compacted as described in Section 5.3. Lean concrete (2,500 lbs/sq.in. minimum compressive strength) can also be used as backfill beneath spread footings, in which case the base dimensions of any undercut excavation needed to remove unsuitable materials can be made the same lateral dimensions as the spread footing.

It is important to note that a temporary earth retention system may need to be installed in order to make a mass excavation for the project. The temporary excavation support system will need to be designed to retain the existing structures to remain north of Ohio Street and south of Wabash Street, as well as the adjacent streets, sidewalks, underground utilities, etc. surrounding the proposed structure. It must be noted that it is not possible to accurately determine beforehand the excavation depths that will be necessary in order to remove all of the unsuitable materials at footing excavations and deeper excavations may become necessary at some isolated locations.

It will be necessary to use a proprietary intermediate foundation system or in-place soil modification/ground improvement technique such as aggregate columns or rigid inclusions to modify and improve the existing subsurface materials at the spread footing locations where the Main Concourse Level is the lowest floor level (i.e., at the west entrance and the east gymnasium areas) such that spread footings could be used without the need for complete removal and replacement of the unsuitable materials as described above. The use of a proprietary ground improvement system or intermediate foundation system will eliminate the need for extensive undercutting of unsuitable soils to variable depths, and backfilling after removal of the unsuitable materials. This approach also results in more predictable foundation costs and scheduling since it eliminates the need for extensive undercutting and replacement of unsuitable soils to variable depths, which is unquantifiable beforehand.

If aggregate columns or rigid inclusions are to be used, the specialty geotechnical contractor selected to improve the existing subsurface materials in-place must be consulted regarding the installation of such ground improvement elements adjacent to existing facilities such as buildings, pavements, utilities, etc. to ensure that the existing features are not adversely affected due to the installation of the aggregate columns or rigid inclusions, including the serviceability of any existing operations, equipment or functions within the existing facilities due to vibrations from the installation process. Consideration must also be given to the installation sequencing of the aggregate columns or rigid inclusions with respect to the construction of the Court Level such that the installation process does not adversely affect the new basement walls or foundations, or that excavation for the basement does not compromise the integrity of previously installed aggregate columns or rigid inclusions, depending upon the specific construction sequence.

A specialty geotechnical contractor should be consulted regarding applicability of their specific ground improvement system and installation methods for this project. The specialty ground improvement contractor shall be responsible for the design, installation, performance and warranty of the ground improvement system. The ground improvement system selected must be able to suitably improve the existing subsurface materials within the depth zone required for proper bearing of spread footings and to also control settlement within the limits prescribed by the architect and structural engineer for serviceability and structural considerations of the building. Consideration must also be given to the presence of apparent obstructions at some locations (approximately 15 percent of the test borings and soundings encountered apparent obstructions) and the approach for an alternate course of action in cases where obstructions are encountered. Since aggregate columns and rigid inclusions are proprietary specialty geotechnical systems that result in modified subsurface materials, the ground improvement plan and final spread footing design criteria shall be developed and prepared by an engineer registered in the State of Indiana, retained by, or working for, the specialty geotechnical contractor, who shall be entirely responsible for the design, installation, performance and warranty of the ground improvement system. Additional information regarding ground improvement measures for spread footings are provided in Section 4.4.

Another option for support of the non-basement portions of the structure is the use of auger-cast piles that extend to derive capacity in the competent soils below the upper unsuitable materials. Recommendations for auger-cast piles can be provided if desired.

4.3 Spread Footings – Court Level Area

As described in Section 4.2, the portions of the proposed structure that will include Court Level areas can be supported on conventional spread footings that bear on the natural, medium dense to dense, glacial outwash sand and gravel that was typically encountered in the test borings below the unsuitable materials. It will be necessary to remove old fill, remnants of previous construction, natural cohesive soils or looser sand at some spread footing locations and the spread footings must bear on the natural, medium dense to dense glacial outwash sand and gravel; or on lean concrete fill that is placed over such soils after first removing any unsuitable materials to expose the suitable bearing soils. It is important to note that although soils considered suitable for support of the proposed structure using spread footings (i.e., the natural medium dense to dense glacial outwash soils) were typically encountered at or below approximately El 690 in some of the test borings, unsuitable materials extend deeper at other locations. Thus, it will be necessary to undercut unsuitable materials where identified by the footing inspections at the time of construction, and to backfill the undercut excavations with well-compacted engineered fill or lean concrete fill (minimum compressive strength of lean concrete of 2,500 lbs/sq.in.).

It is essential that the soils exposed at the bases of all spread footing excavations should be carefully observed, tested and evaluated by a representative of Atlas to identify any unsuitable materials that must be removed, determine when suitable bearing soils are encountered and to confirm that all unsuitable materials have been identified and removed so that each spread footing will bear on suitable, competent soils as described above.

In order to limit foundation settlements within acceptable tolerances, the maximum allowable bearing pressure (ABP) for the spread footings beneath the Court Level shall be limited to 6,000 lbs/sq.ft for spread footings bearing at or below El 692. In addition to limiting the settlement of the more heavily loaded columns, it will also be necessary to design the spread footings such that there is a factor of safety of at least 3 relative to a general bearing (or shear strength) failure of the footings. Since the strength based bearing capacity for a spread footing that bears on granular soils (such as those at this project site) is primarily dependent upon the size of the footing (larger spread footings have greater bearing capacity relative to strength, or shear failure). Spread footings that bear on natural medium dense to dense glacial outwash sand and gravel, or on well-compacted engineered fill or lean concrete fill that is placed over the suitable natural medium dense to dense glacial outwash sand and gravel after first removing any unsuitable soils, can be designed for a maximum allowable bearing pressure of 6,000 lbs/sq.ft for column (individual square type) footings and 4,000 lbs/sq.ft for wall (strip type) footings for sustained loading conditions due to dead load, live load and snow load. The allowable bearing pressures can be increased to 7,500 lbs/sq.ft for column footings and 5,000 lbs/sq.ft for wall footings for transient or extreme loading conditions due to wind or earthquake loads.

Wall footings that bear at or below El 692 should be designed based upon a maximum allowable bearing pressure of 4,000 lbs/sq.ft. Wall footings should be a minimum of 2.5 ft wide and column footings should be a minimum of 4 ft wide for bearing capacity considerations.

4.3.1 In-Place Ground Improvements for Non-Basement Areas

It will be necessary to use a proprietary intermediate foundation system or in-place soil modification/ground improvement technique such as aggregate columns or rigid inclusions to modify and improve the existing subsurface materials at the spread footing locations in non-basement areas such that spread footings could be used without the need for complete removal and replacement of the existing unsuitable materials as described previously in Section 4.2. In this case, consideration must be given relative to the use of aggregate columns or rigid inclusions near the existing buildings, roadways, underground utilities, etc.; along with any other site elements. If aggregate columns or rigid inclusions are to be used, the specialty geotechnical contractor selected to improve the existing subsurface materials in-place must be consulted regarding the installation of such ground improvement elements adjacent to existing facilities such as buildings, pavements, utilities, etc. to ensure that the existing features are not adversely affected due to the installation of the aggregate columns or rigid inclusions including serviceability of any existing operations, equipment or functions within the existing facilities due to vibrations from the installation process. Consideration must also be given to the sequencing of aggregate column or rigid inclusions installation with respect to the construction of the basement such that the installation process does not adversely affect the new basement walls or foundations, or that excavation for the basement does not compromise the integrity of previously installed aggregate columns or rigid inclusions, depending upon the specific sequence of construction.

It is recommended that a specialty geotechnical contractor be consulted to confirm the compatibility of the proprietary ground improvement system (i.e., aggregate columns, rigid inclusions, etc.) with the subsurface conditions and the project requirements (e.g., loading conditions, settlement criteria, structure types, existing facilities, scheduling, sequencing of activities, etc.). Due to the variability in the type and condition of the existing subsurface materials at this site, which includes miscellaneous uncontrolled fill, zones of weaker cohesive soils, looser granular soils and remnants from previous construction that extend to varying depths below the existing ground surface and at various locations; the ground improvement system selected must be able to suitably improve the existing subsurface materials within the depth zone required for proper bearing and settlement control of spread footings. The specialty geotechnical contractor must be aware of, and design their system taking into account, the variability in the depth to the stronger, more reliable, natural soils over relatively short lateral distances, and thus uncertainty of the condition of the existing subsurface materials at any specific foundation location. The miscellaneous fill, softer natural cohesive soils and looser granular soils extend to depths as described previously in Section 4.2. Therefore, it is recommended that the specialty geotechnical contractor consider appropriate depths of modification to enhance the reliability of the ground improvement measures.

Aggregate columns is a common proprietary ground improvement technique whereby dense-graded crushed limestone is placed in holes in thin lifts and densified using a specially designed dynamic energy source. The result is a pre-stressing of the existing material around the aggregate “columns”, inclusion of stiff reinforcement elements within the existing matrix materials and a partial transfer of foundation loads to the deeper, more competent stratum. Rigid inclusions is another common type of intermediate proprietary foundation system where cementitious grout is injected into the matrix soils during withdrawal of probes after extending the probes to the prescribed depths. After the “in-place” proprietary ground improvement measures are installed, spread footings can be used without the need for undercutting and replacement of the existing unsuitable materials. If such a system is to be used, consideration must be given by the specialty geotechnical contractor to potential issues regarding ground vibrations during installation of the aggregate columns or rigid inclusions and the potential impact on adjacent structures, operations and functions; as well as potential obstructions that may exist within the existing fill materials. It will be necessary to remove any abandoned foundations or utilities and any large debris within the existing fill to prevent obstruction of the aggregate columns or rigid inclusions. The specialty geotechnical contractor should be consulted regarding the type of equipment and method of ground installation techniques used to determine the magnitude of ground vibrations and potential adverse impacts on the existing facilities and operations within the facilities.

Intermediate foundation systems or ground improvement techniques such as aggregate columns and rigid inclusions are proprietary specialty geotechnical design/build procedures that are designed by a registered engineer retained by or working for the specialty geotechnical foundation contractor and installed by the specialty geotechnical contractor. Therefore, the specialty geotechnical contractor should be contacted regarding specific applicability to this project, development of the specific program to meet the project requirements including bearing capacity and settlement limitations. Spread footings that bear on intermediate foundation systems consisting of modified or improved subsurface materials as described above can usually be designed for an allowable bearing pressure in the range of about 5,000 to 8,000 lbs/sq.ft while limiting settlement within required project tolerances without the need for undercutting and replacing the existing subsurface materials or the use of deep foundations. The actual design bearing pressure must be determined by the specialty geotechnical contractor based on the specific criteria of the system, the expected loading conditions and required settlement tolerances. Since aggregate columns and rigid inclusions intermediate foundation systems are proprietary specialty geotechnical systems that result in modified foundation soils, the ground improvement plan and final spread footing design criteria shall be developed and prepared by an engineer registered in the State of Indiana working for or retained by the specialty geotechnical contractor who shall be entirely responsible for the design, installation, performance and warranty of the intermediate foundation system.

4.3.2 Lightly Loaded, Non-Settlement Sensitive Spread Footings

Lightly loaded project elements that are not settlement sensitive, such as site retaining walls, lightly loaded independent canopies (e.g., not attached to other structures), signs, screen walls, decorative elements, etc., can be supported on shallow spread footings bearing on the existing soils at nominal depths, provided that the soils at the bases of these spread footing excavations are carefully observed and evaluated and any clearly unsuitable materials that are identified (i.e., fill that contains collapsible objects or degradable materials, concentrations of rubble and debris, old utilities such as sewers, etc. and soft or loose soils) are first removed and replaced with well-compacted engineered fill. However, it must be must recognized that there is some risk of greater-than-normal settlement in this case since undocumented fill materials, such as those noted in the upper approximately 6.0 ft to 18.5 ft at this site, are not as reliable as naturally deposited soils and the fill could contain compressible or collapsible materials not detected by the test borings or revealed by the field observations at the time of construction. If this risk is unacceptable, then these project elements should be supported on spread footings bearing on firm natural soils in a similar manner as described in Sections 4.2 and 4.3 for the main building, or other alternative foundation elements may be considered, such as auger-cast piles.

Provided that the risk of greater than normal settlement of the lightly loaded, non-settlement-sensitive project elements as described above is acceptable, spread footings that bear on firm existing soil at nominal depths, or on well-compacted engineered fill that is placed over firm existing soil, can be designed for a net allowable soil bearing pressure of 1,500 lbs/sq.ft for column (square type) and wall (strip type) footings. It should be anticipated that some undercutting of very soft or very loose soils, or concentrations of rubble and debris, will be required at some locations even in conjunction with the relatively light soil bearing pressure.

Wall footings should be at least 2 ft wide and column footings should be at least 3 ft wide for bearing capacity considerations.

4.4 General Spread Footing Recommendations

In using the allowable bearing pressures recommended in the preceding report sections, the weights of the spread footings and the backfill material that is placed over the footings, including the weight of the lowest floor slab, need not be considered; hence, only loads applied at or above the lowest finished floor level need to be used for dimensioning the spread footings.

Provided that the spread footings are designed as prescribed herein and the soils at the bases of all of the spread footing excavations are observed and evaluated as outlined above and in Section 5.4, it is estimated that the total and differential foundation settlements for the proposed structure should not exceed about 1.5 in. and 1 in., respectively. Careful field control will contribute substantially to minimizing the settlements.

All exterior spread footings and spread footings in unheated areas should be located at a depth of at least 3 ft below the final exterior grade for frost protection. Although the Indiana Building Code requires only 2.5 ft of foundation embedment below the exterior grade in Marion County, our experience indicates that the actual frost depths in this region can occur deeper.

Uplift forces on the spread footings can be resisted by the weight of the spread footings and the soil material that is placed over the footings. It is recommended that the soil weight considered to resist uplift loads be limited to that immediately above and within the perimeter of the footings unless a much higher factor of safety is used. A soil unit weight of 120 lbs/cu.ft can be used for the backfill material placed above the footings, provided it is compacted as recommended in Section 5.3. It is also recommended that a factor of safety of at least 1.3 be used for calculating uplift resistance from the footings, provided only the weight of the footing and the soil immediately above the spread footing are used to resist uplift forces.

Lateral loads imparted upon spread footings can be resisted by the passive lateral earth pressure against the sides of the footings and by friction between the foundation soil and the bases of the footings. If passive lateral earth pressure is to be used to resist lateral loads imparted on the spread footings, it is essential that the soil that is relied upon to provide the passive lateral earth pressure resistance cannot be excavated or otherwise disturbed at any time in the future. If it is possible that disturbance or an excavation could be made in any portion of the passive zone (including not only soils beside the footings but soils above the tops of the footings), then passive lateral earth pressure resistance should not be considered for resistance of lateral loads. An allowable passive lateral earth pressure (allowable “equivalent fluid pressure”) of 125 lbs/sq.ft per foot of depth below the ground surface can be used for that portion of the footing that is below a depth of 2.5 ft below the final grade (no portion of the footing above these depths should be used for lateral resistance). An allowable coefficient of friction between the base of the footing and the underlying soil of 0.3 (based on a factor of safety of 1.5) can be used in conjunction with the minimum downward load on the base of the footing. The allowable coefficient of friction should be reduced to 0.15 for lightly load spread footings for non-settlement sensitive elements as described in Section 4.3.2.

All spread footings should be located so that the least lateral clear distance between any two footings (including existing and new footings) will be at least equal to the difference in their bearing elevations. It is extremely important to note that this does not define the slope at which excavations can safely be made, which is much flatter, but rather the geometric arrangement necessary to prohibit overstressing foundation soils due to stress interference between footings. If this distance cannot be maintained, the lower footing should be designed to account for the load imparted by the upper footing. If this condition occurs adjacent to a below-grade wall, the wall should be designed for the additional lateral surcharge load that will be imparted upon the wall by the upper footing. The actual slope of a temporary excavation will need to be made flatter and bracing, shoring or underpinning of existing footings may be necessary, depending upon the specific geometric arrangement of the footings and loading conditions on the footings, in order to protect the integrity of the existing footings and to prohibit undermining of soil from beneath spread footings.

Care must be exercised when excavating near the existing and surrounding streets, utilities, etc. to protect the integrity of the existing features. Bracing, shoring or underpinning will be required where it is necessary to excavate below the bottom elevation of the existing footings, floor slabs, streets, utilities, etc.

4.5 Slab-on-Grade Floors

It is expected that relatively clean natural sand and gravel soils will be exposed beneath much of the basement level floor slab. However, where cohesive soils or clayey/silty sand is encountered at the basement floor slab subgrade level and the clean sand and gravel is not exposed at the slab subgrade level, it is recommended that the existing soils be removed to a minimum depth of 6 in. below the bottom of the slab and replaced with a 6 in. (minimum) thick layer of granular material such as sand and gravel or crushed stone. This is to help distribute concentrated loads and equalize moisture conditions beneath the slab. A modulus of subgrade reaction value (k_{30}) of 150 lbs/cu.in. can be used for design of the basement floor slabs.

It appears that it is possible to support the slab-on-grade floors in the non-basement areas on the existing materials provided the slab subgrade is prepared and observed as described in Section 5.2 of this report and any clearly unsuitable fill materials (i.e., fill that contains collapsible objects or degradable materials, concentrations of rubble and debris, old utilities such as sewers, cisterns, wells, etc. and soft or loose soils) are removed and replaced with compacted engineered fill. Based on the type of fill materials encountered in the test borings, in conjunction with the anticipated relatively light floor slab loading, the cost of complete removal and replacement of the existing uncontrolled fill materials beneath the floor slab areas may not be justified in order to completely eliminate the relatively small risk of greater-than-normal floor slab settlement that could occur at some locations if the existing fill is not completely removed. However, the owner must recognize that there is some risk of greater-than-normal floor slab settlement in this case since uncontrolled fill materials are not as reliable as naturally deposited soils and the fill could contain compressible or collapsible materials not detected by the test borings or revealed by the field observations at the time of construction. Alternatively, if it is desired to completely eliminate any risk associated with settlement due to the existing uncontrolled fill and to mitigate unacceptable settlement potential, ground improvement measures could be implemented beneath the floor slabs in a fashion similar to those described for spread footings in Sections 4.2 and 4.3 in order to mitigate and limit settlement of the floor slabs.

It is recommended that the floor slabs in non-basement areas be supported on a 6 in. thick (minimum) layer of granular material such as sand and gravel or crushed stone. This is to help distribute concentrated loads and equalize moisture conditions beneath the slab. Provided that a minimum of 6 in. of granular material is placed below the non-basement floor slab, a modulus of subgrade reaction (k_{30}) of 125 lbs/cu.in. can be used for design of the non-basement floor slabs.

If any floor finishes, flooring adhesives or floor coverings are to be used for the basement level of the building that are sensitive to moisture, or if there are any functions or uses of the basement that could be adversely affected by moisture vapors (such as stored goods in contact with the floor or climate/humidity controlled conditions), a vapor barrier should be included beneath the floor slabs in those areas of the building that will receive the moisture sensitive floor finish, floor covering or otherwise would require a vapor barrier as described above. It is recommended that where vapor barriers are used the vapor barrier should be installed in accordance with ACI Manual of Concrete Practice 302.1R, “Guide to Concrete Floor and Slab Construction”.

4.6 Basement Walls and Drainage

The magnitude of the lateral earth pressure against the basement walls is dependent on the method of backfill placement, the type of backfill material used, drainage provisions and whether or not the wall is permitted to yield during and/or after placement of the backfill. When a wall is held rigidly against horizontal movement, such as a basement wall that is braced by the floors, structural framing and the other walls, the lateral earth pressure against the wall is greater than the "active" lateral earth pressure that is typically used in the design of free-standing retaining walls. Therefore, the basement walls must be designed for higher, "at-rest" lateral earth pressures using an at-rest lateral earth pressure coefficient, K_o. A design illustration to aid in computing lateral earth pressures against the basement walls is included as Figure 3 in the Appendix.

It is recommended that only well-graded, free-draining granular material should be used for backfill behind the basement walls within a zone defined by a plane extending upward and outward on a 1 to 1 slope from the top of the outside edge of the wall footing (see Figure 3 in the Appendix). Provided that well-graded, free-draining granular materials are used for backfill behind the basement walls, a total soil unit weight of 125 lbs/cu.ft and a coefficient of lateral earth pressure at-rest (K_o) of 0.45 can be used to calculate the lateral earth pressure against the basement walls using Figure 3 in the Appendix.

The pressure diagram and method of computation illustrated in Figure 3 in the Appendix presumes that there will be no hydrostatic pressure due to water build-up against the basement walls. Although the projected design high ground water level in the aquifer beneath this site is estimated to be below the basement floor level, it is possible that surface water can infiltrate into the backfill materials and other “perched” water sources may also exist that could result in seepage of water into the backfill around the basement walls. Therefore, it is recommended that the basement walls be damp-proofed and that a perforated drainage pipe be placed along the bases of the walls to drain any surface water or perched ground water that might enter the backfill. All of the drain pipes should drain to a sump pit from which water can be pumped, or to a suitable gravity outfall if possible. While the amount of water to be discharged should not be great most of the time, and no flow is expected for extensive periods of time; it is possible that continuous flow may occur at certain times, particularly during periods of extended and/or heavier precipitation. Based upon the subsurface conditions encountered and the projected design high ground water level, it is our opinion that underslab drains are not needed beneath the basement level floor slab.

4.6.1 <u>Free-Standing Site Retaining Walls</u>

For relatively short site retaining walls that are designed as cantilever retaining walls that are free to rotate sufficiently to develop the active lateral earth pressure condition, an active lateral earth pressure coefficient (K_a) of 0.33 and a total soil unit weight of 125 lbs/cu.ft (or an “equivalent fluid pressure” of 42 lbs/cu.ft) can be used to calculate the lateral earth pressures on the walls and footings provided that well-graded granular backfill material is used behind these walls. It is recommended that a perforated drain pipe be placed along the base of the free-standing retaining walls to drain any surface water or ground water that might enter the backfill. The pipe should drain to a sump pit from which water can be pumped or drain to a suitable gravity outfall that is protected from clogging.

Lateral loads on the free-standing retaining walls can be resisted by the passive lateral earth pressure on the outside face of the wall foundation and by friction between the base of the foundation and the foundation soils. An allowable passive earth pressure of 100 lbs/sq.ft per ft of depth (using a factor of safety of 3 relative to the full passive pressure) below the ground surface can be used on that portion of the foundation located below a depth of 2.5 ft below the exterior grade (no portion of the footing above this depth should be used for lateral resistance). If passive lateral earth pressure is to be used to resist lateral forces, it is essential that the earth that is relied upon to provide the passive pressure resistance cannot be excavated or altered in the future, including the soil above the top of footing level. An allowable coefficient of friction between the base of the retaining wall footings and the foundation soils of 0.15 can be used in conjunction with the minimum downward load on the free-standing retaining wall foundation (based on a factor of safety of 1.5 relative to the ultimate friction).

The footings for the site retaining walls can be designed using the criteria described in Section 4.3.2 for lightly loaded, non-settlement sensitive spread footings in non-basement areas.

4.7 Pavement

The test borings that were drilled for this project revealed uncontrolled fill materials that extend to depths ranging from about 3.5 ft to 18.5 ft below the existing ground surface. Due to the multiple generations of past development at the site that included various types of structures and below-grade elements; it is likely that other types of uncontrolled miscellaneous fill materials (e.g., rubble, debris, remnants from previous construction, such as basement floor slabs, foundations, walls, pits, wells, cisterns, utility lines, etc.) exist at various locations on-site and possibly extend to greater depths. Although the uncontrolled fill materials encountered in the test borings are not as reliable as the underlying naturally deposited soils, it does not appear to be practical and probably not economically justified to remove all of the old fill materials from under the proposed pavement areas. It is, however, recommended that any remnants of previous construction that are exposed at the pavement subgrade level (such as foundations, walls, pits, vaults, etc.) be removed to a depth of at least 2 ft below the base or bottom of the proposed pavement section and replaced with well-compacted engineered fill to provide uniform support directly beneath the pavement sections. Furthermore, any collapsible objects, pockets of “nested” debris or rubble, any soft or otherwise unsuitable materials that are identified beneath the pavement subgrade level should also be removed and replaced with well-compacted engineered fill material. Report Section 5.2 contains additional recommendations regarding site preparation and Section 5.3 describes recommended fill compaction requirements.

If at the time of construction the pavement subgrade is found to be excessively wet, soft or yielding, it is recommended that the subgrade soils be stabilized by discing, aerating and recompacting, if possible. However, if it is not possible to improve the subgrade soils in this manner because of weather conditions, scheduling or other conditions, which is often the case, it is recommended that the pavement subgrade soils be improved or modified using mechanical stabilization (i.e., using a geogrid with additional crushed limestone), or removal of the unsuitable materials and replacement with crushed limestone. The best method for stabilizing the pavement subgrade should be determined in the field at the time of construction based upon the actual field conditions in conjunction with the specific soil type encountered at the locations requiring stabilization, the size of the areas requiring stabilization and the construction schedule.

Based on our experience with the near-surface soils of the type underlying this site, the pavement subgrade soils at this site are likely to become unstable under construction traffic, particularly if the construction will be done during seasons when heavy precipitation and cooler temperatures typically occur (such as late fall, winter and spring). The extent to which yielding pavement subgrades may be a problem is difficult to predict beforehand since it is dependent upon several factors including seasonal conditions, precipitation, cut depths, sequencing and schedule of earthwork, surface and subsurface drainage measures, the weight and traffic patterns of construction equipment, etc. Based on our experience on other projects near this site with similar soil conditions, it appears likely that improvement or stabilization of pavement subgrade soils will be required in most, if not all, areas at this site.

In order to cope with constructability problems and to avoid schedule delays associated with the type of soil conditions described in the preceding paragraph, it would be prudent to develop a contingency plan for subgrade stabilization so that it can be implemented where deemed necessary by the geotechnical engineer at the time of construction based on the specific field conditions encountered. Mechanical subgrade stabilization using a biaxial geogrid in conjunction with additional crushed limestone, or undercutting of the unsuitable soils and replacement with crushed limestone is considered appropriate for pavement subgrade stabilization. It is important that the geotechnical consultant provide continuous inspection during the earthwork operations to identify areas where special stabilization will be required while limiting the stabilization to only those areas where it is necessary.

The pavement subgrade surface should be uniformly sloped to facilitate drainage through the granular base and to avoid ponding of water beneath the pavement. The storm water catch basins in pavement areas should be designed to allow water to drain from the aggregate base into the catch basins. At a minimum, subsurface trench drains should be included that extend out at least 20 ft in four directions from the catchbasins.

Based on the results of classification tests and our experience with similar soils, a resilient modulus value of 4,000 lbs/sq.in. has been estimated for use in pavement design for the subgrade soils encountered at this site. The subgrade soils should be prepared and inspected as described in Sections 5.2 and 5.3 of this report.

The following report sections outline recommendations for asphalt and concrete pavements for automobile parking areas and truck zones. It is important to note that the recommendations for the automobile parking areas are based on the assumption that these areas will not be subject to any heavy truck traffic. Therefore, in areas where truck traffic cannot be controlled (i.e., driveways), it is suggested that the thicker pavement section be utilized.

4.7.1 Asphalt Pavement

Based on a resilient modulus value of 4,000 lbs/sq.in., a design period of 15 years and the conditions encountered at the site, the following asphalt pavement sections are recommended:

Automobile Parking Areas	3.5 in. of asphaltic concrete over 6 in. of granular base.
Driveway Areas and Truck Zones	5 in. of asphaltic concrete over 8 in. of granular base.

The base should be a well-graded crushed stone with a maximum of 10 percent (by weight) finer than the No. 200 sieve such as coarse aggregate size No. 53 in accordance with INDOT Standard Specifications ("commercial grade" No. 53 crushed stone should not be used as pavement base material). The asphaltic concrete pavement should be constructed in accordance with the INDOT Standard Specifications Section 402-Hot Mix Asphalt, HMA, Pavement.

It should be expected that normal maintenance compatible with asphalt pavement and the design period selected will be required during the life of the pavement. Furthermore, overlaying the pavement surface may be desirable at an intermediate time period to extend the life of the pavement and improve serviceability.

4.7.2 Concrete Pavement

Concrete pavement thicknesses were determined from methods developed by the American Association of State Highway and Transportation Officials (AASHTO). These methods assume that the subgrade is firm, well-compacted and non-pumping and that all joints are properly designed, located and sealed to minimize moisture seepage into the subgrade. It is also important to ensure that proper concrete curing practices will be employed and that traffic will not be allowed until the concrete has had sufficient time to cure.

For design calculation purposes, the compressive strength of the concrete was assumed to be 4,000 lbs/sq.in. (or a modulus of rupture of about 600 lbs/sq.in.). The modulus of subgrade reaction of the soil (k) was estimated to be 100 lbs/cu.in.

Based on the above information, the following concrete pavement sections are recommended:

Automobile Parking Areas	5 in. of concrete over a well-compacted, non-pumping subgrade.
Driveway Areas and Truck Zones	8 in. of concrete over a well-compacted, non-pumping subgrade.

The performance of the concrete paving section is highly dependent on controlling the pumping of the subgrade soils. Although no wet surface soils were noted at the time of this study, it is important that surface drainage be controlled to prevent water from ponding in pavement areas.

4.8 Site Grading and Drainage

Proper surface drainage should be provided at the site to minimize increase in moisture content of the foundation soils and to prevent surcharging the Court Level drainage system due to infiltration of excess surface water. The exterior grade should be sloped away from the structure to prevent flow of surface water toward the building and prevent ponding of water around the building. Any roof drains or down spouts should be channeled or piped well away from the structure.

The soils encountered in the test borings below depths of approximately 11.0 ft to 18.5 ft below the existing ground surface generally consist of relatively pervious glacial outwash sand with minor amounts of silt and varying amounts of gravel (higher amounts of silt or fine particles tend to restrict flow/infiltration of water). Based on the granular soils encountered in the test borings below depths of approximately 11.0 ft to 18.5 ft, field infiltration testing on similar soils, the particle size distribution test results, and a consideration of published literature, we recommend a design infiltration rate of no more than 4 in./hr, only where the infiltration elements extend into the natural glacial outwash sand and gravel. The materials above the natural granular soils, however, generally consist of miscellaneous fill that is quite variable and natural silty clay, sandy silty clay, and/or clay, and these materials are generally not suitable for storm water infiltration measures. Therefore, any measures constructed for disposal of storm water by infiltration into the subgrade soils, such as in the west portion of the site, will need to extend down into the more permeable natural glacial outwash sand and gravel. It is recommended that a 12 inch thick (minimum) layer of INDOT No. 5 or No. 8 coarse aggregate be placed beneath underground stormwater detention elements.

It must be noted that although the soils below depths of approximately 11.0 ft to 18.5 ft below the existing grade appear to be generally conducive to disposal of storm water by infiltration methods, subsurface soil and ground water conditions change through time, such as a seasonal rise in the ground water level and a decrease in the permeability of the subsurface soils due to intrusion of fines transported by the storm water into the granular soils. Therefore, it is recommended that any storm water infiltration system include measures for cleaning as well as a suitable alternate outfall should the system performance be diminished or impaired. It is recommended that any stormwater infiltration elements be located well away from the building to prevent surcharging the perimeter drainage system. It is recommended that the base of an infiltration element be located no higher than the Court Level.

4.9 Light Pole Foundations

It is our understanding that new light poles will be installed around the proposed Arena and Convocation Center. Details regarding the light poles and light pole foundations are not available at this time, however, it is understood that the light poles will be of a conventional decorative type, no larger than a typical parking-lot size light pole. It is anticipated that the light poles will be supported by conventional circular reinforced concrete pier foundations. Due to the variability in the existing uncontrolled fill material, it is recommended that the light pole foundations extend a minimum depth of 8 ft into the existing soil. Since the natural outwash sand and gravel will not be encountered at all locations at this depth, a relatively low design allowable bearing pressure of 2,000 lbs/sq.ft should be used for axial loads at the bases of the foundations. If the foundations are extended into natural sand and gravel at all locations, a higher design allowable bearing pressure of 5,000 lbs/sq.ft can be used for axial loads.

Lateral forces on the light poles can be analyzed with resistance by the passive lateral earth pressure against the sides of the foundations. An allowable passive pressure of 125 lbs/sq.ft per foot of depth below the ground surface can be used for that portion of the foundation that is below a depth of 2.5 ft below the final exterior grade (no portion of the pier foundation above this depth should be used for lateral resistance). If passive lateral earth pressure is to be used to resist lateral forces, it is essential that the earth that is relied upon to provide the passive pressure cannot be excavated in the future, including the near surface soils around the foundations.

5 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Since this investigation identified actual subsurface conditions only at the test boring locations, it was necessary to extrapolate these conditions in order to characterize the entire project site. Even under the best of circumstances, the conditions encountered during construction can be expected to vary somewhat from the test boring results and may, in the extreme case, differ to the extent that modifications to the foundation recommendations become necessary. Therefore, we recommend that Atlas be retained as geotechnical consultant through the earth-related phases of this project to correlate actual soil conditions with test boring data, identify variations, conduct additional tests that may be needed and recommend solutions to earth-related problems that may develop.

5.1 Mass Excavation

It will be necessary to make a mass excavation to a depth of as much as about 15 ft to 20 ft, or more, below the existing ground surface in the proposed Court Level area. A temporary earth retention system may be required to retain the surrounding soil and to protect the adjacent buildings, sidewalks, streets and underground utilities. While the design of a temporary earth retention system is beyond the scope of this study and should be performed by an experienced specialty contractor who designs and installs the system, our experience in downtown Indianapolis indicates that such earth retention systems typically consist of soldier piles and wood lagging with soil tie-back anchors. When the proposed earth retention system is designed, consideration should be given to the fact that there may be cobbles and boulders in the glacial outwash materials as well as other man-made obstructions that could impact the installation of the soldier piles and/or anchors.

It is important to recognize that any earth retention system will permit some movement (both horizontal and vertical) of the earth behind the retention system. The earth retention system described above may permit an undesirable amount of movement if placed immediately adjacent to an existing structure. The amount of movement of the system will depend upon the geometry of the system, stiffness of the members, the locations and capacities of the tie-back anchors, the location and loading of existing features, etc., as well as the care and expertise of the installer. A less flexible system, such as a tied-back, steel-reinforced, auger-cast concrete tangent pile wall, may be required in instances where less deflection is required. While this type of wall, which except for the tie-backs can be installed prior to any excavation, will not eliminate all movement behind the wall, our experience indicates that such a wall can be designed to limit lateral movement to about ½ inch or less. It is recommended that the construction documents require that the temporary earth retention system be designed by a registered engineer in the State of Indiana and constructed by a qualified specialty contractor who is well-experienced in this type of work, with only certain performance items specified, such as allowable displacement restrictions (vertical and horizontal deflection), corrosion protection and tie-back testing.

In areas where an open-cut excavation may be possible, and thus an earth retention system is unnecessary, it is recommended that the planned temporary excavation be based on sideslopes made no steeper than 2 (horizontal) to 1 (vertical), provided that there are no structures located immediately adjacent to the crests of the slopes. Unless detailed analyses are made based upon specific excavation geometry, building loads, bearing elevations, etc., the crests of the excavation slopes should be at least 30 ft away from any existing buildings based upon excavation slopes of 2 (horizontal) to 1 (vertical), or flatter. The recommendations for temporary excavation slopes assume that the ground surface at the crest of the excavation slope is flat and that no significant, or permanent, surcharge loading is applied. If there is any surcharge loading on the slope or at the crest of the slope, specific analyses will be required based upon the specific loading conditions, overall extent of the loading, loading intensity, etc. The actual slope configurations of temporary excavations must be determined by the contractor responsible for the temporary excavation, construction means and methods and site safety and should take into account the locations and loading from other adjacent facilities. Some sloughing of loose material should be expected with such slopes and the slopes should be maintained as necessary (including flattening the slope if necessary) and continuously monitored for detection of instabilities that may require remediation. All federal, state and local safety regulations should be followed in regard to open-cut excavations.

It is recommended that a baseline condition and crack survey be made of any nearby structures that could be impacted by the construction before construction is initiated. This should include establishing benchmarks and initial elevations on sidewalks and streets adjacent to the proposed excavation. It is also recommended that a thorough investigation of the existing nearby structures precede any construction to document any existing defects (such as cracks, uneven floors, misaligned windows and doors, etc.) in the existing structures. Periodic monitoring of horizontal and vertical movement of the walls of nearby structures should be incorporated into the retention system program to monitor any movement of the nearby structures.

5.2 Site Preparation

All areas that will support floor slabs and pavements should be properly prepared. After rough grade has been established, the exposed subgrade should be carefully tested, observed and assessed by the geotechnical engineer or a qualified soils technician by probing and testing as needed. The exposed subgrade should furthermore be tested by proofrolling with suitable equipment to check for pockets of soft material hidden beneath a thin crust of better soil. Any remnants from previous construction, unsuitable fill, utility pipes, organic material still in place, frozen, wet, soft or loose soil and any other undesirable materials should be removed and replaced with engineered fill as outlined in Section 5.3. Based on the results of the test borings, it is evident that some areas may need modification or stabilization due to unsuitable subgrade soils. It is suggested that the project include contingency plans for stabilization or modification (such as removal of unsuitable soils and replacement with compacted fill, chemical stabilization, mechanical stabilization, etc.) to be used as determined appropriate based upon careful observations of the specific conditions encountered in the field at the time of construction.

Our experience with soils of the type underlying this site indicates that the near surface subgrade soils may tend to yield and become unstable under construction traffic, particularly if the construction will be done during a period of heavy precipitation. The extent to which yielding subgrade may be a problem is difficult to predict beforehand since it is dependent upon several factors including seasonal conditions, precipitation, cut depths, sequencing and scheduling of the earthwork, surface and subsurface drainage measures, the weight and traffic patterns of construction equipment, etc. Depending on these factors, it may be possible to stabilize some yielding subgrade soils by discing, aerating and then recompacting the soils; however, this is often unsuccessful, particularly in the late fall, winter and spring construction seasons since the weather conditions may not permit drying to occur.

In order to cope with constructability problems and to avoid schedule delays associated with these types of soil conditions, it would be prudent to develop a contingency plan for stabilization of subgrade soils so that it can be implemented, where deemed necessary by the field representative of the geotechnical engineer at the time of construction based on specific field conditions encountered. In general, removal of unsuitable materials and replacement with crushed limestone will likely be the most appropriate stabilization method. Mechanical subgrade stabilization using a biaxial geogrid in conjunction with additional crushed limestone may also be appropriate for stabilization. It is important that the geotechnical consultant provide continuous inspection during the earthwork operations to identify areas where special stabilization will be required while limiting the stabilization to only those areas where it is necessary.

Care must be exercised during the grading operations at the site. Due to the silty and clayey nature of the near surface soils, the traffic of construction equipment may create pumping and general deterioration of the shallower soils, especially if excess surface water is present. It is important that positive surface drainage be established at the beginning of the earthwork operations and be maintained throughout the project. Surface water must not be allowed to pond. Furthermore, compaction and sealing of the subgrade surface is important when precipitation is expected. The site storm drainage elements (i.e., catch basins, pipes, manholes, etc.) should be installed as early as possible, which will aid in control of surface and ground water.

5.3 Fill

Any engineered fill that is placed beneath spread footings that are designed for an allowable bearing pressure of 6,000 lbs/sq.ft or less should be compacted to at least 100 percent of the standard Proctor maximum dry density (ASTM D698), or lean concrete can be used. All engineered fill beneath floor slabs and pavements should be compacted to a dry density of at least 95 percent of the standard Proctor maximum dry density (ASTM D698).

The compaction should be accomplished by placing the fill in about 8 in. thick (or less) loose lifts and mechanically compacting each lift of fill with a vibratory compactor to at least the specified minimum dry density. The moisture content of the fill materials should be within a range of 2 percent below the optimum moisture content to the optimum moisture content. Field density tests should be performed on each lift as necessary to verify that adequate moisture conditioning and compaction is being achieved.

It is recommended that only well-graded granular material, such as sand and gravel that contains no more than 10 percent material finer than the No. 200 sieve or INDOT No. 53 crushed limestone, should be used to fill undercut excavations beneath footings with a bearing pressure of 6,000 lbs/sq.ft or less and other excavations of limited lateral dimensions where proper compaction of cohesive materials is difficult and compaction can only be accomplished with small vibratory equipment. Lean concrete with a compressive strength of at least 2,500 lbs/sq.in. can also be used as fill for undercut excavations beneath spread footings.

5.4 Foundation Excavations

It is essential that the soil at the base of each spread footing excavation should be carefully observed, tested and evaluated by an engineer or a qualified geotechnical field technician working under the direction of the geotechnical engineer-of-record to verify that each spread footing will bear on the natural medium dense to dense glacial outwash sand and gravel as described in Sections 4.2 and 4.3 of this report and to identify any unsuitable materials that must be removed and replaced. All uncontrolled fill, remnants from previous construction, cohesive soils, pockets of looser granular soils and any otherwise undesirable materials must be removed at the spread footing locations so that the footings will bear on satisfactory material compatible with the design of the spread footings as described in Sections 4.2 and 4.3 (i.e., medium dense to dense glacial outwash sand and gravel). At the time of such observations, it will be necessary to make hand auger borings, use a hand penetration device or perform a small test pit in the base of the foundation excavation to evaluate the soils below the base of the spread footings. The necessary depth of penetration will be established by the geotechnical engineer or geotechnical field technician. It is recommended that the natural sand and gravel exposed at the base of the spread footing excavations be compacted with a vibratory compactor prior to placing reinforcing steel and the footing concrete.

It appears that it will be necessary to remove and replace unsuitable materials at some footing locations in the Court Level area. Where undercutting is required to remove unsuitable materials, the proposed spread footing bearing elevation may be re-established by backfilling with appropriate fill materials as described in Section 5.3 after all undesirable materials have been removed. The undercut excavation beneath each spread footing in basement areas should extend as deep as necessary to reach suitable bearing soils as described in Sections 4.2 and 4.3. If granular fill materials (such as sand and gravel, crushed limestone, etc.) are to be used to backfill the undercut excavations for spread footings designed for an allowable bearing pressure of 6,000 lbs/sq.ft or less, the dimensions of the excavation base should be determined by imaginary planes extending outward and downward on a 2 (vertical) to 1 (horizontal) slope from the base perimeter of the footing (see Figure 4 in the Appendix). The entire excavation should then be refilled with compacted engineered fill, or lean concrete can be used to fill the undercut excavations. The undercut excavations for spread footings designed for an allowable bearing pressure of 6,000 lbs/sq.ft or less can be backfilled with well-graded granular material such as sand and gravel or INDOT No. 53 crushed limestone compacted as described in Section 5.3, or with lean concrete. If lean concrete is used to fill undercut excavations beneath the spread footings, the lateral dimensions at the base of the undercut excavation can be made the same as the footing dimensions.

All existing facilities should be suitably protected from undermining due to excavation for the new structures. Depending on the relative depths and locations of the excavations and the need to remove unsuitable materials at footing locations, bracing or underpinning will likely be needed to protect some of the existing facilities. All federal, state and local safety regulations should be followed in this regard.

Soils exposed in the bases of all satisfactory foundation excavations should be protected against detrimental change in condition such as from disturbance, rain and freezing. Surface run-off water should be drained away from the excavation and not allowed to pond. If possible, all footing concrete should be placed the same day the excavation is made. If this is not practical, the footing excavations should be adequately protected. It is suggested that concrete “mud mats” be placed at the bases of the footing excavations to protect the foundation soils from deterioration due to seepage of water, construction activity, etc., and to aid in the proper placement of reinforcing steel.

5.5 Construction Dewatering

The normal ground water level appears to generally be several feet below the proposed foundations for the Court Level. Depending upon the prevailing conditions at the time of construction, it is possible that higher ground water levels could be encountered during the construction of the foundations for the Court Level.

The specific means for temporary dewatering during construction shall be the responsibility of the contractor. It is recommended that the ground water level be depressed and maintained at least 3 ft below the deepest excavation level and that no excavations should be made until it is confirmed/demonstrated that the ground water level has been suitably and reliably depressed at least 3 ft below the deepest expected excavation level. The suitable, proper and reliable dewatering and depressing of the ground water level is critical for this project, and insufficient, improper or inadequate dewatering could result in heaving of soils in the bases of excavations that could further result in excessive foundation settlement.

Depending on the seasonal conditions, some seepage of water into excavations at higher elevations should be expected, particularly since “perched” or “trapped” water is often encountered within miscellaneous fill materials above the normal ground water level. It is anticipated that such seepage will either infiltrate downward into the more pervious granular subsurface soils or can be handled by conventional dewatering methods such as by pumping from sumps located outside the zone of influence of the foundations. This method, however, will not be effective for any excavation that extends below the actual ground water level.

6 FIELD INVESTIGATION

Seventeen test borings and 48 soundings were drilled at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). The test borings were extended to depths of 10 ft to 40 ft below the existing grade. Split-barrel samples were obtained by the Standard Penetration Test procedures (ASTM D1586) at 2.5 ft and 5.0 ft intervals.

Logs of all test borings, which show visual descriptions of all soil strata encountered using the Unified Soil Classification System (ASTM D2488), have been included in numerical order in the Appendix. Ground water observations, sampling information and other pertinent field data and observations are also included. In addition, a "Field Classification System for Soil Exploration" document defining the terms and symbols used on the logs and explaining the Standard Penetration Test procedure is provided immediately following the Test Boring Logs.

7 LABORATORY INVESTIGATION

The soil samples obtained from the test borings were inspected in the laboratory by a geotechnical engineer. The natural soil was classified in general accordance with the Unified Soil Classification System (ASTM D2488) and the test boring logs were edited as necessary based upon the visual inspection and laboratory test results. The laboratory tests performed on the selected soil samples are summarized in the following table. The results of the laboratory tests are included on the Test Boring Logs and test result sheets in the Appendix.

Table No. 5 – Laboratory Testing Program

Laboratory Test Description	Test Method Designation
Classification of Soils for Engineering Purposes	ASTM D2488
Moisture Content Test of Soils	ASTM D2216
Atterberg Limits Tests	ASTM D4318
Unconfined Compressive Strength of Soil	ASTM D2166
Laboratory Determination of Density and Unit Weight of Soil	ASTM D7263
Particle-Size Distribution of Soils Using Sieve Analysis	ASTM D6913
Organic Content (Loss-on-Ignition Test)	ASTM 2974
Marl Content ($CaCO_3$/$MgCO_3$ Content)	ITM 507
Calibrated Hand Penetrometer Test (“Pocket Penetrometer Test”)	NA

NA – Not applicable, no standardized test method available

8 LIMITATIONS OF STUDY

An inherent limitation of any geotechnical engineering study is that conclusions must be drawn on the basis of data collected at a limited number of discrete locations. The recommendations provided in this report were developed from the information obtained from the test borings that depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. The nature and extent of variations between the borings may not become evident until the course of construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during the excavation period and noting the characteristics of any variation.

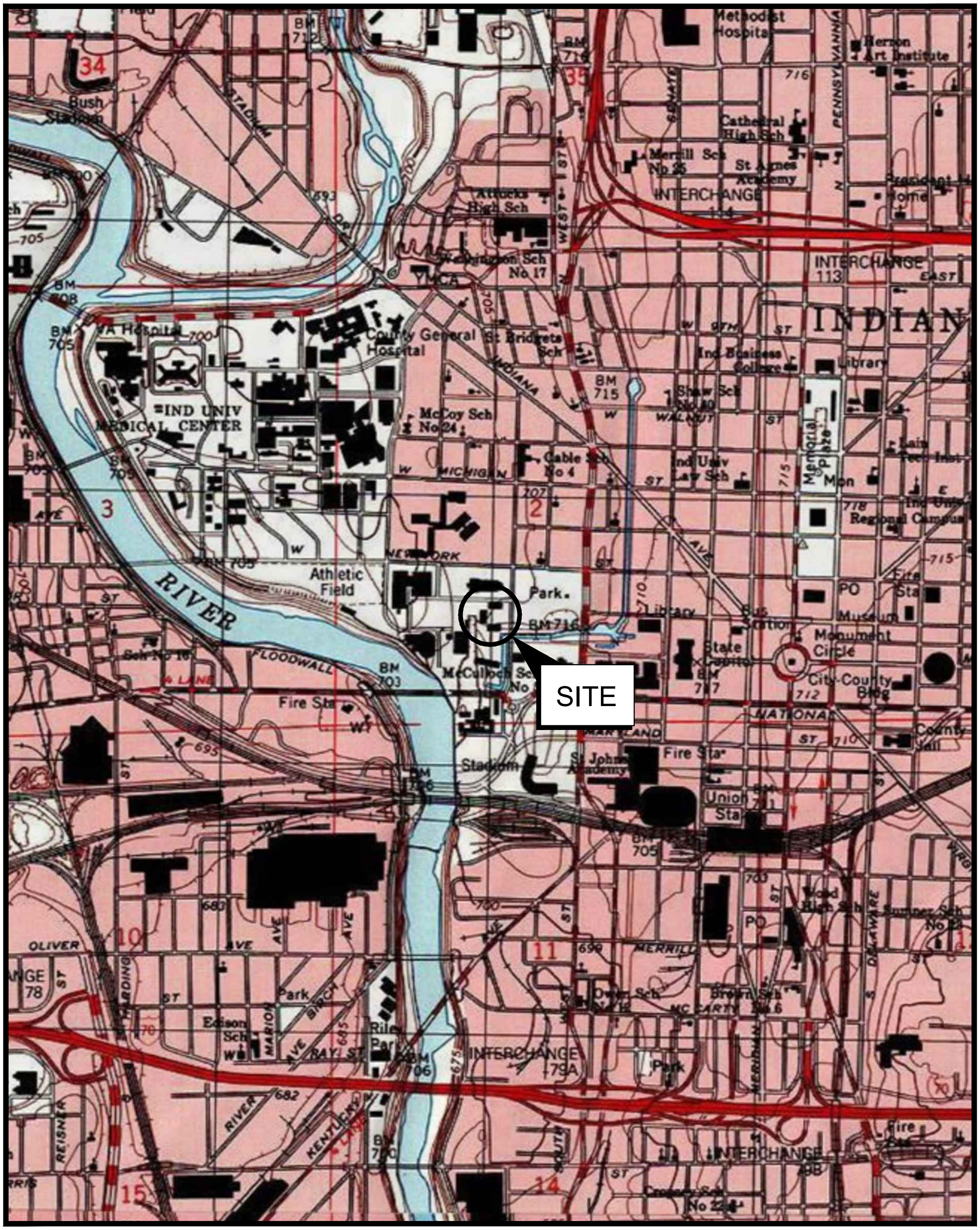
Any comments or recommendations made herein regarding construction related issues or temporary conditions are solely for the purpose of evaluating feasibility and constructability and planning the design of the proposed facilities. The scope of this investigation is not sufficient to identify all potential construction related issues, variations, anomalies, etc. or all factors that may affect construction means, methods and costs.

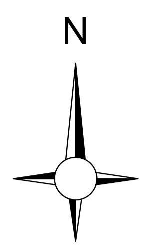
Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either express or implied. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on the field exploration and laboratory test data presented in this report.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, ground water or surface water within or beyond the site studied.

Atlas assumes no responsibility for any construction procedures, temporary excavations (including utility trenches), temporary dewatering or site safety during or after construction. The contractor shall be solely responsible for all construction procedures, construction means and methods, construction sequencing and for safety measures during construction as well as the protection of all existing facilities. All applicable federal, state and local laws and regulations regarding construction safety must be followed, including current Occupational Safety and Health Administration (OSHA) Regulations including OSHA 29 CFR Part 1926 “Safety and Health Regulations for Construction”, Subpart P “Excavations”, and/or successor regulations. The Contractor shall be solely responsible for designing and constructing stable, temporary excavations and should brace, shore, slope, or bench the sides of the excavations as necessary to maintain stability of the excavation sides and bottom and to protect the integrity of all existing facilities (i.e., existing foundations, floor slabs, pavement, equipment, utilities, etc.).

Appendix





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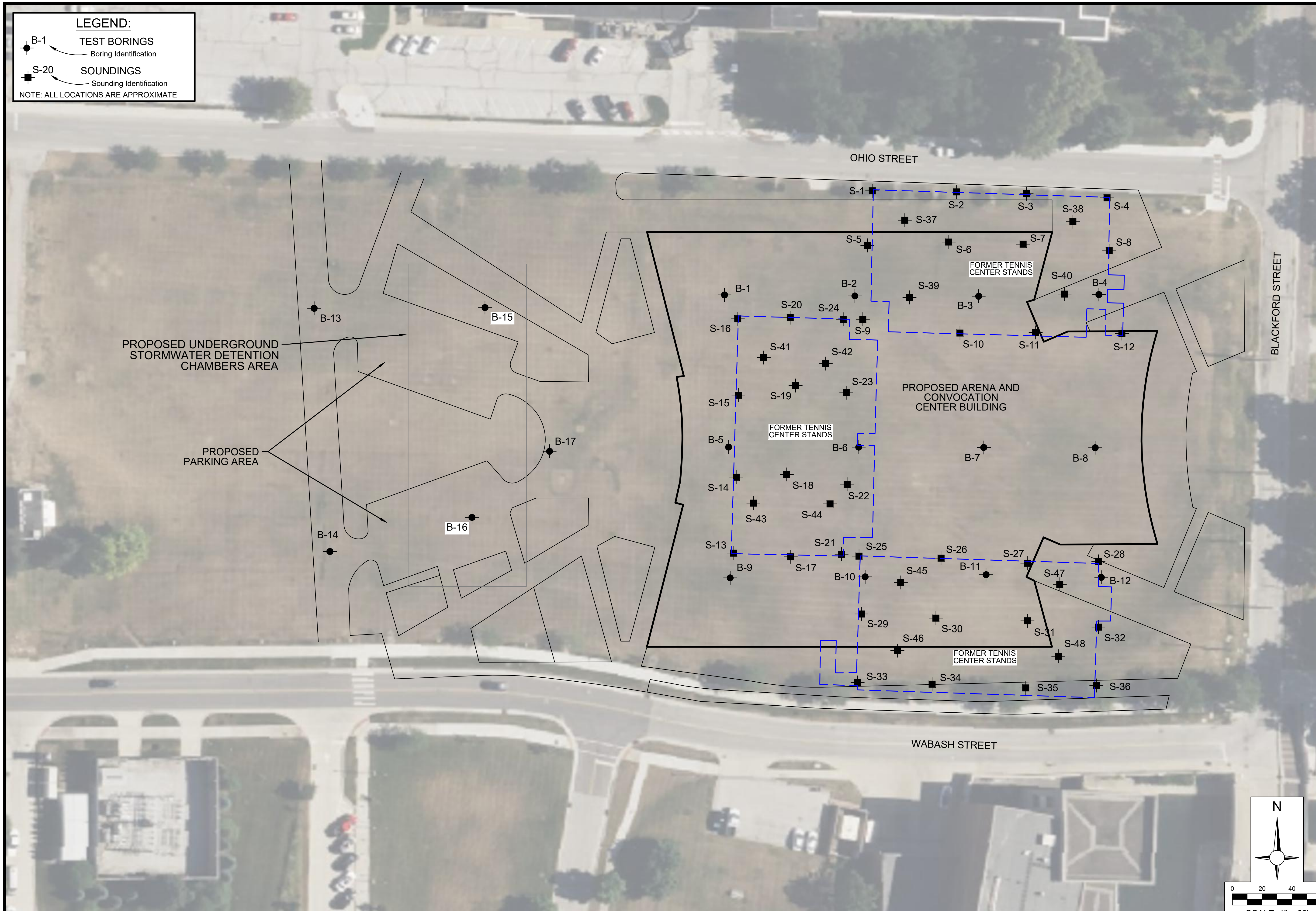
VICINITY MAP

PROPOSED ARENA AND CONVOCATION CENTER
INDIANA UNIVERSITY - INDIANAPOLIS
OHIO STREET AND BLACKFORD STREET
INDIANAPOLIS, INDIANA

Project Number: 170GC01791		Drn. By: MS
Date: 06/07/2024	Scale: 1":2,000'	Ckd. By: DM
ATLAS		1



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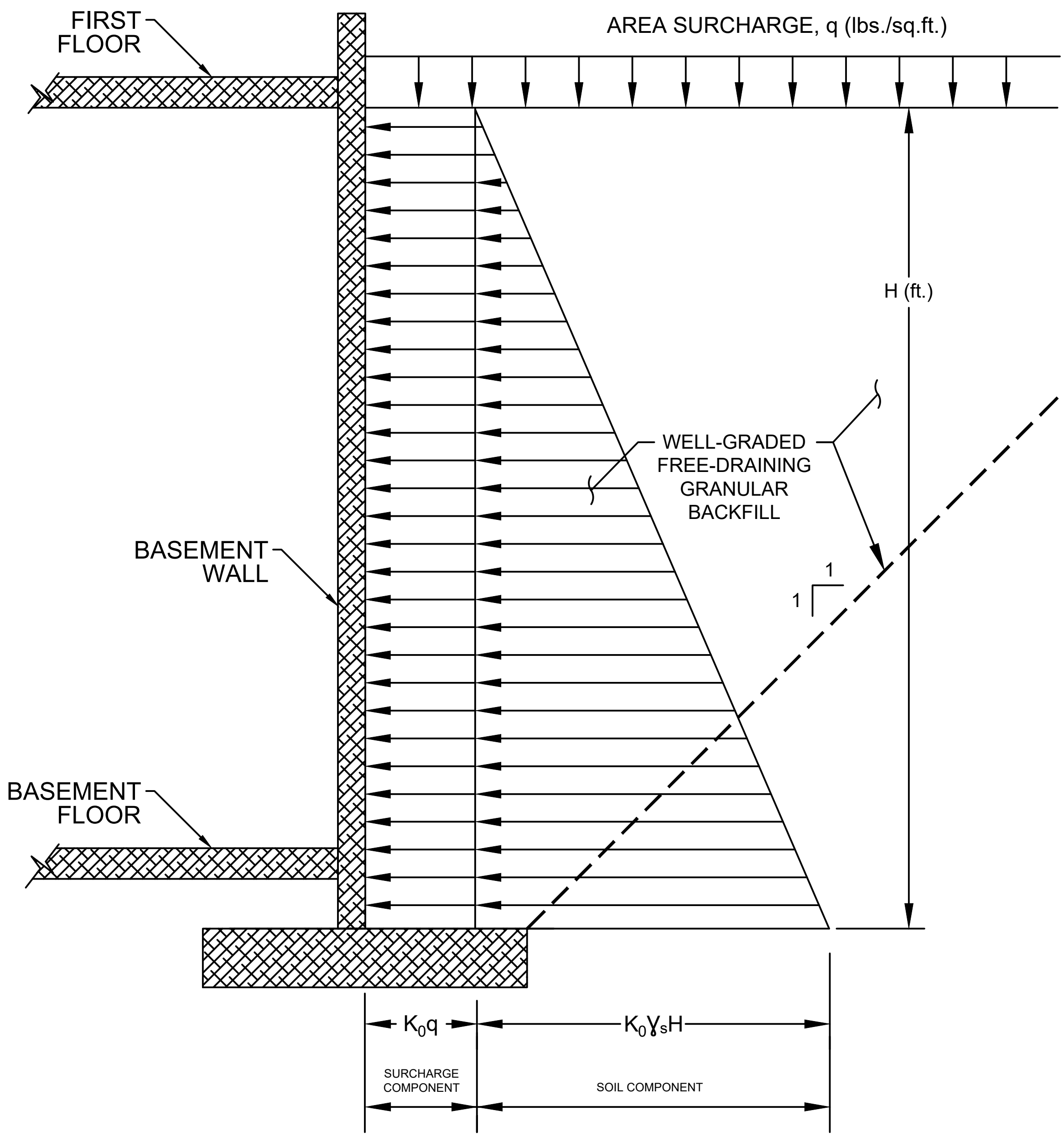
ATLAS

BORING PLAN

PROPOSED ARENA AND CONVOCATION CENTER
INDIANA UNIVERSITY - INDIANAPOLIS
OHIO STREET AND BLACKFORD STREET
INDIANAPOLIS, INDIANA

Project Number: 170GC01791	
Date: 07/08/2024	
Drn. By: MS	Ckd. By: DM
Scale: AS SHOWN	
Figure: 2	



NOTE:

- s = TOTAL SOIL UNIT WEIGHT (lbs./cu. ft.)
- H = DEPTH FROM GROUND SURFACE TO BOTTOM OF WALL (ft.)
- q = AREA SURCHARGE (lbs./sq.ft.)
- K_0=AT-REST LATERAL EARTH PRESSURE COEFFICIENT

LATERAL EARTH PRESSURE AGAINST BASEMENT WALL
ASSUMING DRAINED BACKFILL WITH NO HYDROSTATIC PRESSURE

PROPOSED ARENA AND CONVOCATION CENTER
INDIANA UNIVERSITY - INDIANAPOLIS
OHIO STREET AND BLACKFORD STREET
INDIANAPOLIS, INDIANA

Project Number: 170GC01791		Drn. By: MS
Date: 07/08/2024	Scale: NOT TO SCALE	Ckd. By: DM
ATLAS		3

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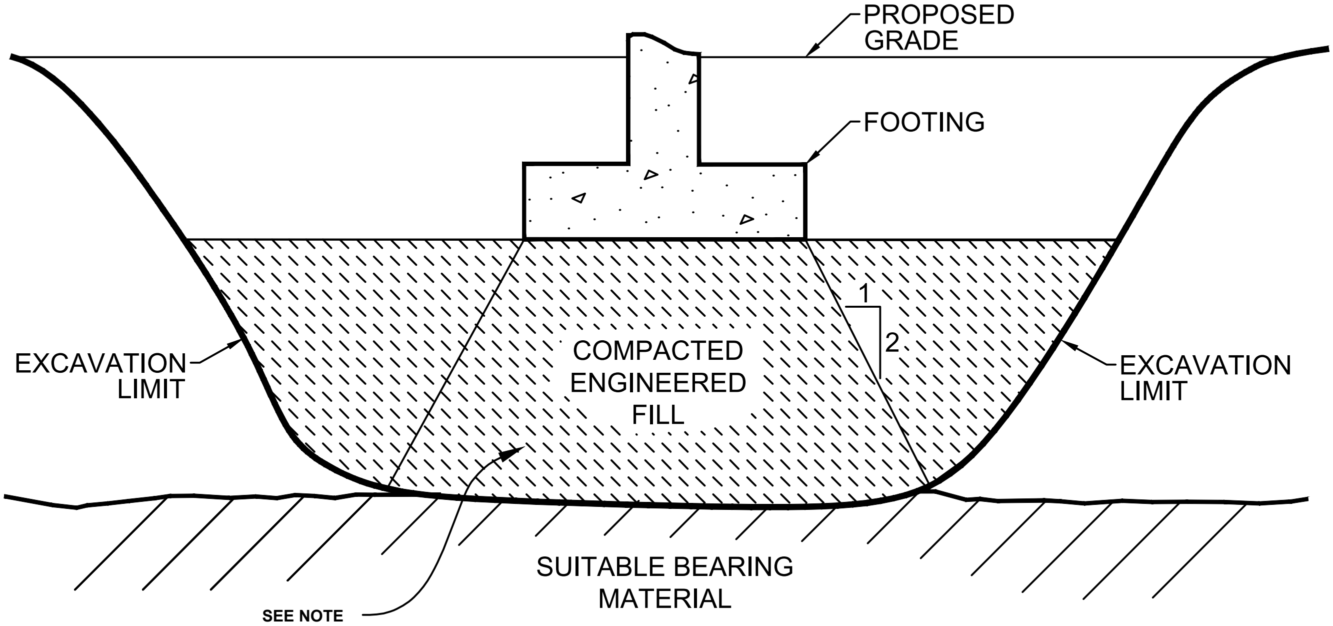

NOTE:
EXPANDED (2V : 1H) UNDERCUT ZONE NOT NECESSARY WHERE CONCRETE/LEAN CONCRETE IS USED AS UNDERCUT BACKFILL IN LIEU OF ENGINEERED FILL AND WHERE ADEQUATE BEARING SOILS ARE EXPOSED AT THE BASE OF UNDERCUT.
REFER TO REPORT SECTION 5.3.

DESIGN ILLUSTRATION
FOOTINGS WITH UNDERCUTS

PROPOSED ARENA AND CONVOCATION CENTER
INDIANA UNIVERSITY - INDIANAPOLIS
OHIO STREET AND BLACKFORD STREET
INDIANAPOLIS, INDIANA

Project Number: 170GC01791		Drn. By: MS
Date: 06/07/2024	Scale: NOT TO SCALE	Ckd. By: DM
ATLAS		4

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TEST BORING LOG

CLIENT **Indiana University**
PROJECT NAME **Proposed Arena and Convocation Center**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-1**
JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/14/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/14/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Topsoil	704.5	0.5									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Dark gray, slightly moist, sandy silty clay with little gravel, trace brick fragments, and trace cinders (FILL)	702.0	3.0		1	SS			10-16-20	9.9		
Brown, moist, sandy silty clay with brick fragments and trace gravel (FILL)			5	2	SS			10-7-4	9.5		
				3	SS			4-3-2	19.6		
	696.5	8.5									
Dark brown, moist, medium stiff, CLAY (CH) with some sand and trace gravel	694.5	10.5	10	4	SS			5-4-5	15.5		**Sample No. 4:** Atterberg Limits: LL=57 PL=22 PI=35 Unconfined Compressive Strength = 2.0 tsf Dry Density = 107.8 pcf
Dark brown, moist, very loose, SAND (SP-SC) with little gravel and trace clay				5	SS			1-2-1			
	691.5	13.5									
Brown, slightly moist, medium dense, SAND (SP-SM) with little gravel and trace silt			15	6	SS		Cave 14.8	9-4-8			
				7	SS			9-10-16			
			20	8	SS			11-12-12			**Sample Nos. 8 & 9:** Finer than #200 Sieve = 7.0%
				9	SS			10-8-12			
			25	10	SS			9-10-11			
			30	11	SS			15-15-13			
- wet below 33.5 ft.			35	12	SS		● 33.5	10-12-10			
Bottom of Test Boring at 40.0 ft.	665.0	40.0		13	SS			12-13-15			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **33.5** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **14.8** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**
PROJECT NAME **Proposed Arena and Convocation Center**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-2**
JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/14/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/14/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Topsoil	704.5	0.5									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sandy silty clay with little gravel and trace rock fragments (FILL)				1	SS			6-12-11	12.2		
				2	SS			4-10-7	7.3		
	699.5	5.5	5								
Gray, slightly moist to moist, sandy silty clay with little gravel, trace concrete fragments, trace brick fragments, and trace cinders (FILL)				3	SS			7-5-4	10.0		
				4	SS			6-7-4	11.4		
			10	5	SS			4-2-4	14.3		
	691.5	13.5									
Brown, slightly moist, very soft, SANDY SILTY CLAY (CL) with little gravel			15	6	SS			3-1-2	11.5		
	689.0	16.0									
Brown, slightly moist, medium dense to dense, SAND (SP-SM) with little gravel and trace silt				7	SS		Cave	4-6-12			
			20	8	SS			9-10-24			
				9	SS			17-17-16			
			25	10	SS			11-12-16			
				11	SS			12-14-15			
	675.0	30.0	30								
Bottom of Test Boring at 30.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **16.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**

PROJECT NAME **Proposed Arena and Convocation Center**

PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-3**

JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/14/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/14/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION 705

Soil Classification	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Topsoil	704.5	0.5								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sandy silty clay with sand and trace gravel (FILL)	702.0	3.0		1	SS		19-13-20	6.3		
Brown, slightly moist, sandy silty clay with little gravel (FILL)			5	2	SS		5-3-3	8.1		
				3	SS		3-2-2	9.7		
			10	4	SS		6-4-4	12.4		
				5	SS		3-4-3	12.3		
Brown, slightly moist, medium dense to dense, SAND (SP-SM) with little gravel and trace silt	691.5	13.5		6	SS		8-9-12			
			15			Cave (15.5)				
				7	SS		14-19-31			
			20	8	SS		10-14-13			
				9	SS		14-13-12			
			25	10	SS		12-13-14			
	675.0	30.0	30	11	SS		16-14-14			
Bottom of Test Boring at 30.0 ft.										

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **15.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Indiana University**
BORING #: **B-4**
PROJECT NAME: **Proposed Arena and Convocation Center**
JOB #: **170GC01791**
PROJECT LOCATION: **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/13/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/13/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION
SURFACE ELEVATION 705

Soil Classification	Stratum Elevation	Stratum Depth, ft	Sample No.	Sample Type	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	704.7	0.3						Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist to moist, silty sand with trace to little gravel (FILL)			1	SS	13-13-15			
			2	SS	10-29-42			
			3	SS	43-50/0.3			
			4	SS	8-12-14			
			5	SS	15-18-19			
			6	SS	12-16-14			
			7	SS	10-15-17			
	686.5	18.5						
Brown, slightly moist, loose to medium dense, SAND (SP-SM) with little to some gravel and trace silt			8	SS	8-6-5			**Sample Nos. 8 & 9:** Finer than #200 Sieve = 8.5%
			9	SS	5-4-5			
			10	SS	6-7-6			
	676.0	29.0						
Brown, wet, medium dense to dense, SILTY SAND (SM) with trace to little gravel			11	SS	10-12-12			
			12	SS	13-18-21			
Bottom of Test Boring at 40.0 ft.	665.0	40.0	13	SS	10-12-18			

Depth Scale, ft: 5, 10, 15, 20, 25, 30, 35

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **29.0** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **16.3** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Indiana University**
BORING #: **B-5**
PROJECT NAME: **Proposed Arena and Convocation Center**
JOB #: **170GC01791**
PROJECT LOCATION: **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION
SURFACE ELEVATION 705

Soil Classification	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	704.7	0.3								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sand with little gravel and rock fragments (FILL)	702.0	3.0		1	SS		7-9-16			
Dark gray and brown, slightly moist, sandy silty clay with little gravel, trace brick, trace concrete fragments, and trace crushed limestone fragments (FILL)			5	2	SS		10-12-13	9.1		
				3	SS		15-12-12	12.5		
	694.0	11.0	10	4	SS		3-4-6			
Dark brown, moist, very stiff, SANDY SILTY CLAY (CL) with trace gravel	692.0	13.0		5	SS		8-6-10	12.9		
Dark brown, moist, loose to very loose, SILTY SAND (SM) with some gravel			15	6	SS		4-3-3			**Sample Nos. 6 & 7:** Atterberg Limits: Non-Plastic Finer than #200 Sieve = 19.0%
	686.5	18.5		7	SS		2-2-2			
Brown, slightly moist, loose to medium dense, SAND (SP-SM) with little gravel and trace silt			20	8	SS	Cave	7-5-5			
				9	SS		10-11-10			
			25	10	SS		13-11-18			
	675.0	30.0	30	11	SS		10-9-10			
Bottom of Test Boring at 30.0 ft.										

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **19.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University** | BORING # **B-6**
PROJECT NAME **Proposed Arena and Convocation Center** | JOB # **170GC01791**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Topsoil	704.6	0.4									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sand with little gravel, trace rock fragments, and trace roots (FILL)	702.0	3.0		1	SS			4-6-7			
Brown, moist, silty sand with little gravel and trace rock fragments (FILL)			5	2	SS			7-11-20			
				3	SS			19-21-25			
	694.5	10.5	10	4	SS			15-21-23			
Brown, slightly moist, sandy silty clay with little gravel an trace asphalt fragments (FILL)	691.5	13.5		5	SS			15-17-18	9.6		
Brown, slightly moist, medium dense to very dense, SAND (SP-SM) with little to some gravel and trace silt			15	6	SS			12-13-17			
				7	SS			12-20-20			**Sample Nos. 7 & 8:** Finer than #200 Sieve = 8.4%
			20	8	SS		Cave Depth 20.4	11-14-19			
				9	SS			19-27-28			
			25	10	SS			12-19-18			
	675.0	30.0	30	11	SS			17-20-21			
Bottom of Test Boring at 30.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **20.4** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**

PROJECT NAME **Proposed Arena and Convocation Center**

PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-7**

JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/18/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/18/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION
SURFACE ELEVATION 704

Soil Classification	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Topsoil	703.6	0.4								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist to moist, sand with little gravel and trace rock fragments (FILL)				1	SS		9-9-13			
				2	SS		8-19-24			
			5	3	SS		18-24-27			
- with crushed limestone fragments below 8 ft.				4	SS		5-20-29			
	693.0	11.0	10							
Brown, slightly moist, medium dense to dense, SAND (SP-SM) with trace to little gravel and trace silt				5	SS	Cave depth	23-17-13			
				6	SS		12-13-13			
			15	7	SS		7-9-12			
				8	SS		9-8-11			
			20	9	SS		10-11-15			
				10	SS		12-9-8			
			25			Noted on drilling tools				
- wet below 28 ft.				11	SS		11-12-11			
			30							
			35	12	SS		14-16-16			
Bottom of Test Boring at 40.0 ft.	664.0	40.0		13	SS		12-13-12			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **28.0** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **11.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**

PROJECT NAME **Proposed Arena and Convocation Center**

PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-8**

JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/18/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/18/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION

SURFACE ELEVATION 704

Soil Classification	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Topsoil	703.6	0.4								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, silty clay with little gravel and trace rock fragments (FILL)	700.5	3.5		1	SS		11-10-12			
Brown, moist, silty sand with little gravel and trace rock fragments (FILL)	693.5	10.5	5	2	SS		6-17-21			
				3	SS		27-30-30			
			10	4	SS		18-20-24			
Brown, slightly moist, sand with little gravel and trace brick fragments (FILL)	690.5	13.5		5	SS		24-25-28			
Brown, slightly moist, loose, SAND (SP-SM) with little gravel and trace silt	688.0	16.0	15	6	SS		4-3-3			
Brown, slightly moist, medium dense, SAND (SP-SM) with little gravel and trace silt	676.0	28.0		7	SS		5-9-13			
			20	8	SS	Cave Depth 20.5	9-9-13			
				9	SS		10-12-13			
			25	10	SS		12-12-15			
Brown, wet, dense, SAND (SP-SM) with some gravel and trace silt	674.0	30.0	30	11	SS	Noted on Drilling Tools 28.0	14-16-19			
Bottom of Test Boring at 30.0 ft.										

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Depth to Groundwater
- Noted on Drilling Tools **28.0** ft.
- At Completion **None** ft.
- After **--** hours **--** ft.
- Cave Depth **20.5** ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- CA - Casing Advancer
- MD - Mud Drilling
- HA - Hand Auger

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TEST BORING LOG

CLIENT: **Indiana University**
PROJECT NAME: **Proposed Arena and Convocation Center**
PROJECT LOCATION: **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING #: **B-9**
JOB #: **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	6/18/24	Hammer Wt.	140 lbs.
Date Completed	6/18/24	Hammer Drop	30 in.
Drill Foreman	R. Warren	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION / SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
3 in. Topsoil	704.7	0.3								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Gray and dark gray, slightly moist, sandy silty clay with little gravel, trace brick fragments, trace concrete fragments, and cinders (FILL)	699.5	5.5		1	SS		15-16-15	9.1		
				2	SS		10-5-6			
Dark brown, moist, clayey sand with trace brick fragments and gravel (FILL)	697.0	8.0	5	3	SS		3-4-4			
Gray and dark gray, slightly moist, sandy silty clay with trace gravel and concrete fragments (FILL)	691.5	13.5		4	SS	Cave (10.0 ft)	13-11-4	11.4		
			10	5	SS		3-2-3			
Brown, moist, medium stiff, SANDY SILTY CLAY (CL) with trace gravel	689.0	16.0	15	6	SS		3-3-6	20.8	1.0	**Sample No. 6:** Atterberg Limits: LL=35 PL=17 PI=18
Brown, slightly moist, medium dense to dense, SAND (SP-SM) with little gravel and trace silt				7	SS		7-8-10			
			20	8	SS		7-8-9			
				9	SS		17-15-16			
			25	10	SS		17-15-19			
- wet below 28 ft.	675.0	30.0	30	11	SS	Noted on drilling tools (28 ft)	11-14-21			
Bottom of Test Boring at 30.0 ft.										

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools 28.0 ft.
At Completion None ft.
After -- hours -- ft.
Cave Depth 10.0 ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**

PROJECT NAME **Proposed Arena and Convocation Center**

PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-10**

JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/18/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/18/24**	Hammer Drop	**30** in.
Drill Foreman	**R. Warren**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SURFACE ELEVATION 705

SOIL CLASSIFICATION	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
3 in. Topsoil	704.7	0.3								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, silty sand with trace to little gravel (FILL)				1	SS		10-14-21			
				2	SS		13-21-23			
			5							
- trace brick fragments and concrete fragments below 6 ft.				3	SS		13-23-24			
				4	SS	Cave Depth (9.0 ft)	20-25-28			
	694.5	10.5	10							
Brown, slightly moist, sandy silty clay with little gravel and rock fragments (FILL)				5	SS		13-14-18	7.9		
	692.0	13.0								
Brown, slightly moist, sand with little gravel, trace concrete fragments, and trace silt (FILL)				6	SS		12-13-13			
			15							
				7	SS		8-9-7			
	686.5	18.5								
Brown, slightly moist, medium dense to dense, SAND (SW-SM) with trace to little gravel and trace silt				8	SS		8-9-12			
			20							
				9	SS		8-10-11			**Sample Nos. 9 & 10:** Finer than #200 Sieve = 8.9%
				10	SS		9-12-13			
			25							
						Noted on Drilling Tools (28.0 ft)				
- wet below 28 ft.				11	SS		11-16-19			
			30							
				12	SS		13-15-15			
			35							
Bottom of Test Boring at 40.0 ft.	665.0	40.0		13	SS		8-10-13			

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **28.0** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **9.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University** BORING # **B-11**
PROJECT NAME **Proposed Arena and Convocation Center** JOB # **170GC01791**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**R. Warren**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 704	Stratum Elevation	Stratum Depth, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	703.7	0.3							Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist to moist, silty sand with little to some gravel and trace rock fragments (FILL)			1	SS		8-12-10			
			2	SS		9-10-15			
			3	SS		19-22-35			
			4	SS		14-17-22			
- asphalt and concrete fragments near 11.5 ft.			5	SS		25-38-36			
					Cave depth 13.0 ft.				
			6	SS		9-9-7			
	688.5	15.5							
Dark gray, moist, sandy silty clay with trace gravel and brick fragments (FILL)	687.0	17.0	7	SS		6-11-16	10.5		
Brown, slightly moist, sand with asphalt fragments and little gravel (FILL)	685.5	18.5	8	SS		12-10-8			
Brown, slightly moist, medium dense, SAND (SP-SM) with little to some gravel and trace silt			9	SS		11-13-16			
			10	SS		11-14-12			
					Noted on drilling tools 28.0 ft.				
- wet below 28 ft.			11	SS		11-11-12			
	674.0	30.0							
Bottom of Test Boring at 30.0 ft.									

Depth Scale, ft: 5, 10, 15, 20, 25, 30

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **28.0** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **13.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**
PROJECT NAME **Proposed Arena and Convocation Center**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-12**
JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started **6/17/24**
Date Completed **6/17/24**
Drill Foreman **R. Warren**
Inspector **D. McIlwaine**
Boring Method **HSA**

Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2.0** in.
Rock Core Dia. **--** in.
Shelby Tube OD **--** in.

TEST DATA

SOIL CLASSIFICATION

SURFACE ELEVATION 705

Soil Classification	Stratum Elevation	Stratum Depth, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	704.7	0.3							Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown and dark brown, slightly moist, silty sand with little gravel (FILL)			1	SS		12-28-30			
			2	SS		20-35-40			
- trace concrete and brick fragments below 6 ft.			3	SS		30-28-29			
			4	SS		16-20-23			
- with crushed limestone fragments between 11 ft and 13 ft	692.0	13.0	5	SS	Cave depth	19-32-32			
Dark brown and brown, moist, sandy silty clay with rock fragments and trace gravel (FILL)	689.0	16.0	6	SS		5-5-6	10.8		
Brown, slightly moist, medium dense to dense, SAND (SP-SM) with trace to little gravel and trace silt			7	SS		19-19-16			
			8	SS		9-9-12			
			9	SS		12-22-24			
			10	SS		13-16-15			
- wet below 29 ft			11	SS	Noted on drilling tools	13-14-18			
			12	SS		14-15-14			
Bottom of Test Boring at 40.0 ft.	665.0	40.0	13	SS		15-14-16			

Depth Scale, ft: 5, 10, 15, 20, 25, 30, 35

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **29.0** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **12.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**
PROJECT NAME **Proposed Arena and Convocation Center**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-13**
JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/14/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/14/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 706	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
3 in. Topsoil	705.7	0.3									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sand with little gravel (FILL)	702.5	3.5		1	SS			8-10-13			
Brown and dark brown, moist, medium stiff, SILTY CLAY (CL) with some sand and trace gravel	700.5	5.5	5	2	SS			2-3-3	18.8	1.5	
Brown, moist, soft, SILTY CLAY (CL) with trace sand	697.5	8.5		3	SS		Cave	3-1-3	20.5	1.25	**Sample No. 3:** Atterberg Limits: LL=26 PL=18 PI=8
Brown, moist, medium stiff, SILTY CLAY (CL) with some sand and trace gravel	696.0	10.0	10	4	SS			4-5-5			
Bottom of Test Boring at 10.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **7.1** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **Indiana University**
BORING #: **B-14**
PROJECT NAME: **Proposed Arena and Convocation Center**
JOB #: **170GC01791**
PROJECT LOCATION: **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 706	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Topsoil	705.6	0.4									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Dark gray and black, slightly moist, sandy silty clay with little gravel, trace clay tile, and cinders (FILL)	703.0	3.0		1	SS			10-10-6	16.8		
Brown and black, moist, silty clay with little sand, trace gravel, and cinders (FILL)	700.5	5.5	5	2	SS			2-1-3	18.1		
Black and dark gray, slightly moist, sandy silty clay with little gravel and cinders (FILL)	698.0	8.0		3	SS			5-4-9	25.7		
Brown, moist, silty clay with little sand, trace gravel, and cinders (FILL)	696.0	10.0	10	4	SS			2-4-4	20.3		
Bottom of Test Boring at 10.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **6.1** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **Indiana University**
PROJECT NAME **Proposed Arena and Convocation Center**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-15**
JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/14/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/14/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Topsoil	704.5	0.5									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Brown, slightly moist, sandy silty clay with little gravel (FILL)	702.0	3.0		1	SS			10-17-13	10.0		
Dark gray and dark brown, slightly moist, sandy silty clay with little gravel and trace cinders (FILL)	699.0	6.0	5	2	SS			6-7-6	14.3		
Gray, moist, very stiff, SILTY CLAY (CL) with trace marl, organics and sand	697.0	8.0		3	SS			10-10-10	14.7	3.5	**Sample No. 3:** Organic Content = 2.3% Marl Content = 9%
Brown, slightly moist, very stiff, SILTY CLAY (CL) with little sand and trace gravel	694.5	10.5	10	4	SS			8-10-12			
Brown, slightly moist, loose, SILTY SAND (SM) with some gravel				5	SS		Cave	5-6-4			**Sample Nos. 5 & 6:** Finer than #200 Sieve = 13.5%
	689.0	16.0	15	6	SS			3-2-6			
Brown, slightly moist, medium dense, SAND (SP-SM) with trace gravel and silt				7	SS			8-9-11			**Sample Nos. 7 & 8:** Finer than #200 Sieve = 7.4%
	685.0	20.0	20	8	SS			12-13-15			
Bottom of Test Boring at 20.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **11.9** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

7988 Centerpoint Drive, Suite 100
Indianapolis, IN 46256
(317) 849-4990
Fax (317) 849-4278

TEST BORING LOG

CLIENT **Indiana University**

PROJECT NAME **Proposed Arena and Convocation Center**

PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

BORING # **B-16**

JOB # **170GC01791**

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Topsoil	704.6	0.4								Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Dark gray, gray, and brown, slightly moist, sandy silty clay with little gravel, trace brick fragments, and cinders (FILL)				1	SS		11-11-13	10.2		
				2	SS		7-8-10	5.2		
	699.0	6.0	5							
Brown, moist, stiff, SILTY CLAY (CL) with trace sand and gravel				3	SS		8-6-7	21.9		**Sample No. 3:** Atterberg Limits: LL=27 PL=18 PI=9
	697.0	8.0								
Brown, slightly moist, very loose, SAND (SP-SM) with little silt and trace gravel				4	SS		2-1-2			**Sample No. 4:** Finer than #200 Sieve = 11.0%
	694.5	10.5	10							
Tan, slightly moist, loose, SAND (SP-SM) with trace silt				5	SS		4-4-6			
	691.5	13.5								
Brown, slightly moist, medium dense, SAND (SW-SM) with little gravel and trace silt				6	SS		13-15-13			**Sample Nos. 6 & 7:** Finer than #200 Sieve = 6.5%
			15							
				7	SS	Cave	8-10-11			
				8	SS		9-10-12			
	685.0	20.0	20							
Bottom of Test Boring at 20.0 ft.										

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Depth to Groundwater
- Noted on Drilling Tools **None** ft.
- At Completion **None** ft.
- After **--** hours **--** ft.
- Cave Depth **16.4** ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- CA - Casing Advancer
- MD - Mud Drilling
- HA - Hand Auger

7988 Centerpoint Drive, Suite 100
Indianapolis, IN 46256
(317) 849-4990
Fax (317) 849-4278

TEST BORING LOG

CLIENT **Indiana University**
BORING # **B-17**
PROJECT NAME **Proposed Arena and Convocation Center**
JOB # **170GC01791**
PROJECT LOCATION **Ohio Street and Blackford Street**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**6/17/24**	Hammer Wt.	**140** lbs.
Date Completed	**6/17/24**	Hammer Drop	**30** in.
Drill Foreman	**J. Mitchner**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 705	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	704.7	0.3									Ground surface elevation estimated from topographic map provided by American Structurepoint, Inc.
Dark gray and black, slightly moist, sandy silty clay with little gravel, trace cinders, and asphalt fragments (FILL)	702.0	3.0		1	SS			7-15-13	16.4		
Brown, slightly moist, silty clay with little sand, gravel, brick fragments, and concrete fragments (FILL)	699.0	6.0	5	2	SS			13-11-11	12.2		
Brown, moist, medium stiff, SILTY CLAY (CL) with trace sand and gravel	697.0	8.0		3	SS			5-3-3	20.6		**Sample No. 3:** Atterberg Limits: LL=32 PL=16 PI=16
Brown, slightly moist, loose, SAND (SP) with little gravel	695.0	10.0	10	4	SS			9-2-6			
Bottom of Test Boring at 10.0 ft.											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **7.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS

(Silt, Sand, Gravel and Combinations)

Density		SPT*
Very Loose	-	5 blows/ft or less
Loose	-	6 to 10 blows/ft
Medium Dense	-	11 to 30 blows/ft
Dense	-	31 to 50 blows/ft
Very Dense	-	51 blows/ft or more

Relative Proportions

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders	-	8 inch or greater	
Cobbles	-	3 to 8 inch	
Gravel	-	Coarse	- 1 to 3 inch
		Medium	- ½ to 1 inch
		Fine	- ¼ to ½ inch
Sand	-	Coarse	2.00mm to ¼ inch (dia. of pencil lead)
		Medium	0.42 to 2.00mm (dia. of broom straw)
		Fine	0.074 to 0.42mm (dia. of human hair)
Silt			0.074 to 0.002mm (cannot see particles)

COHESIVE SOILS

(Clay, Silt and Combinations)

Consistency		SPT*
Very Soft	-	3 blows/ft or less
Soft	-	4 to 5 blows/ft
Medium Stiff	-	6 to 10 blows/ft
Stiff	-	11 to 15 blows/ft
Very Stiff	-	16 to 30 blows/ft
Hard	-	31 blows/ft or more

Plasticity

Degree of Plasticity	Plasticity Index
None to slight	0 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

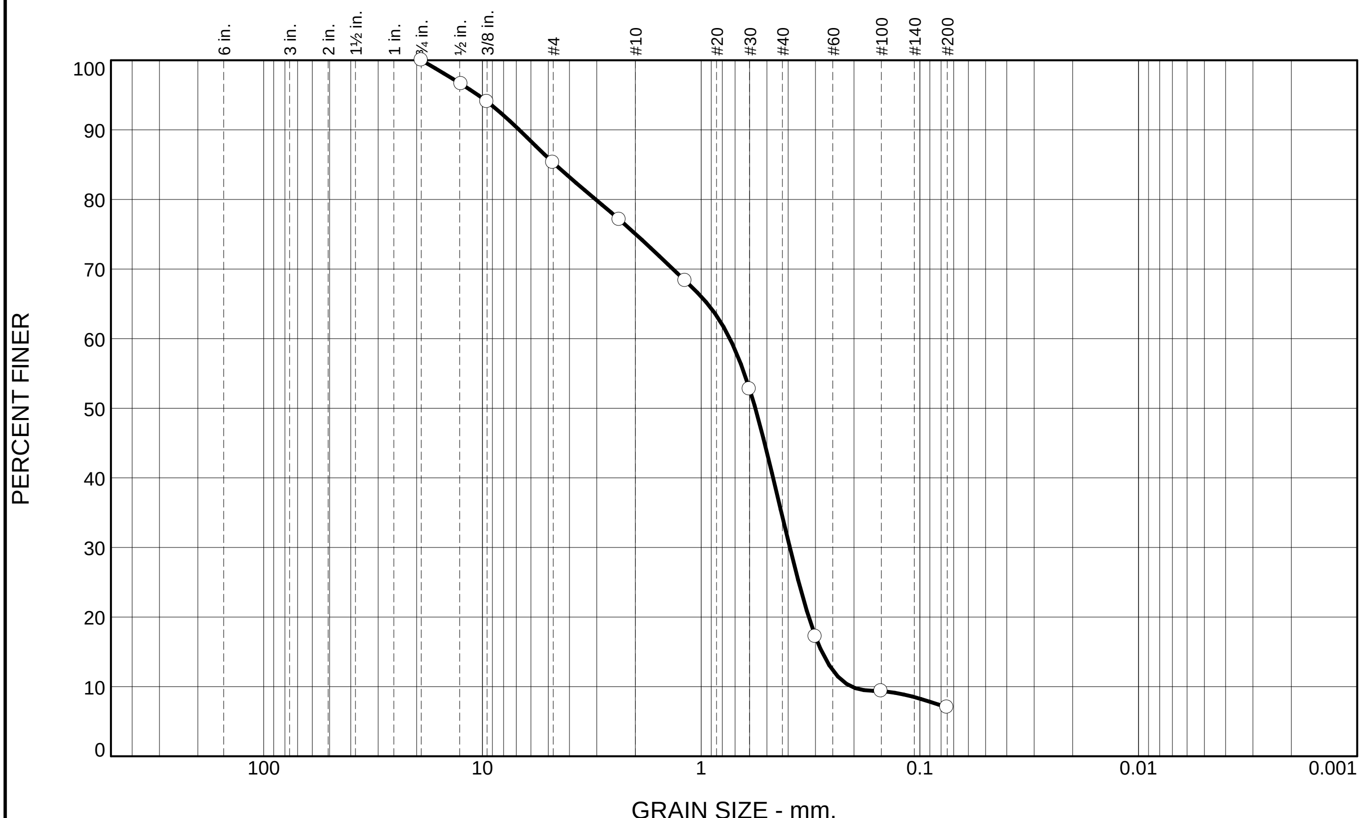
Classification on the logs are made by visual inspection of samples.
*Based upon results of Standard Penetration Test as described below.

Standard Penetration Test — Driving a 2.0" O.D. 1-3/8" I.D. sampler a distance of 12 inches into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary for ATC to drive the split-barrel sampler 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the split-barrel sampler and making the test are recorded for each 6 inches of penetration of the sampler (Example – 6-8-9). The standard penetration test result can be obtained by adding the last two figures (i.e., 8 + 9 = 17 blows/ft). The Standard Penetration Test is performed according to ASTM D-1586-18.

Strata Changes — In the column "Soil Classifications" on the Test Boring Logs the horizontal lines represent strata changes. A solid line (______) represents an actually observed change. A dashed line (_ _ _ _ _ _) represents an estimated change.

Ground Water observations were made at the times and conditions indicated on the Test Boring Logs. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.7	10.2	40.7	27.4	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2"	96.6		
3/8	94.0		
#4	85.3		
#8	77.1		
#16	68.3		
#30	52.7		
#50	17.2		
#100	9.4		
#200	7.0		

* (no specification provided)

Material Description

Sand with little Gravel and trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.7933 D_{85}= 4.6362 D_{60}= 0.7387
D_{50}= 0.5652 D_{30}= 0.3930 D_{15}= 0.2803
D_{10}= 0.2049 C_u= 3.60 C_c= 1.02

Classification

USCS= SP-SM AASHTO=

Remarks

Source of Sample: 15991 **Depth:** 18.5'-22.5'
Sample Number: B-1; S-8 & 9 **Date:**

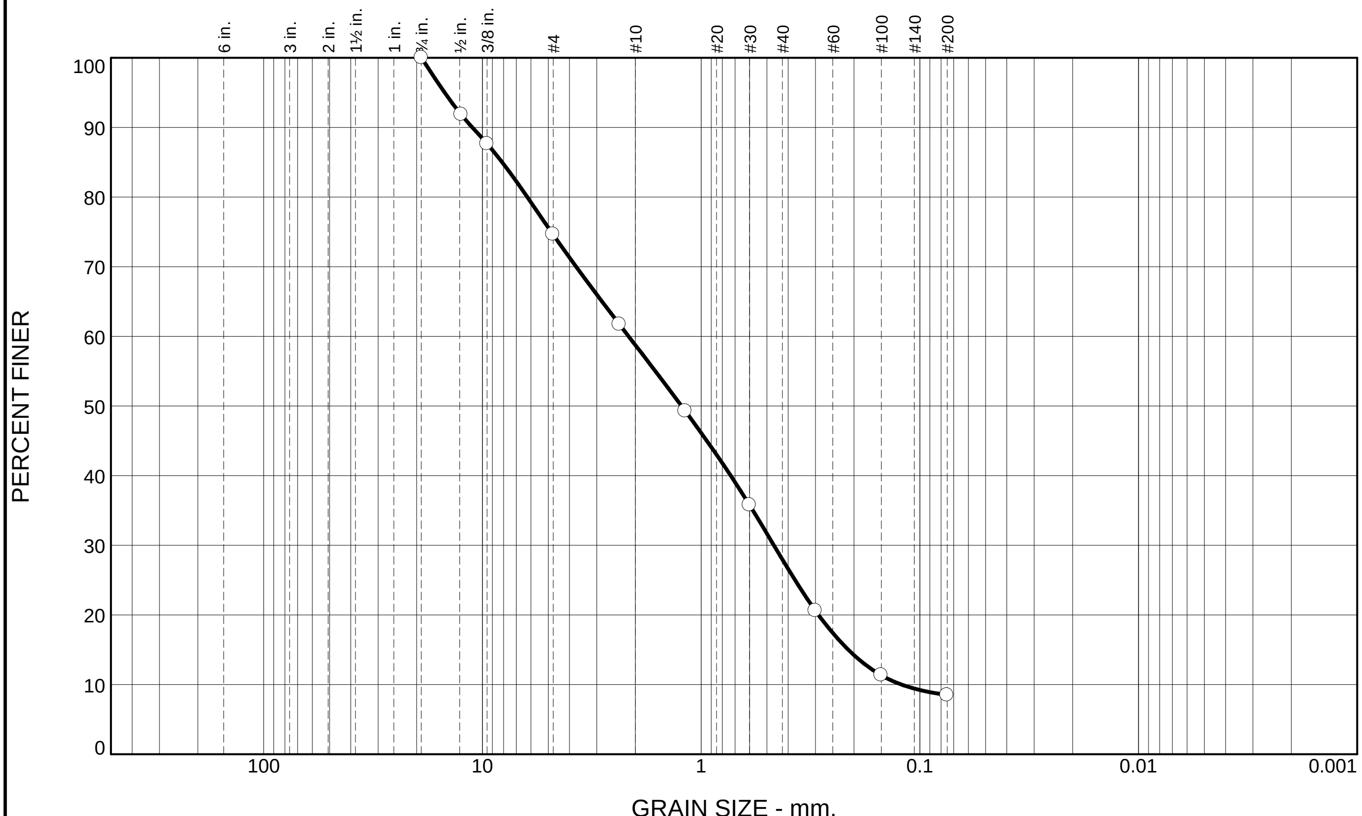
Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena

Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	25.4	15.8	30.8	19.5	8.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2"	91.8		
3/8	87.6		
#4	74.6		
#8	61.7		
#16	49.3		
#30	35.8		
#50	20.6		
#100	11.3		
#200	8.5		

* (no specification provided)

Material Description

Sand with some Gravel and trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 11.1159 D_{85}= 8.1240 D_{60}= 2.1438
D_{50}= 1.2285 D_{30}= 0.4648 D_{15}= 0.2122
D_{10}= 0.1213 C_u= 17.67 C_c= 0.83

Classification

USCS= SP-SM AASHTO=

Remarks

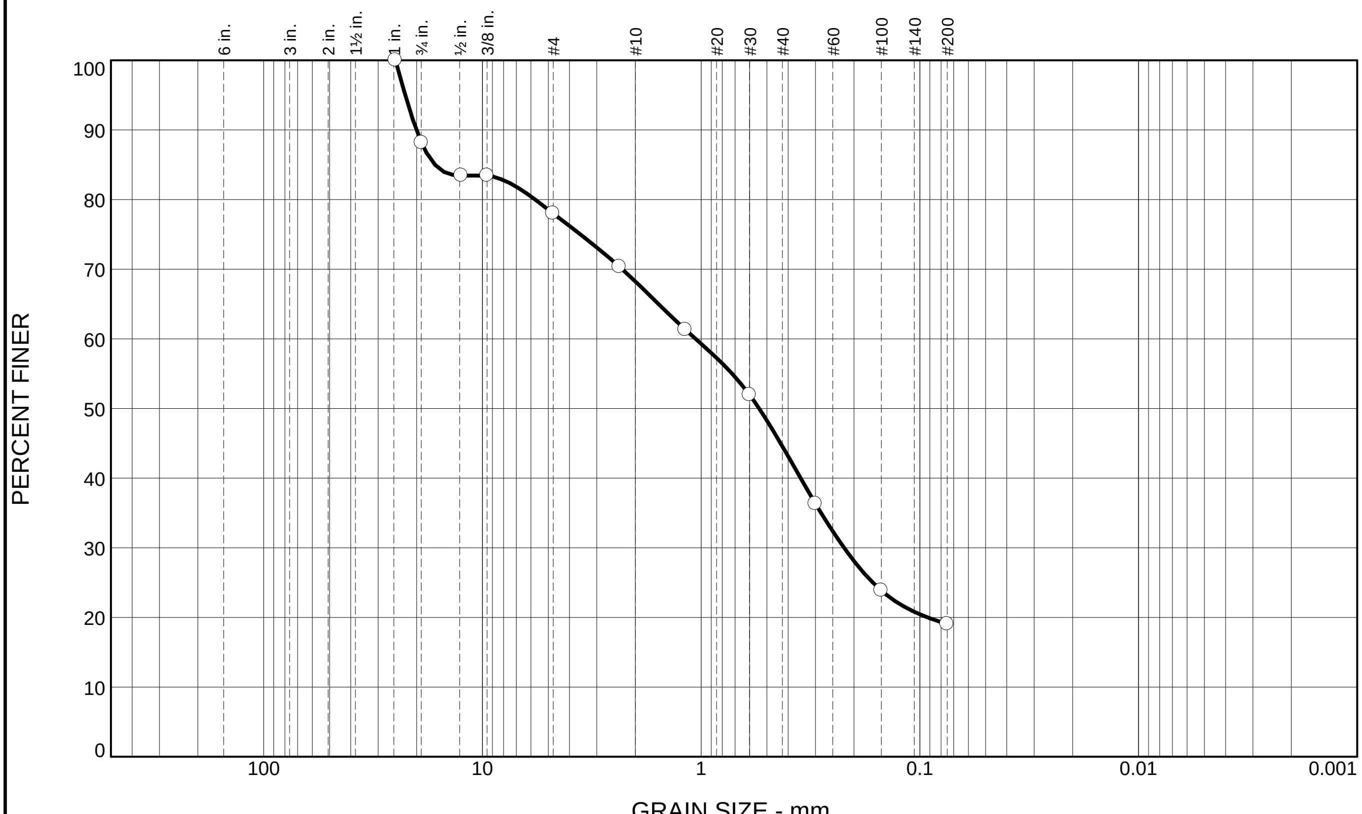
Source of Sample: 15991 **Depth:** 18.5'-22.5'
Sample Number: B-4; S-8 & 9 **Date:**

Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena
Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	11.7	10.3	9.7	23.7	25.6	19.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	88.2		
1/2"	83.5		
3/8	83.5		
#4	78.0		
#8	70.3		
#16	61.3		
#30	52.0		
#50	36.3		
#100	23.9		
#200	19.0		

* (no specification provided)

Material Description

Silty Sand with some Gravel

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 20.0401 D_{85}= 16.4802 D_{60}= 1.0595
D_{50}= 0.5427 D_{30}= 0.2219 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

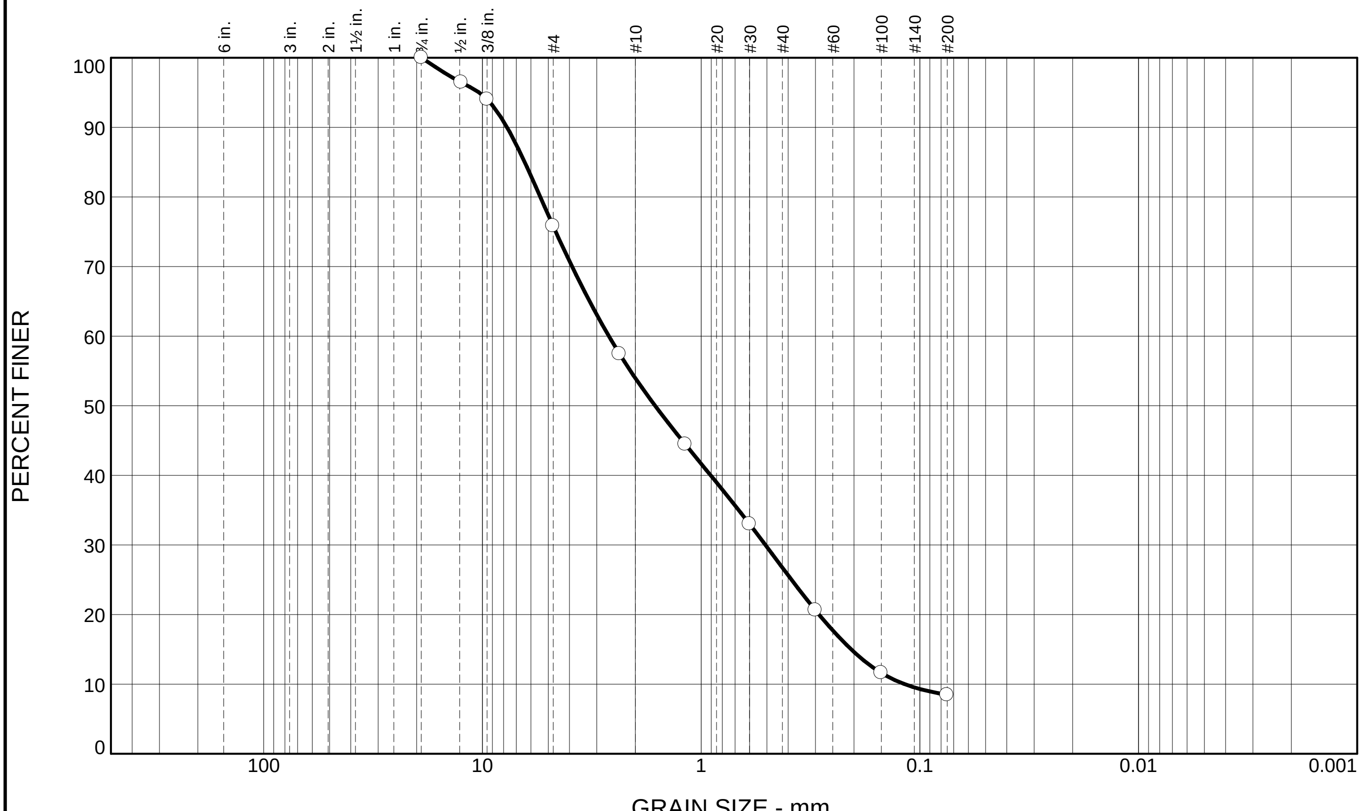
Source of Sample: 15995 **Depth:** 13.5'-17.5'
Sample Number: B-5; S-6 & 7 **Date:**

Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena
Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	24.2	21.8	27.3	18.3	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2"	96.5		
3/8	94.0		
#4	75.8		
#8	57.5		
#16	44.5		
#30	33.0		
#50	20.6		
#100	11.6		
#200	8.4		

* (no specification provided)

Material Description

Sand with some Gravel and trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 7.7181 D_{85}= 6.4087 D_{60}= 2.6409
D_{50}= 1.6231 D_{30}= 0.5080 D_{15}= 0.2057
D_{10}= 0.1172 C_u= 22.53 C_c= 0.83

Classification

USCS= SP-SM AASHTO=

Remarks

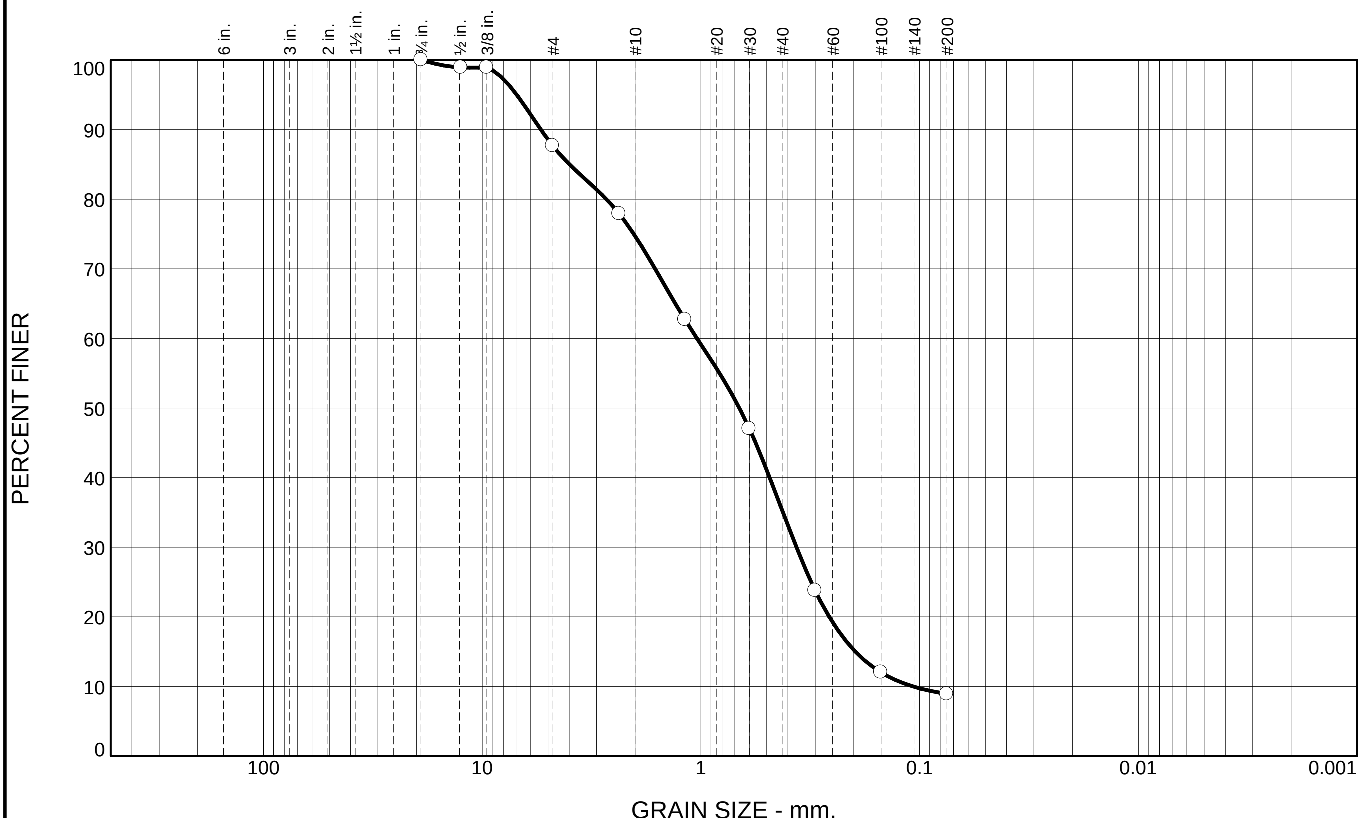
Source of Sample: 15995 **Depth:** 16.0'-20.0'
Sample Number: B-6; S-7 & 8 **Date:**

Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena
Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.3	13.0	39.4	26.4	8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2"	98.9		
3/8	98.9		
#4	87.7		
#8	77.9		
#16	62.7		
#30	47.0		
#50	23.8		
#100	12.0		
#200	8.9		

* (no specification provided)

Material Description

Sand with little Gravel and trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 5.3882 D_{85}= 3.9878 D_{60}= 1.0414
D_{50}= 0.6670 D_{30}= 0.3655 D_{15}= 0.1966
D_{10}= 0.1071 C_u= 9.72 C_c= 1.20

Classification

USCS= SW-SM AASHTO=

Remarks

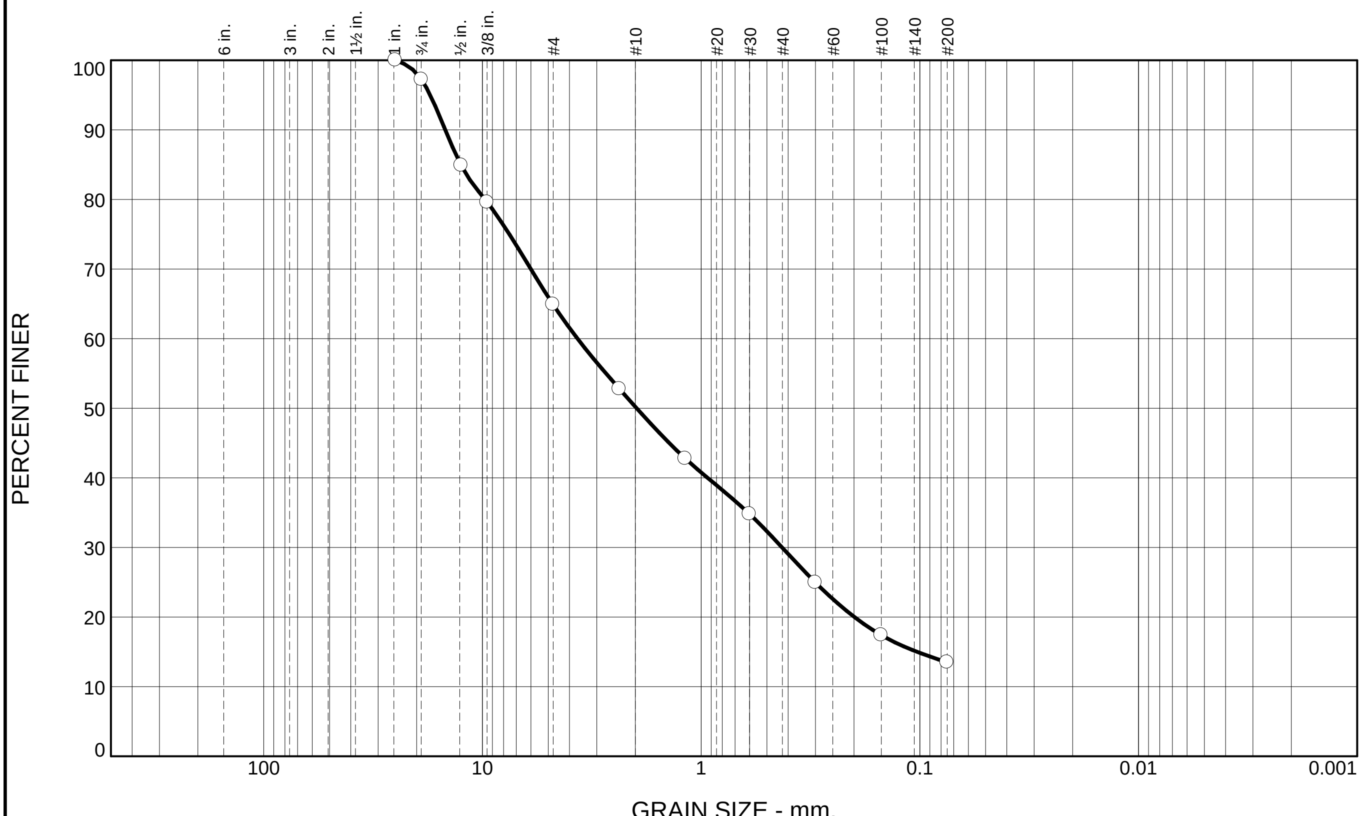
Source of Sample: 15995 **Depth:** 21.0'-25.0'
Sample Number: B-10; S-9 & 10 **Date:**

Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena
Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	32.4	14.7	20.2	16.5	13.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	97.2		
1/2"	84.9		
3/8	79.6		
#4	64.9		
#8	52.8		
#16	42.8		
#30	34.8		
#50	25.0		
#100	17.4		
#200	13.5		

* (no specification provided)

Material Description

Silty Sand with some Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 14.7908 D_{85}= 12.5556 D_{60}= 3.6738
D_{50}= 1.9712 D_{30}= 0.4261 D_{15}= 0.1027
D_{10}= C_u= C_c=

Classification

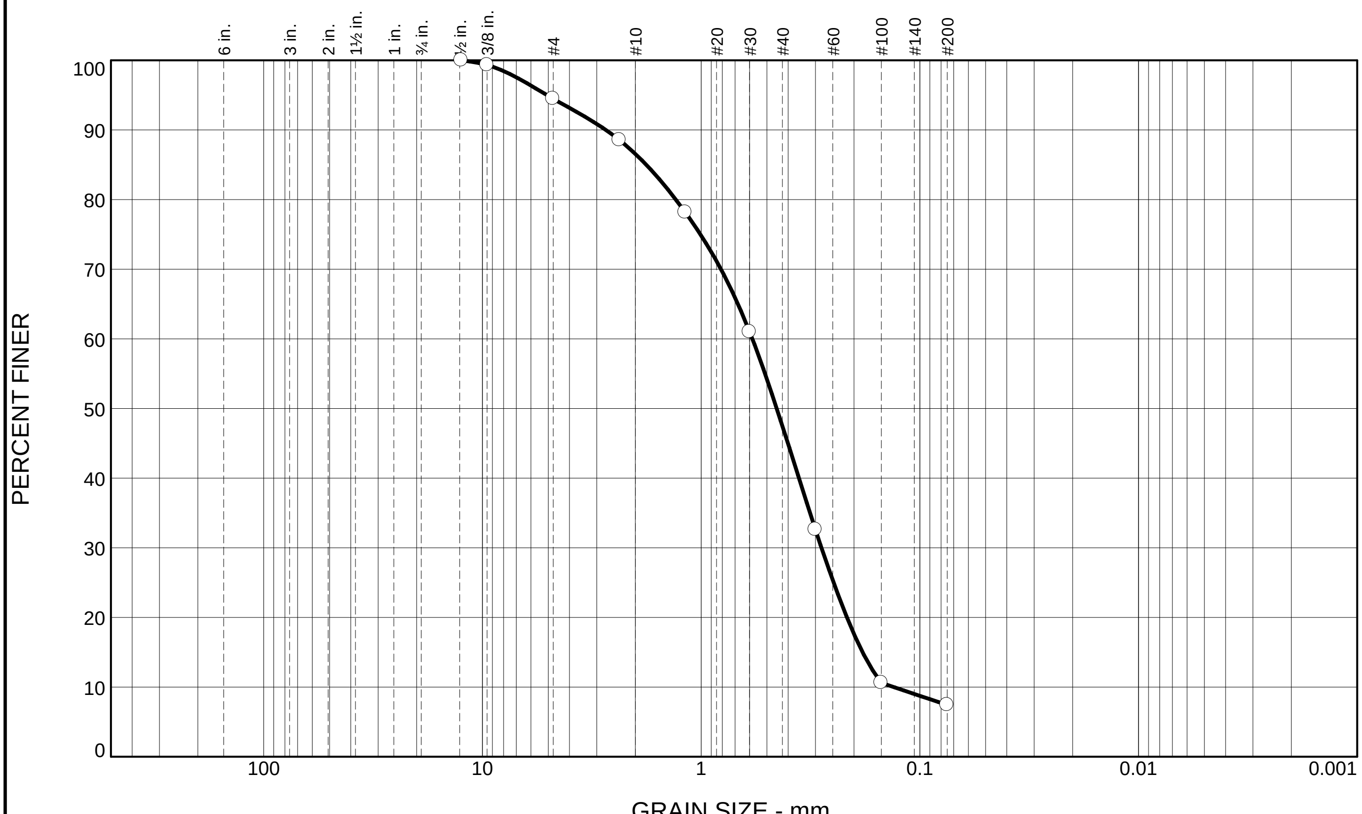
USCS= SM AASHTO=

Remarks

Source of Sample: 15991 **Depth:** 11.0'-15.0'
Sample Number: B-15; S-5 & 6 **Date:**

Atlas **Indianapolis, Indiana**	**Client:** Indiana University **Project:** IUI Arena **Project No:** 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.5	7.9	39.1	40.1	7.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1/2"	100.0		
3/8	99.3		
#4	94.5		
#8	88.5		
#16	78.2		
#30	61.0		
#50	32.6		
#100	10.6		
#200	7.4		

* (no specification provided)

Material Description

Sand with trace Silt and Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 2.7267 D_{85}= 1.7823 D_{60}= 0.5830
D_{50}= 0.4511 D_{30}= 0.2815 D_{15}= 0.1826
D_{10}= 0.1313 C_u= 4.44 C_c= 1.04

Classification

USCS= SP-SM AASHTO=

Remarks

Source of Sample: 15991 **Depth:** 16.0'-20.0'
Sample Number: B-15; S-7 & 8 **Date:**

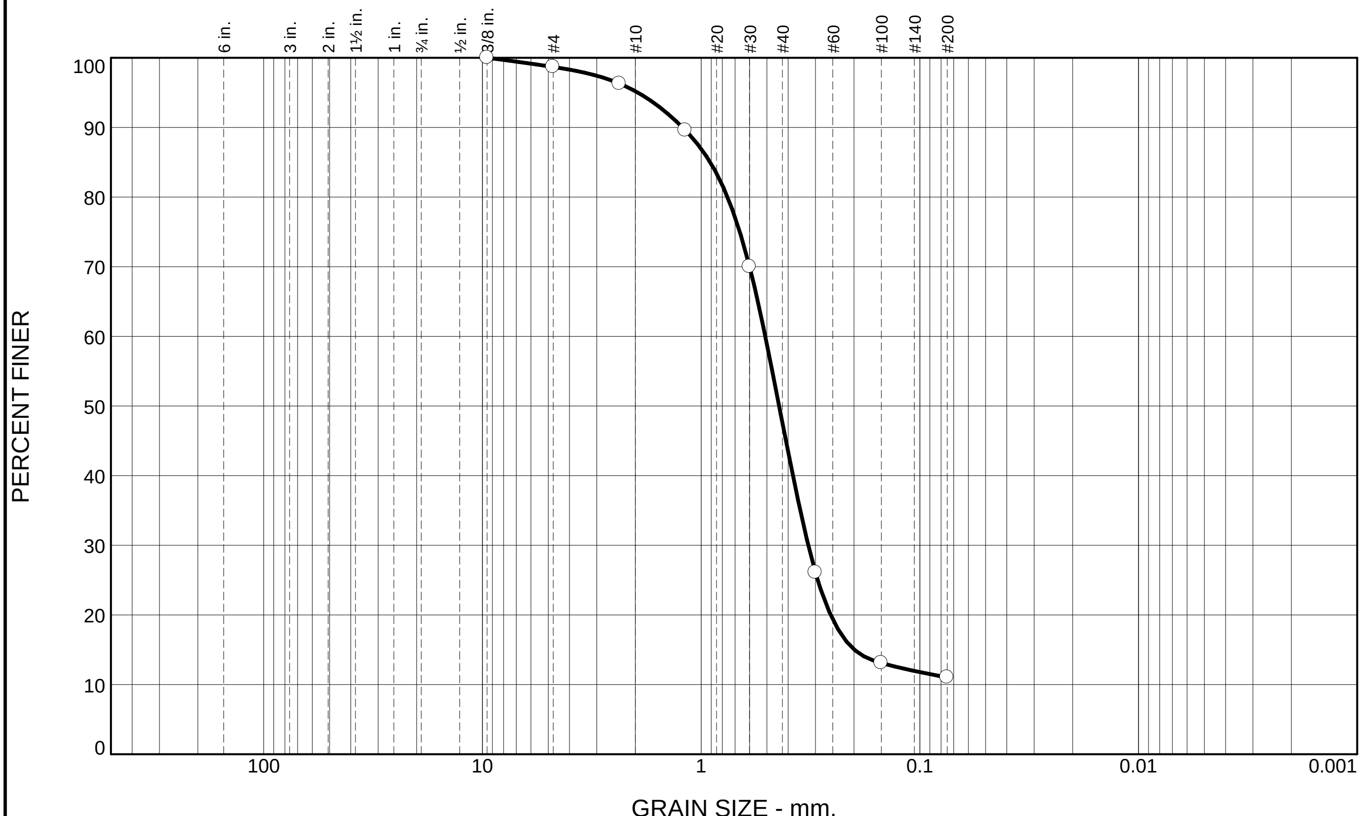
Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena

Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	3.5	47.6	36.6	11.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.7		
#8	96.3		
#16	89.6		
#30	70.0		
#50	26.1		
#100	13.1		
#200	11.0		

* (no specification provided)

Material Description

Sand with little Silt and trace Gravel

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.2156 D_{85}= 0.9085 D_{60}= 0.5089

D_{50}= 0.4398 D_{30}= 0.3236 D_{15}= 0.1990

D_{10}= C_u= C_c=

Classification

USCS= SP-SM AASHTO=

Remarks

Source of Sample: 15995 **Depth:** 8.5'-10.0'

Sample Number: B-16; S-4

Date:

Atlas

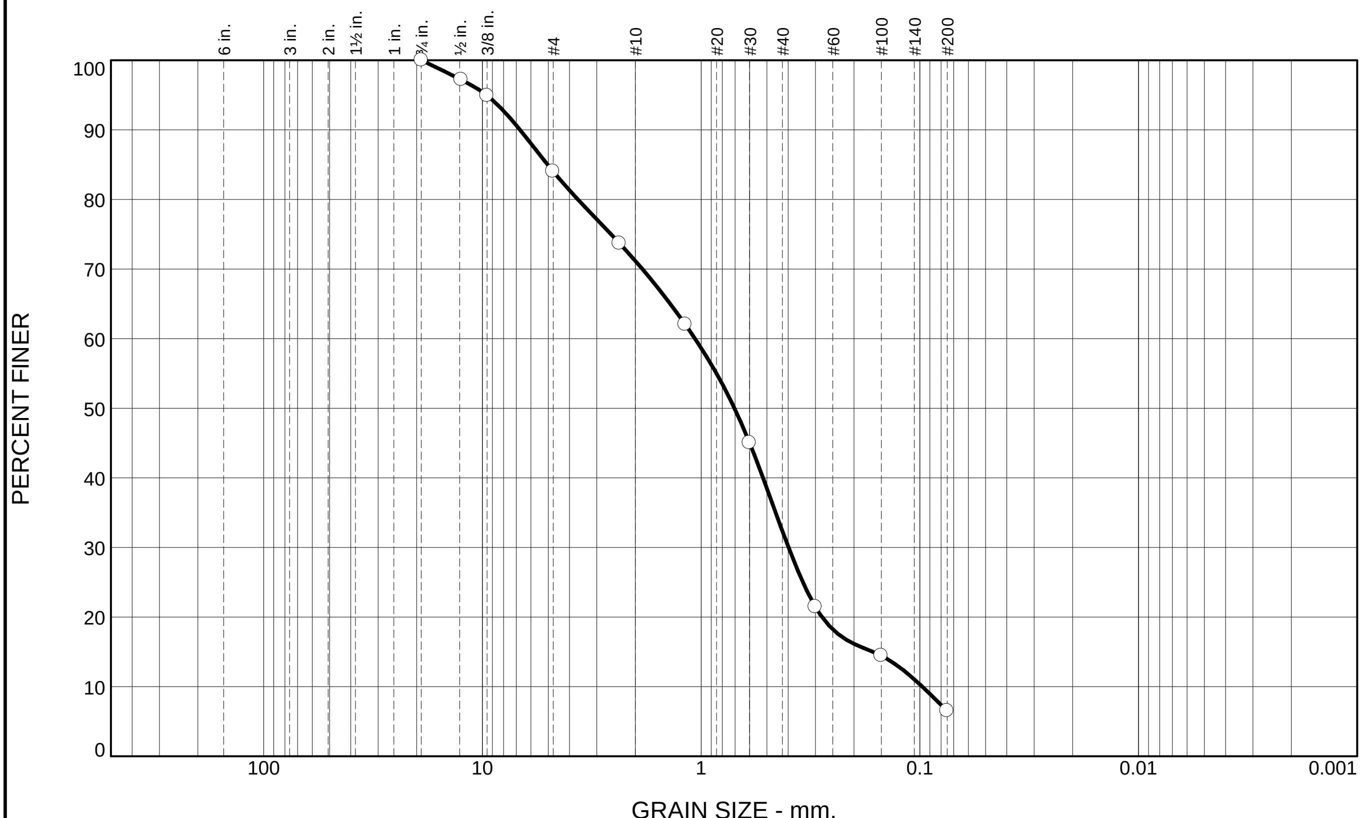
Indianapolis, Indiana

Client: Indiana University

Project: IUI Arena

Project No: 170GC01791 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	16.0	12.8	38.8	25.9	6.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2"	97.2		
3/8	94.9		
#4	84.0		
#8	73.7		
#16	62.0		
#30	45.0		
#50	21.4		
#100	14.5		
#200	6.5		

* (no specification provided)

Material Description

Sand with little Gravel and trace Silt

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 6.7314 D_{85}= 5.0336 D_{60}= 1.0660
D_{50}= 0.7039 D_{30}= 0.3983 D_{15}= 0.1634
D_{10}= 0.0973 C_u= 10.95 C_c= 1.53

Classification

USCS= SW-SM AASHTO=

Remarks

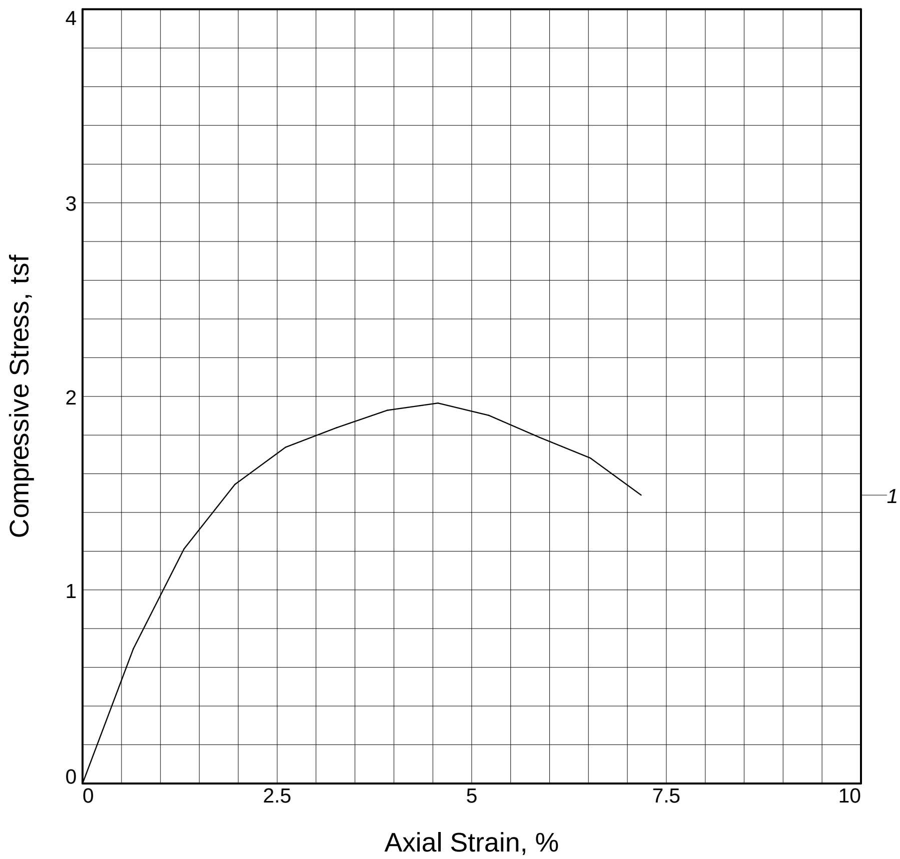
Source of Sample: 15995 **Depth:** 13.5'-17.5'
Sample Number: B-16; S-6 & 7 **Date:**

Atlas

Indianapolis, Indiana

Client: Indiana University
Project: IUI Arena
Project No: 170GC01791 **Figure**

UNCONFINED COMPRESSION TEST



Sample No.	1			
Unconfined strength, tsf	1.966			
Undrained shear strength, tsf	0.983			
Failure strain, %	4.6			
Strain rate, %/min.	2.00			
Water content, %	15.5			
Wet density, pcf	124.5			
Dry density, pcf	107.8			
Saturation, %	74.1			
Void ratio	0.5639			
Specimen diameter, in.	1.38			
Specimen height, in.	3.07			
Height/diameter ratio	2.23			

Description:

LL =	**PL =**	**PI =**	**Assumed GS=** 2.7	**Type:** Split spoon

Project No.: 170GC01791
Date Sampled:
Remarks:

Client: Indiana University

Project: IUI Arena

Source of Sample: 15991 **Depth:** 8.5' - 10.0'
Sample Number: B-1; S-4

UNCONFINED COMPRESSION TEST
Atlas
Indianapolis, Indiana

Figure QU01791

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply this report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you GBC-Member geotechnical engineer for more information.

GEOTECHNICAL BUSINESS COUNCIL
of the Geoprofessional Business Association

8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@geoprofessional.org www.geoprofessional.org

BID FORM
for

IN128 JAMES T. MORRIS ARENA
Indiana University Indianapolis
Indianapolis, Indiana
IU 20240127

TO: The Trustees of Indiana University
Bloomington, Indiana

****Submit bid online via www.iuplanroom.com****

FROM:

Bidder's Name ____

Address ____

City, State, Zip Code ____

Phone Number ______________________ FAX Number ______________________

CONTACTS:

Bid / Contract Information: Name: ______________________________

Phone: ____________________ E-mail: ____________________

Proposed Project Manager: Name: ______________________________

Phone: ____________________ E-mail: ____________________

Indicate if your firm is a certified minority-, women-, or veteran-owned business ___Yes ___ No
If "Yes", please attach a copy of certification

FOR: **Unified Bid** to include General, Mechanical, and Electrical Construction Work

Bidders:

LUMP SUM BASE BID

The undersigned Bidder, with a complete understanding of existing conditions at the Project Site and a complete understanding of the Bidding Documents, including any Addenda acknowledged hereinafter, for IN128 JAMES T. MORRIS ARENA on the Indiana University Indianapolis campus, as prepared by RATIO, 101 S. Pennsylvania St., Indianapolis, IN 46204, hereby proposes to complete the project, in full and complete accordance with the requirements of the Bidding documents, for the LUMP SUM BASE BID PRICE of:

____ Dollars $________________
(written amount) (numerals)

MAJOR SUBCONTRACTORS

Subcontractors and other persons and organizations proposed by the Bidder and accepted by the Owner and the Owner's Representative must be used on the work for which they were proposed and accepted and shall not be changed except with the written approval of the Owner and the Owner's Representative.

If requested, the supplemental Subcontractors and Products List will be submitted by email to the Owner, bidtab@indiana.edu, and RATIO within 48 hours of the bid opening. The understanding of the Owner and the design team is that these same Major Subcontractors will be the same subcontractors listed below.

The Contractor proposes to utilize the following primary subcontractors for the work indicated.

List one major subcontractor per trade. Any deviation could result in the Owner removing the bid from consideration.

Indicate which are certified by the State of Indiana as an MBE, WBE, or VBE company by circling the M/W/VBE after the name.

Cast In Place Concrete Contractor: ______________________ M/W/VBE

Mechanical Contractor: _________________________ M/W/VBE

Electrical Contractor: ____________________ M/W/VBE

Plumbing Contractor: ___________________ M/W/VBE

ALTERNATE PROPOSALS

1. Alternate proposals are requested under Alternates of the Bidding Documents. (See Specification Index)
2. The alternate proposal shall indicate the amount to be added to or deducted from the Lump Sum Base Bid if the alternate proposal is accepted by the Owner.
3. The alternate proposal shall include all costs necessary for the complete installation of the materials or items indicated for the alternate proposal, including materials, labor, equipment, operations, administration, overhead, profit, and taxes (as applicable).
4. The alternate proposal shall also include all costs for changes in the work (including work of other Separate Contracts) that will be made necessary by acceptance of the alternate proposal.
5. The Bidder shall submit prices for all the alternates listed below in the manner indicated. Cross out (Add) or (Deduct) as applicable. If there is no change in price to the Lump Sum Base Bid, write in "No Change".

Alternate No. 1: *Sports Floor*

(Add) (Deduct) ____Dollars $_________________
(written amount) (numerals)

Alternate No. 2A: *Aluminum Sunshades*

(Add) (Deduct) ____Dollars $_________________
(written amount)

Alternate No. 2B: *Terra Cotta Sunshades*

(Add) (Deduct) ____Dollars $_________________
(written amount)

Mandatory Alternate No. 3: Air Handler(s) Alternate

Provide Air Handler(s) No. AHU 00-01, AHU 00-02, AHU 00-03, AHU 01-01, AHU 02-01, AHU 02-02, and AHU 02-03.

Bidder is required to list a price for AT LEAST ONE (1) Air Handler Manufacturer, although bidders are encouraged to offer prices for more than one (1) Air Handler Manufacturer. The submitted equipment will be evaluated as described in Section 237313 - AIR-HANDLING UNITS and factors other than price may be taken into consideration as the bids are analyzed.

In order for the Air Handler Manufacturer's price – submitted by the Bidder – to be valid, the Air Handler Manufacturer must submit the appropriate submittals as defined in subparagraph 1.4 of Section 237313 - AIR-HANDLING UNITS.

Upload all proposed air handler submittals in PDF format along with required bid form and supplemental documents.

*Label each PDF submittal as follows:

"[your company name] – IU [project number] – [manufacturer name]"

Alternate No. 3A: Haakon

(Add) (Deduct) ____Dollars $_________________
(written amount) (numerals)

Alternate No. 3B: Ventrol

(Add) (Deduct) ____Dollars $_________________
(written amount) (numerals)

Alternate No. 3C: Air Enterprises

(Add) (Deduct) ____Dollars $_________________
(written amount) (numerals)

Alternate No. 4: *Grills/Fryers*

(Add) (Deduct) ____Dollars $__________________
(written amount) (numerals)

Alternate No. 5: *South Concession Stand*

(Add) (Deduct) ____Dollars $__________________
(written amount)

Alternate No. 6: *Acoustical Panels*

(Add) (Deduct) ____Dollars $__________________
(written amount)

Alternate No. 7: *Video Production Equipment*

(Add) (Deduct) ____Dollars $__________________
(written amount) (numerals)

Alternate No. 8: *Interior Stone Cladding*

(Add) (Deduct) ____Dollars $__________________
(written amount)

Alternate No. 9: *Masonry Partitions*

(Add) (Deduct) ____Dollars $__________________
(written amount)

TAX EXEMPTIONS

The undersigned Bidder has informed himself and all his prospective sub-contractors and suppliers of the tax exempt status of the Owner, as set forth in the General Conditions, and therefore, has not included these taxes in his Lump Sum Base Bid price.

SUBSTITUTIONS

The undersigned Bidder has based his bid upon the materials, products, articles, equipment, brands, manufacturers and processes described in the Bidding Documents or upon approved equivalents. Proof of equivalency of substitutions is the responsibility of the Bidder, but the Architect/Engineer shall be the sole judge of equivalency. Proposed equivalent substitutions shall be equal in all respects to the requirements of the Bidding Documents, including but not limited to the design, quality, physical size, performance characteristics, strength, previous history of use, and to the method of installation, attachment, or connection to related or adjoining work. Determination of equivalency of proposed substitutions shall be by the Architect/Engineer, before the bid opening date, as described in paragraph entitled "Substitutions" in the Instructions to Bidders.

COMPLETION DATE

The Undersigned Bidder agrees to coordinate and expedite his work and shall take into consideration any lead time and schedule parameters with all contractors, and that this Work will be completed no later than September 21, 2026.

ASSIGNMENT OF COORDINATION

The undersigned Bidder agrees to the assignment of Mechanical and Electrical work to the successful General Contractor for the responsibility of complete coordination of the work as stated in the Instructions to Bidders.

PERFORMANCE AND PAYMENT BOND

The undersigned Bidder agrees, if awarded the Contract, to deliver to the Owner a satisfactory Performance Bond, in the full amount (100%) of the total Contract price, not later than the date of execution of the contract. The cost of the Bond shall be included in the Lump Sum Base Bid contained in this Proposal.

SUPPLEMENTAL AND REQUIRED DOCUMENTS

Bid Security; State Form 96 (Revised 2013); Written Drug Testing Program, which must be in full compliance with IC 4-13-18; a completed Minority, Women's and Veteran's Business Enterprise Participation Plan; Contractor Asbestos Certification; Asbestos Protocol for Contractors.

MINORITY BUSINESS ENTERPRISE PARTICIPATION COMMITMENT

The undersigned Bidder agrees, if awarded the Contract, to achieve a minimum of 20% diversity spend on the project to Indiana-certified MBE/WBE/VBE suppliers.

Contractors will find a listing of all MBE/WBE/VBE suppliers certified by the State of Indiana at the following website: www.in.gov/idoa/mwbe/2743.htm. You may also use IU Purchasing's Diverse Supplier Search tool at https://purchasing.iu.edu/diversity-search/index.shtml.

Owner retains the discretion to **hold payment, and/or to reject future bids submitted by the successful Contractor** in the event that Contractor misrepresents either MBE/WBE/VBE participation in this Project, or its efforts to obtain MBE/WBE/VBE participation in this project or fails to report MBE/WBE/VBE spend on this project.

ADDENDA

The following Addenda have been received by the undersigned Bidder; and all costs resulting from these Addenda have been included in the preparation of this Bid Form:

Addendum No. ______ Dated ________

Addendum No. ______ Dated ________

Addendum No. ______ Dated ________

SIGNATURES

1. **When a Bidder is an Individual**:

______________________________ ____________________________________

Witness

Bidder

Date: ___________________ Address:___________________________________

____

2. **When a Bidder is a Partnership**: __________________________________

Name of Partnership

Date: ___________________ Address: __________________________________

____

______________________________ ____________________________________

Partner Partner

3. **When Bidder is a Corporation:** __________________________________

Name of Corporation

Date: ___________________ Address: __________________________________

____

By: ____________________________________

President

Attest: ________________________

Secretary

CORPORATE SEAL

END

****Submit bid online via www.iuplanroom.com****

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 Part 3 "Schedule of Alternates" Article 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 No. 1: Sports Floor.

1. Base Bid: Provide Robbins Unimax 100 with 2-1/4 inch slab recess as indicated on Drawings and as specified in Section 09466 "Wood Athletic Flooring."
2. Alternate: Provide Robbins MVP with 2-7/8 inch slab recess as indicated on Drawings and as specified in Section 09466 "Wood Athletic Flooring."

B. Alternate No. 2: Sunshades

1. Base Bid: Delete sunshades as specified in Section 107113 “Exterior Sun Control Devices” and 107115 “Terra Cotta Sunshades”

2. Alternate 2A: Provide aluminum sunshades, curtain wall supported as indicated on Drawings and as specified in Section 107113 "Exterior Sun Control Devices."
3. Alternate 2B: Provide terracotta sunshades as indicated on Drawings and as specified in Section 107115 "Terra Cotta Sunshades."

C. Alternate No. 3: Air Handlers

1. For the following air-handler unit alternates, list a price for AT LEAST ONE (1) air handler manufacturer below. The submitted equipment will be evaluated as described in Specification Section 237313. Factors other than price may be taken into consideration as the bids are analyzed.
   a. Alternate 3A: Haakon
   b. Alternate 3B: Ventrol
   c. Alternate 3C: Air Enterprises

D. Alternate No. 4: Grills/Fryers

1. Base Bid: Delete Fryers and Griddles (B15 & B17 on QF201 and C15 & C17 on QF301) from concourse concessions.
2. Alternate: Provide Fryers and Griddles (B15 & B17 on QF201 and C15 & C17 on QF301) as shown on the documents.

E. Alternate No. 5: South Concession Stand

1. Base Bid: Delete all equipment shown on drawing QF301 with the exception of “C26, FLOOR TROUGH WITH GRATE”, which shall be provided. All values for Alternate No. 5 shall assume the Base Bid Condition of Alternate No. 4.

2. Alternate: Provide all equipment shown on drawing QF301 as shown on the documents. All values for Alternate No. 5 shall assume the Base Bid Condition of Alternate No. 4.

F. Alternate No. 6: Acoustical Panels

1. Base Bid: Delete Stretched Fabric Wall Systems as specified in Section 097713 and Expanded Metal Wall Structure as specified in Section 055900. Wall surfaces behind acoustical panels shall receive paint in lieu of acoustical panels.
2. Alternate Bid: Provide Stretched Fabric Wall Systems as specified in Section 097713 and Expanded Metal Wall Structure as specified in Section 055900.

G. Alternate No. 7: Video Production Equipment

1. Base Bid: Delete Section 116350 Video Production.
2. Alternate: Provide Video Production Equipment as specified in Section 116350 Video Production.

H. Alternate No. 8: Interior Stone Cladding

1. Base Bid: Delete Stone cladding as specified in Section 074320 along with associated backup systems where located inside the exterior envelope, ref C1/A-501, C1/A-502, and C3/A-502. Finish and paint underlying gypsum surfaces.
2. Alternate: Provide all stone cladding as shown on the drawings.

I. Alternate No. 9: Masonry partitions

1. Base Bid: Provide all interior Concrete Masonry Unit Partitions as shown on the drawings.
2. Alternate: In lieu of the following masonry partitions shown on A-002, substitute the following partition types. All partition heights, fire ratings, and acoustical attenuation modifiers shall match that shown for masonry partitions on the drawings.
    a. M4A: S3A.A
    b. M6A: S3A.A
    c. M8A: S6A.A
    d. M8A.2 (2HR RATED): S6B.2.A
    e. M8E: S6A.A

END OF SECTION 012300

SECTION 019113 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 – GENERAL

1.1 SUMMARY

A. Summary: The Owner has hired the Commissioning Provider (CxP) for this project.

Firm: BSA LifeStructures
Primary Contact: Scott Weaver sweaver@bsalifestructures.com

The Commissioning Provider will guide the commissioning work related to this project. The Contractors shall support this overall process, as described below.

B. System to be Commissioned:

1. Mechanical including HVAC equipment & controls, Fire Protection including Fire Pump, Plumbing including domestic hot water systems, pumps, and controls, Electrical including service, distribution, lighting, and controls, including daylighting controls, and verification of emergency fed equipment upon loss of normal power and subsequent return to normal power, and Renewable systems. Refer to individual Commissioning Specification Sections for specific information:

   a. Division 01 Section 017900 “Demonstration and Training”
   b. Division 21 Section 210800 “Commissioning of Fire Protection”
   c. Division 22 Section 220800 “Commissioning of Plumbing”.
   d. Division 23 Section 230800 “Commissioning of HVAC”.
   e. Division 26 Section 260800 “Commissioning of Electrical”.
   f. Division 28 Section 280800 “Commissioning of Electronic Safety”

1.2 DESCRIPTION

A. Commissioning is a quality-focused process for enhancing the delivery of a project. The process focuses on verifying and documenting that the facility and all its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the Owner's Project Requirements. The commissioning process shall encompass and coordinate the traditionally separate functions of system documentation, equipment start-up, control system calibration, test, adjust, balance, performance testing, and trend data collection and analysis.

B. Commissioning during the Construction Phase is intended to achieve the following specific objectives:

1. Verify that applicable equipment and systems are installed according to the manufacturer’s recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.
2. Verify and document proper performance of equipment and systems.
3. Provide Systems Manual documentation for Owner.

4. Verify that building operators and building occupants have received the required training.

C. The commissioning process does not take away from or reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product.

D. Abbreviations: The following are common abbreviations used in the Commissioning Specifications and in the Commissioning Plan:

A/E	Architect and Engineer	FT	Functional Test
CC	Construction Checklist	FP	Fire Protection Contractor
GC	General Contractor	MC	Mechanical Contractor
Cx	Commissioning	PC	Plumbing Contractor
Cx Plan	Commissioning Plan	Subs	Subcontractors
CxP	Commissioning Provider	TAB	Test, Adjust, and Balance Contractor
EC	Electrical Contractor	ECC/TCC	Environmental/Temperature Controls System Contractor

1.3 COORDINATION

A. Commissioning Team: The members of the commissioning team consist of the Commissioning Provider (CxP), the Owner, the Owner's Facility Manager, the designated commissioning representative of the General Contractor (CM), the architect and design engineers of record (A/E) (particularly the mechanical engineer), the Mechanical Contractor (MC), the Electrical Contractor (EC), the Test, Adjust, and Balance Contractor (TAB), the Environmental Control System Contractor (ECC) and other installing subcontractors or suppliers of equipment.

B. Scheduling. The CxP will work with the General Contractor according to established protocols to schedule the commissioning activities. The CxP will provide sufficient notice to the General Contractor for scheduling commissioning activities. The General Contractor will integrate all commissioning activities into the master schedule.

C. The CxP will provide the initial schedule of primary commissioning events at the commissioning kickoff meeting. The Cx Plan provides a format for this schedule. As construction progresses more detailed schedules are developed by the CxP.

1.4 COMMISSIONING PROCESS

A. Commissioning Plan:

1. The Cx plan shall provide further guidance in the execution of the commissioning process.
2. Following the commissioning kick-off meeting (see below) the CxP will update the plan, which is then considered the “final” plan, though it will continue to evolve and expand as the project progresses.

B. Commissioning Process: The following narrative provides a brief overview of the commissioning tasks during construction and the general order in which they occur:

1. Commissioning during construction begins with a kick-off meeting conducted by the CxP to review the scope of the commissioning work, review the commissioning plan, and review the preliminary commissioning schedule. At this meeting the CxP shall present the Construction Checklists to the contractors for review and comments.
2. Additional meetings will be required throughout construction, to include a meeting to present functional test procedures to the contractors for review and comment, and a final test scheduling meeting to be held in conjunction with equipment start-up. Meetings will be scheduled by the CxP in conjunction with the General Contractor with necessary parties attending.
3. Equipment submittals and shop drawings are submitted to the CxP during normal submittals. The submittal documentation requirements are explicitly described in the individual technical specification sections of the equipment/systems to be commissioned.
4. The CxP, through the General Contractor, provides the ECC, MC, PC, EC, FP, and TAB, checklists to be filled out during construction:

   a. Typically, there will be checklists for each equipment or system. The General Contractor, ECC, MC, PC, EC, FP, and TAB contractors fill out the construction checklists under their own direction and in accordance with the schedule requirements which are stated in the Cx Plan.
   b. Completed construction checklists are submitted to the General Contractor who provides copies to the CxP.
   c. The CxP reviews the checklists and reports to the General Contractor any deficiencies which need correction by the trades.

5. Equipment startup:

   a. Scheduled by the General Contractor.
   b. Prior to scheduled start-up, the CxP shall request and review contractor start-up and checkout forms from the ECC, MC, PC, EC, FP, TAB which will include the commissioning start-up checklist and the manufacturer's detailed start-up documentation referred to above.
   c. The CxP documents that the start-up was completed according to the approved plans through review and selected observation.

6. Development of Functional Tests:

   a. The CxP develops specific equipment and system functional test procedures.
   b. The commissioning team members review the procedures and provide comment.
   c. CxP incorporates comments as appropriate.

7. Review of Specified Test Reports (e.g., duct leakage, flushing and cleaning, etc.):

   a. For all systems/equipment being commissioned, the General Contractor provides the CxP a schedule for submission of test results required by the specifications.

b. The CxP reviews test results and provides comment to the General Contractor.
c. Items of non-compliance are corrected at the Contractor's expense and revised test results submitted for review.

8. Execution of Functional Tests:

a. Scheduled by the General Contractor for the individual systems and equipment to be tested.
b. Shall not be executed until after the Contractor has satisfied all test prerequisites.

1) Fully completed construction checklists for associated systems/equipment, approved by the CxP.
2) Completed specified-required tests.
3) Completed TAB and controls checkout.

c. The Contractor shall also conduct “dry-runs” of the functional test steps on their own before functional testing with the CxP present.
d. The functional test procedures are executed by the ECC, MC, PC, EC, FP, TAB as appropriate, under the direction of the CxP.
e. Items of non-compliance in material, installation, and operation are corrected and the system retested at the Contractor’s expense.

1) Deficiencies requiring re-test because of findings during the functional test procedures will result in a cost to the Contractor of $200 per man hour. These charges are to be reimbursed to the Commissioning Provider and accrue during re-test site visits by the Commissioning Provider.

9. Deferred testing is conducted, as specified, or required.
10. Except for deferred testing, functional testing is completed before Substantial Completion.
11. Verification by the CxP of commissioning process activities shall include random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the owner requirements. Systemic issues identified through random sampling will require corrective action for the equipment tested as well as all similar equipment or components. If additional sampling is required at the request of the owner due to systemic issues, the additional testing will result in a cost to the Contractor of $200 per man hour. These charges are to be reimbursed to the Commissioning Provider and accrue during additional site visits by the Commissioning Provider.

12. Specification-required training is conducted and documented by the Contractor.

a. Training Requirements
1) Follow Specification “017900 Demonstration and Training”

2) Submit training session outline and schedule to the Owner and Commissioning Provider no later than 14 days prior to Substantial Completion.
3) Incorporate comments from the Owner and Commissioning Provider into the final outline.
4) Schedule training with Owner, through the Commissioning Provider, with at least seven days' notice. Training shall not be scheduled until equipment and/or system is 100% complete, operational and commissioned.
5) Submit completed Staff Training and Orientation Records to the Owner and Commissioning Provider.
6) The skilled trade shop responsible for the specific system shall receive training.
7) Equipment specific training requirements are listed in the specification section for the respective equipment, and in 01 7900.
8) Instructors shall be persons familiar with the specific installation. In most cases this will be the actual installing and/or startup factory technician along with the foreman or site superintendent from the appropriate subcontractor.
9) The party giving training is responsible for documenting who received training.
10) The Owner or the CxP on behalf of the Owner will determine that the training was acceptable.

13. Documentation for a “Systems Manual” will be provided to the CxP by commissioning team members. The following describes the documentation required and who will provide it:

a. PDF must be searchable and include bookmarks
b. Executive Summary (CxP)
c. Owner’s Project Requirements (Owner)
d. Basis of Design (A/E)
e. Construction Record Documents and Specs (General Contractor with input from Subs)
f. Record drawing (as-built) sequences of operation for all equipment, including schedules, detailed point listings, setpoints, and setpoint ranges. (ECC)
g. Approved Submittals (General Contractor)
h. Maintenance summary – list of manufacturers recommended PM and frequency for equipment, pulled from O&Ms (CxP with content from O&Ms)
i. Ongoing optimization – list of recommendations of trends, etc. to observe to identify degradation of operation (CxP with input from ECC)
j. Operation and Maintenance Manuals for all equipment including recommended maintenance and frequency of each task. (General Contractor with content from Subs)
k. Training Records (CxP)
l. Cx Report
m. Current Facility Requirements (CFR) and O&M Plan

1) Sequences of Operation (ECC)
2) Building Occupancy Schedule (ECC, input from Owner)
3) Equipment run-time schedules (ECC)
4) Setpoints for all HVAC equipment (ECC)
5) Lighting levels throughout building (CxP with input from A/E
6) Minimum outdoor air requirements (CxP with input from A/E)
7) Seasonal / day of week / time of day schedule changes (ECC with input from Owner)
8) System narrative describing mechanical and electrical systems (CxP with input from A/E)
9) PM Plan for mechanical and electrical equipment – list of manufacturers recommended PM and frequency for equipment, pulled from O&Ms (CxP with input from Subs)
10) Sensor and actuator calibration recommendations. (ECC)
11) Cx Program / Ongoing Cx Plan (CxP)
    a) Functional performance test results (benchmarks), blank test forms, and recommended schedule for retesting. (CxP)

14. Near Warranty-end Issues Resolution: At 10 to 11 months, and/or 22 to 23 months into the 24-month warranty period, the CxP will review the current building operation with facility staff and the contractor and address the condition of outstanding issues related to the Owner's Project Requirements. Problems that are covered under warranty will be identified to the Owner within the warranty period so outstanding problems can be remedied under warranty without cost to the Owner.

1.5 RELATED WORK

A. Additional commissioning requirements will be given in the following specification sections. All the following sections apply to the Work of this section.

a. Division 01 Section 01 7900 “Demonstration and Training”
b. Division 22 Section 220800 “Commissioning of Plumbing”.
c. Division 23 Section 230800 “Commissioning of HVAC”.
d. Division 26 Section 260800 “Commissioning of Electrical”.
e. Division 28 Section 280800 “Commissioning of Electronic Safety”

1.6 RESPONSIBILITIES

A. All Parties:

1. Follow the Cx Plan.
2. Attend commissioning meetings as necessary.
3. Properly schedule, log, and discharge commissioning activities and responsibilities throughout this project.

B. General Contractor:

1. Construction Phase:

a. Assign a single person to manage the commissioning activities on behalf of the General Contractor and serve as a single point of contact and communication for the General Contractor in all commissioning activities.
b. Include commissioning activities in the master construction schedule and ensure MC, PC, EC, TAB, and ECC participation and responsiveness in the commissioning process. The following activities shall be included in the master construction schedule:

MEP & Controls Readiness

1) Domestic Water Systems Flushed, Treated, & Tested
2) Hydronic Systems Cleaned, Flushed, and Filled
3) HVAC Equipment - Electrical Terminations Completed
4) VFD Start-ups Completed
5) Mechanical Equipment Startup (AHU, Pumps, Humidifier, TMV, & Specialty Packages)
6) Chilled Water Active to Building
7) Steam Active to Building
8) Light Fixtures and Occupancy Controllers Installed
9) Controls - Programming, Controllers Pre-loaded, Network Cabling, & All Installation
10) Generator & Automatic Transfer Switch Installed

iii. HVAC Start-up & Controls Testing

Hydronic Controls Testing
AHUs Controls Startup & Testing
VAVs - Final Testing
Exhaust Fans - Test and Start-up
Lighting Startup (by manufacturer's rep)
Generator & ATS Startup
Test & Balance Hydronic & Air & Domestic Systems

iv. MEP Commissioning

Chilled Water
Heating Hot Water
Domestic Water
Air Handling & Exhaust
VAVs and other Terminals
Lighting Controls & Loss of Power

v. Project Completion

LEED Building Flush (as applicable)
Move-in Begins

The General Contractor is responsible for dividing the Work among Subcontractors and Suppliers and for delineating the work to be performed by specific trades. The following are suggestions as to how the Work may be divided. This is not a complete list of all the work: Refer to the commissioning plan for more detailed information:

c. Mechanical Subcontractor:

1) Provide related work as specified herein to support the mechanical systems Cx work being performed by CxP.
2) Perform system start-up functions including, but not necessarily limited to: Operate all motorized equipment to confirm proper function.
3) Correct all mechanical system deficiencies identified by CxP.
4) Provide documentation required for systems manual.
5) Participate in training.

d. Electrical Subcontractor:

1) Provide related work as specified herein to support the electrical systems Cx work being performed by CxP.
2) Perform system start-up functions including, but not necessarily limited to: Operate all electrical equipment to confirm proper function.
3) Correct all electrical system deficiencies identified by CxP.
4) Provide documentation required for systems manual.
5) Participate in training.

e. Fire Alarm Subcontractor:

1) Provide related work as specified herein to support the fire alarm interface with HVAC Cx work being performed by CxP.
2) Correct all system deficiencies identified by CxP.
3) Provide documentation required for systems manual.
4) Participate in training.

f. Testing, Adjusting and Balancing (TAB) Engineer:

1) Participate in a Pre-Balance Conference.
2) Provide timely notice to mechanical Subcontractor and CxP of all incomplete work and deficiencies which prevent proper performance of work.
3) Test, adjust, and balance all air and hydronic systems and prepare final report.
4) Coordinate with the CxP and ECC to support TAB work to be reviewed and inspected by the CxP on a statistical sampling basis. TAB contractor to demonstrate under direction of CxP.
5) Correct all deficiencies in TAB work and TAB report as identified by CxP.

g. Environmental Control System (ECC) Subcontractor:

1) Participate in a meeting to review the ECC sequence of operations documents with representatives of the CxP, Project Engineer, Owner's Engineer, and Owner's Maintenance personnel prior to official submission of the ECC Control drawings.
2) Provide related work as specified herein to support the mechanical systems Cx work being performed by CxP.
3) Perform 100% checkout of each control point, sensor calibration, and actuator. Provide documentation that every control point of the control system has been tested and is commanding, reporting, and controlling as specified in the construction documents prior to Functional Testing. More than 3 control points, 0 sensor calibrations, or 0 valve/damper stroke failures during functional testing shall be grounds for 25% additional sampling. Re-testing / additional sampling costs shall be covered by the responsible party.
4) In a timely manner, review and comment on feasibility and usefulness of functional test (FT) steps as developed by CxP.
5) Operate all Environmental Control devices to support Cx work:

   a) Operate each phase of the EC system separately, or in conjunction one with the other for a sufficient period of time to demonstrate the ability of the system to meet performance requirements in accordance with the true intent and purpose of these Specifications.
   b) ECC is responsible for verifying and demonstrating that each Sequence of Operation is being performed and design

conditions stably maintained under operating conditions using FT procedures. ECC shall work with CxP in development of FT procedures.

6) Provide trend data to the CxP for use in enhanced functional testing. CxP to provide a list of requested analog, digital, and virtual points to be trended at 15 minute intervals. A minimum of one week of trend data shall be provided for requested points, both 1. At substantial completion, and 2. During seasonal/deferred testing.
7) Correct all environmental control system deficiencies identified by CxP.
8) Provide systems level training.

h. Enforce on-time submittal of commissioning documentation by ECC, MC, EC, and TAB, especially, but not limited to, construction checklists and systems manual documentation. Contractor response(s) to commissioning reports issued by the Owner's commissioning agent shall be provided in writing within 10 days from the date of report issuance.
i. Attend commissioning kickoff meeting and other commissioning team meetings to facilitate the commissioning process. Contractor and his tier 1 subcontractors for Controls, Mechanical, Electrical and Sheet Metal shall be present at commissioning meetings when required by the CxP.
j. Perform the normal review of Contractor submittals.
k. Furnish a copy of all construction documents, addenda, change orders and approved submittals and shop drawings related to commissioned equipment to the CxP.
l. When necessary, observe and witness construction checklist completion, start-up and functional testing of selected equipment.
m. Furnish CxP a copy of specification-required construction test reports, e.g., pipe cleaning, pipe flushing, pipe and duct leak tests.
n. Review commissioning progress and Issues Logs.
o. Coordinate the resolution of deficiencies identified in all phases of commissioning.
p. Develop a training plan documenting all specification required training. Training plans shall include the following information:

1) Equipment.
2) Trainer’s name and company.
3) Time required for the training session.
4) Agenda: To include the following:

a) Conceptual overview of how the equipment works.
b) Intended sequence of operation in all modes of operation.
c) Sources of utility support.
d) Common problems and their diagnosis and repair.
e) Relevant health and safety practices/concern.
f) Proper maintenance schedule, tasks and procedures with demonstrations.

g) Emergency responses, documentation and recovery procedure

q. Compile O&M manuals, according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

2. Warranty Period:

a. Ensure that Subs execute seasonal or deferred function performance testing, witnessed by the CxP, according to the Specifications.
b. Ensure that Subs correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

C. Equipment Suppliers:

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner to keep warranties in force.
2. Assist in equipment testing as specified in agreements with Subs.
3. Include all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price to the Contractor, except for stand-alone data logging equipment that may be used by the CxP.
4. Through the contractors to whom they supply products, analyze specified products and verify that the designer has specified the newest most updated equipment.
5. Provide information requested by CxP regarding equipment sequence of operation and testing procedures.
6. Review test procedures for equipment installed by factory representatives.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform start-up and initial checkout and required functional testing shall be provided by the contractor for the equipment being tested.
B. Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment shall be included in the base bid price, and left on site, except for stand-alone data logging equipment that may be used by the CxP.
C. Portable data logging equipment and associated software, if used to test equipment will be provided by the CxP, but shall not become the property of the Owner.
D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified in the Owner’s project requirements document

1. All calibration shall be to NIST traceable standards. (National Institute of Standards and Technology)

2. All equipment shall be calibrated according to the manufacturer's recommended intervals and immediately after being dropped or damaged.
3. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 GENERAL

A. The attached documents are samples of a Construction Checklist and Functional Test. The samples are for reference only and are intended to provide a general definition of the rigor of system testing. Specific test procedures will be developed, by system, for this project by the Commissioning Provider.

END OF SECTION 019113

CLIENT
CITY, ST
PROJECT
Construction Checklist
Air Handler AHU-1

BSA LifeStructures
Creating inspired solutions that improve lives

Construction checklist items are to be completed as part of startup & initial checkout, prior to functional testing.

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).

If this form is not used for documenting, one of similar rigor shall be used.

Contractor assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

"Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = architect/engineer, All = all contractors, CxP = commissioning provider, ECC = controls contractor, EC = electrical contractor, GC = general contractor, MC = mechanical contractor, SC = sheet metal contractor, TAB = test and balance contractor

1 Requested Documentation

Check if Okay. Enter comment if deficient

Document	**AHU-1**	**Contractor**
Manufacturer's cut sheets		MC
Start-up Report		MC
Leak Test		MC
Vibration Test Report - Supply Fans		MC
Vibration Test Report - Return Fans		MC
Operation and Maintenance Manual		MC
Start-up Report – Energy Wheel		MC
Field casing leakage test		MC
Operation and Maintenance Manual – Energy Wheel		MC
Balance Report		TAB

Above complete per contract documents? Yes/No		MC

2 Delivery

A Model Verification

Field		Contractor	Enter Data
Manufacturer	submitted	MC	
	delivered	MC	
Model	submitted	MC	
	delivered	MC	
Serial #	delivered	MC	
Cooling Capacity	submitted	MC	
(MBH/GPM)	delivered	MC	
Heating Capacity	submitted	MC	
(MBH/GPM)	delivered	MC	
Supply Airflow,	submitted	MC	
design/minimum (CFM)	delivered	MC	
Supply fan motor	submitted	MC	
power/speed(HP/RPM)	delivered	MC	
Voltage / Phase /	submitted	MC	
Frequency (V/-/Hz)	delivered	MC	
Return Airflow,	submitted	MC	
design/minimum (CFM)	delivered	MC	
Return fan motor	submitted	MC	
power/speed(HP/RPM)	delivered	MC	
Voltage / Phase /	submitted	MC	
Frequency (V/-/Hz)	delivered	MC	

Installed equipment matches the spec? Yes/No ______ MC

B Physical Checks

Check if Okay. Enter comment if deficient

	Yes	**No (add comment)**	**NA**	**Contractor**
Unit is free from physical damage				MC
Coil surface areas free from damage				MC
Air openings are sealed with plastic				MC
Water openings are sealed with plastic plugs				MC
All components present and in proper order				MC
All access doors are operable				MC
Unit tags affixed				MC

All applicable items in part 2 complete? Yes/N ______ MC

3 Construction Checklist

Check Check if Okay. Enter comment if deficient

A Cabinet and general installation	**Yes**	**No (add comment)**	**NA**	**Contractor**
Unit secured as required by manufacturer and specifications				MC
Adequate clearance around unit for service				MC
Casing condition good: no dents, leaks, door gaskets installed				MC
Access doors close tightly - no leaks				MC
All components accessible for maintenance				MC
Unit can be removed from the building				MC
Cooling coil pan drains slope correctly				MC
Internal vibration isolators in good condition and shipping bolts are removed				MC
Belts are tight				MC
Unit labeled and label is easy to see				MC
Permanent labels affixed, including for fans				MC
Thermal insulation properly installed and according to specification				MC
Clean up of equipment completed per contract documents				MC
Pre-filters and Final Filters installed and replacement type and efficiency permanently affixed to housing – construction filters removed				MC
Pre-filters MERV 8 or per spec				MC
Final Filters MERV 14 or per spec				MC
(1) Spare set of each provided				MC
Magnahelic pressure gauge complete with static pressure tips, hardware and fittings installed for each bank				MC

B1 Chilled Water Piping, Valves, and Coils	Yes	No (add comment)	NA	Contractor
All piping components have been installed (in the correct order and direction) as required by detail drawing				MC
Piping arranged for ease of unit coil removal				MC
Piping supported as required by specifications				MC
Piping is clean				MC
Strainers in place and clean				MC
Piping system properly flushed				MC
No leaking apparent around fittings				MC
Piping insulation is complete and installed as per specifications				MC
All valves and test ports are easily accessible				MC
Valve tags attached				MC
Pipes properly labeled				MC
All coils are clean and fins are in good condition				MC
All condensate drain pans clean and slope to drain, per spec				MC
Condensate drain piping per detail and insulated				MC

B2 Heating Water Piping, Valves, and Coils	Yes	No (add comment)	NA	Contractor
All piping components have been installed (in the correct order and direction) as required by detail drawing				MC
Piping arranged for ease of unit coil removal				MC
Piping supported as required by specifications				MC
Piping is clean				MC
Strainers in place and clean				MC
Piping system properly flushed				MC
No leaking apparent around fittings				MC
Piping insulation is complete and installed as per specifications				MC
All valves and test ports are easily accessible				MC
Valve tags attached				MC
Pipes properly labeled				MC
All coils are clean and fins are in good condition				MC

C Fans	Yes	No (add comment)	NA	Contractor
Supply fan motor premium efficiency and inverter rated, if specified?				MC
Supply fan and motor alignment correct				MC
Supply fan belt tension & condition good				MC
Supply fan protective shrouds for belts in place and secure				MC
Supply fan area clean				MC
Supply fan and motor properly lubricated				MC
Relief/return fan motor premium efficiency and inverter rated, if specified?				MC
Relief/return fan and motor aligned				MC
Relief/return fan belt tension & condition good				MC
Relief/return fan protective shrouds for belts in place and secure				MC
Relief/return fan area clean				MC
Relief/return fan and motor lube lines installed and lubed				MC

D Energy Recovery Wheel	Yes	No (add comment)	NA	Contractor
Installed level			NA	MC
Secured to structural support with anchor bolts			NA	MC
Flashed airtight			NA	MC
Clearances for service and maintenance			NA	MC
Filters for both airstreams installed prior to running unit			NA	MC
Drains piped from pan to drain, same size as condensate drain			NA	MC

E Duct connections	Yes	No (add comment)	NA	Contractor
Adequate locations available for test and balance				SC
Dampers are accessible (access doors)				SC
Vibration isolators installed				SC
Boot between duct and unit tight and in good condition				SC
Ductwork is clean and free of debris				SC
Sound attenuators installed				SC
Smoke and fire dampers installed properly per contract docs (proper location, access doors, appropriate ratings verified)				SC
Duct joint sealant properly installed				SC
No apparent severe duct restrictions				SC
Turning vanes in square elbows as per drawings				SC
OA intakes located away from pollutant sources & exhaust outlets				SC
Leakage tests complete				SC

G Controls	Yes	No (add comment)	NA	Contractor
Control panel accessible and labeled				ECC
OAT, MAT, SAT, EAT, chilled water supply sensors properly located and secure (related OAT sensor shielded)				ECC
All dampers close tightly				ECC
All damper linkages have minimum play				ECC
Low limit sensor located to deal with stratification & bypass				ECC
Safeties in place and operable				ECC
Control system interlocks hooked up and functional				ECC
All control devices mounted and wiring complete				ECC

F Electrical	Yes	No (add comment)	NA	Contractor
Pilot lights are functioning				EC
Local disconnects in accessible location and labeled				EC
All electric connections tight				EC
Proper grounding installed for components and unit				EC
Starter overload breakers installed and correct size				EC
Supply fan rotation correct				EC
Return/relief fan rotation correct				EC
VFC programming and start-up complete and reports received				EC
HOA switch functions to activate and deactivate unit				EC

H1 Temporary operation provisions (if approved)	Yes	No (add comment)	NA	Contractor
Quality filters on RA grills, etc. to minimize dirt in the ductwork and coils and in any finished areas				SC
Verify moisture migration is not a problem, due to improper pressures between spaces				SC
Safeties in place and functioning for pressure, temperature, fire, and smoke?				ECC

H2 Mechanical Startup	Yes	No (add comment)	NA	Contractor
Unit is clean				MC
Internal isolators free to move				MC
Fans and motors lubricated and aligned				MC
Fan belts have proper tension and are in good condition				MC
Protective shrouds for fans and belts in place and secure				MC
Terminal unit dampers manually opened or are controllable and open				MC
Filters installed properly (no bypass air) and are clean				MC
System starts and runs without unusual noise or vibration				MC
Manufacturer's startup checklist attached and complete				MC

I Controls Startup	Yes	No (add comment)	NA	Contractor
Safeties in place and functioning for pressure, temperature, fire, and smoke?				ECC
All dampers (OA, EA, RA, etc.) stroke fully without binding				ECC
Damper end switch operation field verified				ECC
Valves stroke fully and easily				ECC
Valves verified to not be leaking through at normal system pressure				ECC
Point to point checks complete				ECC
Sensor calibrations complete and offsets in place				ECC
Specified sequences of operation implemented and tested				ECC
Cooling sequence verified				ECC
Heating sequence verified				ECC
Warm-up sequence verified				ECC
Cool-down sequence verified				ECC
Economizer sequence verified				ECC
Unoccupied sequence verified				ECC
Control loop tuning complete				ECC
Graphics complete				ECC
Alarms in place and tested				ECC
Trending in place				ECC

J TAB	Yes	No (add comment)	NA	Contractor
Filters and coils are clean				TAB
Water strainers are clean				TAB
Motor rotation verified - each motor				TAB
Motor voltage and amps verified - each phase of each motor				TAB
Motor RPM verified - each fan				TAB
Entering and leaving cooking coil air temperature				TAB
Entering and leaving heating coil temperature				TAB
Entering and leaving chilled water temperature				TAB
Entering and leaving hot wat temperature				TAB
Coil flow and air/water pressure drops verified - each coil				TAB

All applicable items in part 3 complete? Yes/N ☐ MC

5 Comments

Enter Mechanical comments	
Enter Controls comments	
Enter Electrical comments	
Enter Sheet Metal comments	

6 Participants

I have reviewed the above Construction Checklist document and agree that the information included is accurate.

Name	Date and Company

Mechanical Contractor

I have reviewed the above Construction Checklist document and agree that the information included is accurate.

Name	Date and Company

Controls Contractor

I have reviewed the above Construction Checklist document and agree that the information included is accurate.

Name	Date and Company

Electrical Contractor

I have reviewed the above Construction Checklist document and agree that the information included is accurate.

Name	Date and Company

Sheet Metal Contractor

Reference: ASHRAE Guideline 1.1 2007

--END OF CHECKLIST--

Blue font denotes enhancements from BSALS spec and or BSALS checklist

CLIENT
PROJECT
Functional Test
AHU-1, HUMIDIFIER H-1, COIL PUMP HCP-1, EF-1,2,4

BSA LifeStructures
Creating inspired solutions
that improve lives

Project #
System Location
Date of test
Time of Test
Weather Conditions
Contractors Representative
Design Engineer Representative
Commissioning Representative
Control Reference

Performance of the following procedures shall in all circumstances comply with applicable

SETPOINTS SUMMARY

Parameter	**Spec**	**Pre-Test Value**	**Returned to Pre-test Value? (Y / N / NA)**
Duct Static Pressure Setpoint	1.0" WG		
Duct Static Pressure Reset	0.6 to 2" WG from setpoint (0.1 increments every 5 minutes to maintain a damper > 95%		
Mixed air setpoint	53ºF		
Preheat air setpoint	52ºF		
Supply air setpoint, cooling mode	55ºF		
Discharge air setpoint reset	None.		
Return air humidity upper limit	NA		
Return fan tracking CFM offset	12,000 CFM		
Return fan tracking CFM offset, startup	0 CFM		
Startup timer	300s		
Heating coil discharge setpoint, upon shutdown.	NSºF		
Economizer Disable	above 70ºF OAT		
Min OA damper minimum position	PER TAB or 100%		
RA damper minimum position	100% open		
EA damper minimum position	100% closed		
VFC operating range	assume 15 to 60 Hz		
Coil Pump			
PHC pump enable	50, disable at 55 OAT		

Unoccupied Mode			
Schedule	10PM-6AM		
Unoccupied Recirc Temperature Enable	60ºF and 80ºF		
Unoccupied Recirc Humidity Enable	NS		
Unoccupied Recirc return fan tracking CFM offset	Null		
Winter Chilled Water Mode			
Mode enable	50ºF OAT, disable above 52		
Chilled water valve position	50%		
Supply air setpoint	52ºF		
Humidifiers			
Humidifier enable	Below 70ºF OAT		
Humidifier return control point	25% RH		
Software supply humidity high limit	85% RH		
Hardware supply humidity high limit	90% RH		
Cutout, low flow	Yes		
Safeties and Alarms			
Low Limit thermostat (minimum 2)	38ºF		
High Pressure Limit (Software)	2.5" WG		
High Pressure Limit (Hardwired Safety)	3.5" WG		
Return Duct Lo Pressure Limit (Hardwired)	(-)3.0" WG		
Mixed Air Temp Alarm	NS		
Supply Air Temp Alarm	NS		
Air filters			
PreFilter Efficiency	MERV 8		
Final Filter Efficiency	MERV 14		
Pre-Filter Switch	Per manufacturer - 1.0" WG?		
Final Filter Switch	Per manufacturerer - 1.5" WG?		

SENSOR CALIBRATION SUMMARY

Criteria for Acceptance: Air temperature sensors +/- 1 F degrees from measured values. Static pressure sensors, less than +/- 0.1" from measured values. Relative humidity sensors, less than +/- 5% RH (30% RH to read between 25 and 35%).

#	Control Type	Sensor Location	location ok	Measured	Sensed	Acceptable? Comments
AI-1	RETURN AIR TEMPERATURE					
AI-2	RETURN AIR HUMIDITY					
AI-3	MIXED AIR TEMPERATURE					
AI-4	PREHEAT COIL DISCHARGE TEMPERATURE					
AI-5	SUPPLY AIR TEMPERATURE					
AI-6	SUPPLY AIR HUMIDITY					
AI-7	SUPPLY AIR STATIC PRESSURE					
AI-8	STATIC PRESSURE 90%					
AI-9	SUPPLY FAN VOLUME B					
AI-10	SUPPLY FAN VOLUME A					
AI-11	RETURN FAN VOLUME					
AI-12	OUTDOOR AIR TEMPERATURE					
AI-13	PREFILTER PRESSURE DROP					
AI-14	FINAL FILTER PRESSURE DROP					

FUNCTIONAL TEST

#	System Event	Required Response	Y	N	N/A	Remarks
	1 Point to point				**Run #**	**1**
1	Verify full stroke, preheat coil valve	Graphics correctly represent actual position at 0% ,50%, 100% open.				
		Document Preheat coil valve fail position				
2	Verify full stroke, humidifier control valve	Graphics correctly represent actual position at 0% ,50%, 100% open.				
		Graphics correctly represent actual position at 0% ,50%, 100% open.				
3	Verify full stroke, cooling coil valve	Graphics correctly represent actual position at 0% ,50%,				
		Cooling coil valve fails open.				
4	Verify full stroke, min outdoor air damper	Graphics correctly represent closed and open positions.				
		Dampers spring return closed on loss of power.				
5	Verify full stroke, max outdoor air damper	Graphics correctly represent closed and open positions.				
		Dampers spring return closed on loss of power.				
6	Verify full stroke, return air damper	Graphics correctly represent closed and open positions.				
		Dampers spring return open on loss of power.				
7	Verify full stroke, relief air damper	Graphics correctly represent closed and open positions.				
		Dampers spring return closed on loss of power.				

	2 Safeties				Run #	1
	Demonstrate safeties are in place and function as specified.					
A	Supply high limit static pressure exceeds switch, set to 3.5” WG	Pressure is sensed at fan discharge.				
		Record initial and final trip point.				
		Supply fan stops				
		Return fan stops				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		Outdoor air dampers closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closes.				
		Heating coil valve closes or maintains preheat temp at setpoint.				
		An alarm is noted at the BAS.				
		Switch is reset manually (local)				
B	Low limit temperature is below 38º F.	Switch located as per schematic.				
		Supply fan stops				
		Return fan stops				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		Outdoor air dampers closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve opens 100%				
		Heating coil valve closes or maintains preheat temp at setpoint.				
		An alarm is noted at the BAS.				
		Switch is reset manually (local)				

C	Return lo limit static pressure exceeds switch, set to (-)3.0” WG	Pressure is sensed at return fan inlet.				
		Record initial and final trip point.				
		Supply fan stops				
		Return fan stops				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		Outdoor air dampers closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closes.				
		Heating coil valve closes or maintains preheat temp at setpoint.				
		An alarm is noted at the BAS.				
		Switch is reset manually (local)				
DEFG HI	Demonstrate fan status alarm functions.	Reduce supply and return fan speeds to minimum speed.				
		Turn off Supply Fan at VFC				
		An alarm is noted at the BAS.				
		Turn off Return Fan at VFC				
		An alarm is noted at the BAS.				
		Turn off Preheat Coil Pump				
		An alarm is noted at the BAS.				
		Turn off Exhaust Fan EF-1 at STARTER				AHU-1
		An alarm is noted at the BAS.				
		Turn off Exhaust Fan EF-2 at STARTER.				AHU-1
		An alarm is noted at the BAS.				
		Turn off Exhaust Fan EF-4 at STARTER.				AHU-1
		An alarm is noted at the BAS.				
	Return setpoints and turn fans and pumps back on .	All alarms are cleared.				

J	With FA in test mode, simulate smoke sensed at the return air duct detector.	There is no duct detector shutdown for this unit.				
		Supply fan stops				
		Return fan stops				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		Outdoor air dampers closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closes.				
		Heating coil valve closes or maintains preheat temp at setpoint.				
		An alarm is noted at the BAS.				
		Switch is reset manually (local)				
		Smoke isolation damper(s) close.				
K	With FA in test mode, simulate smoke sensed at the supply air duct detector.	Response is as above.				
	Return all setpoints.					
	3 System Disable				**Run #**	**1**
1	Command AHU OFF at the BAS.	Supply and return fans stop				
		Outdoor air damper closed.				
		Return air damper open				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		Relief air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closed.				
		Heating coil valve closed.				
	Simulate PH temperature below 60ºF	Document heating coil control valve function.				
	Return all setpoints.					

	4A System Enable				Run #	1
1	AHU is started from DDC Panel or from command of facility management system.	All H-O-A switches to be in “auto” position.				
		Supply fan starts				
		Return fan starts.				
		Return fan tracking CFM setpoint initially is zero.				
		OAD, MOAD, EAD remain closed, RAD open.				
		Supply and return fans slowly ramp up to achieve duct static pressur at setpoint.				
		Supply air temperature setpoint control is active.				
		Humidifier is disabled.				
		Exhaust Fan EF-1,2,4 still off (AHU-1)				
		After 300s, economizer is enabled, or if OAT is above 70, OAD goes to fixed minimum position.				
		Humidifier is active.				
		Exhaust Fan EF-1,2,4 start (AHU-1)				
		Retrun fan tracking CFM setpoint ramps up to final setpoint to induced design quantity of outdoor air.				
	4B Optimal Start Enable -- Cold Weather				Run #	1
	Demonstrate Optimal Start Algorithm is in place and functions	Record current minutes per degree AHU is currently programmed to start.				
		Observe optimal start operation.				
	4C Optimal Start Enable -- Warm Weather				Run #	1
	Demonstrate Optimal Start Algorithm is in place and functions	Record current minutes per degree AHU is currently programmed to start.				
		Observe optimal start operation.				

	5A Economizer Operation -- 50 to 70 degF.				**Run #**	**1**
1	Demonstrate Economizer operation / Supply air control loop when OAT is above 52 and below 70° F	OAT is below 70°F. Record OAT:				
	Record SAT setpoint	SAT setpoint = 55°F				
		Economizer dampers (EAD, RAD) modulate to maintain MAT equal to SAT setpoint minus an offset (2°F specified)				
		Cooling coil control valve closed.				
		Heating coil control valve closed.				
	Lower the mixed air setpoint	EAD, OAD modulate toward open				
		RAD modulates toward closed				
	Lower the mixed air setpoint	EAD, OAD reaches 100% open				
		RAD reaches 100% closed				
	Lower the supply air setpoint	The cooling coil control valve modulates to maintain SAT, while EAD is 100% open, RAD is 100% closed.				
	Raise the supply air setpoint	The cooling coil control valve shall be modulated closed.				
	Raise the mixed air setpoint	EAD, OAD modulate toward closed/min				
		RAD modulates toward open				
	Raise the mixed air setpoint	OAD is at minimum position,				
		EAD closed, RAD open				
		Preheat coil control valve modulates open to maintain PHT equal to SAT setpoint minus an offset (5°F specified)				

	5B Economizer Operation -- Below 50 degF.				Run #	1
1	Demonstrate Economizer operation / Supply air control loop when OAT is below 50° F	OAT is below 50°F. Record OAT:				
		Heating coil pump runs.				
	Record SAT setpoint	SAT setpoint = 52°F				
		Economizer dampers (EAD, RAD) modulate to maintain SAT setpoint.				
		Cooling coil control valve 50% open.				
		Heating coil control valve closed.				
	Lower the supply air setpoint	EAD, OAD modulate toward open				
		RAD modulates toward closed				
	Lower the supply air setpoint	EAD, OAD reaches 100% open				
		RAD reaches 100% closed				
	Lower the supply air setpoint	The cooling coil control valve modulates to maintain SAT, while EAD is 100% open, RAD is 100% closed.				
	Raise the supply air setpoint	EAD, OAD modulate toward closed/min				
		RAD modulates toward open				
	Raise the supply air setpoint	OAD is at minimum position,				
		EAD closed, RAD open				
		Preheat coil control valve modulates open to maintain SAT.				
	Simulate an OAT above 52.	System reverts to normal economizer mode.				
	Simulate an OAT above 55	Heating coil pump turns off.				

	6 Cooling Mode				Run #	
1	Demonstrate Economizer operation / Supply air control loop when OAT is above 70° F	OAT is above 70°. Record OAT:				
	Raise the supply air setpoint	The economizer shall be fixed in minimum position and the cooling coil control valve modulates toward closed to maintain supply air temperature set point.				
	Lower the supply air setpoint	The economizer shall be fixed in minimum position and the cooling coil control valve modulates toward open to maintain supply air temperature set point.				
	7 Static Pressure Control (and Reset), Return Fan Tracking				Run #	
1	Demonstrate VFC control loop static pressure control responds to a change in static pressure setpoint.	Locate duct static pressure sensors and note location on drawings.				
		Record duct static pressure setpoint:				
		Setpoint is to be 1.0” W.G. or lower per TAB.				
		Record effective duct pressure setpoint:				
		Record effective duct pressure setpoint range (minimum and maximum):				
	Record supply and return CFMs	Offset matches design / TAB				
2	Override the duct static pressure setpoint to be higher than the current effective setpoint.	Supply fan VSC ramps up to maintain new setpoint, at the location with the lowest sensed pressure.				
		Return fan speed increases to maintain constant offset.				
	Override the duct static pressure setpoint to be higher	Fan speed is limited by software pressure limit, installed after final filters.				
		Return fan speed increases to maintain constant offset.				
	Override the duct static pressure setpoint to be lower than the current effective setpoint.	Supply fan VSC ramps down to maintain new setpoint.				
		Return fan speed increases to maintain constant offset.				
	Override the duct static pressure setpoint to be lower	Review terminal box position to determine the box(es) driving the reset.				

3	Demonstrate reset functions as specified.	If one or more boxes are 95% or more open, pressure setpoint is reset up.				
		If setpoint reaches 2.0", an alarm is annunciated at the BAS.				
		If the most open critical box damper position is between 90-95%, pressure setpoint is held constant.				
		If all critical box damper positions are less than 90%, pressure setpoint is reset down.				
	Return all setpoints					
	8 Humidity Control				**Run #**	1
1	Demonstrate that the Humidification control loop responds to a change in humidity.					
	Raise the return air humidity setpoint	Humidifier actuator modulates open to increase the humidity to maintain the humidity at setpoint.				
	Raise the return air humidity setpoint	Humidity limited by supply software setpoint				
	Lower the return air humidity setpoint	Humidifier actuator modulates closed to decrease the humidity to maintain return sensed humidity at setpoint. .				
2	Test the high limit humidistats	Set to 90%. Humidity above this level shuts the steam valve.				
3	Test the flow switches	Steam valve shuts upon loss of flow when fan speed is less than 20 Hz.				
4	Test the OAT interlock	Steam valve shuts when OAT is above 70º				
5	Return all setpoints					

	9 Unoccupied Mode				Run #	
	Place system in unoccupied mode.	Supply fan stops				
		Return fan stops				
		Outdoor air damper closed.				
		Return air damper open				
		Relief air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closed.				
		Heating coil valve closed or under control.				
		Exhaust Fan EF-1,2,4 stop with AHU-1				
		All associated terminal box air and heating valves close.				
	Simulate space temperature above 80 deg F	Supply fan starts				
		Return fan starts.				
		Return fan tracking CFM setpoint initially is zero.				
		OAD, EAD remain closed, RAD open.				
		Exhaust Fan EF-1,2,4 still off (AHU-1)				
		Supply and return fans slowly ramp up to achieve duct static pressure at setpoint.				
		Supply air temperature setpoint control is active.				
		Humidifier is disabled.				
		All associated terminal box air and heating valves closed.				
		For boxes where space temp is above 80, box is open to cool space.				
	Simulate space temperature below 78 deg F	Supply fan stops				
		Return fan stops				
		Outdoor air damper closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closed.				
		Heating coil valve closed or under control.				
		All associated terminal box air and heating valves closed.				

	Simulate space temperature below 60 deg F	Supply fan starts				
		Return fan starts.				
		Return fan tracking CFM setpoint initially is zero.				
		OAD, EAD remain closed, RAD open.				
		Supply and return fans slowly ramp up to achieve duct static pressur at setpoint.				
		Supply air temperature setpoint control is active.				
		Humidifier is disabled.				
		All associated terminal box air and heating valves closed.				
		For boxes where space temp is below 62, box is open to heat space.				
	Simulate space temperature above 62 deg F	Supply fan stops				
		Return fan stops				
		Outdoor air damper closed.				
		Return air damper open				
		Releif air damper closed.				
		Humidifier control valves close.				
		Cooling coil valve closed.				
		Heating coil valve closed or under control.				
		All associated terminal box air and heating valves closed.				

	10 Trends, Graphics, and Alarms					1
	Graphics are in place and accurately depict the system.					
	Alarms annunciate at the graphic display.	Tested elsewhere in the sequence.				
	Provide on week of trending for the following points, at 15 minute intervals.					
	AI-1	RETURN AIR TEMPERATURE				
	AI-2	RETURN AIR HUMIDITY				
	AI-3	MIXED AIR TEMPERATURE				
	AI-4	PREHEAT COIL DISCHARGE TEMPERATURE				
	AI-5	SUPPLY AIR TEMPERATURE				
	AI-6	SUPPLY AIR HUMIDITY				
	AI-7	SUPPLY AIR STATIC PRESSURE				
	AI-8	STATIC PRESSURE 90%				
	AI-9	SUPPLY FAN VOLUME B				
	AI-10	SUPPLY FAN VOLUME A				
	AI-11	RETURN FAN VOLUME				
	AI-12	OUTDOOR AIR TEMPERATURE				
	AI-13	PREFILTER PRESSURE DROP				
	AI-14	FINAL FILTER PRESSURE DROP				
	AO-1	MAX OA RETURN AND EXHAUST				
	AO-2	MIN OA DAMPER				
	AO-3	PREHEAT COIL VALVE				
	AO-4	COOLING COIL VALVE				
	AO-5	HUMIDIFIER ACTUATOR				
	AO-6	SUPPLY FAN B VSC				
	AO-7	SUPPLY FAN A VSC				
	AO-8	RETURN FAN VSC				
		(VIRTUAL) EFFECTIVE SUPPLY AIR SETPOINT				
		(VIRTUAL) HUMIDITY SETPOINT				
		(VIRTUAL) EFFECTIVE DUCT STATIC SETPOINT				

Notes

#	Remark

Issues

#	Remark

SECTION 055900 - EXPANDED METAL WALL ENCLOSURE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Expanded metal mesh.
2. Enclosure frames and supports.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Paint products.

B. Shop Drawings:

1. Include plans, sections, and attachment details.
2. Signed and sealed by the qualified professional engineer responsible for their preparation.

C. Delegated Design Submittals: For enclosures, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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.

B. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

D. Welding certificates.

E. Delegated design engineer qualifications.

1.4 QUALITY ASSURANCE

A. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in [**state**] <**Insert jurisdiction**> where Project is located and who is experienced in providing engineering services of the type indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.
3. AWS D1.3/D1.3M.
4. AWS D1.6/D1.6M.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with enclosures by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design enclosure.

B. Structural Performance: Enclosures to withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

C. Seismic Performance: Enclosure to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

2.2 EXPANDED METAL ENCLOSURE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Basis of Design: AMICO, a Gibraltar Industries company, APEX02 Expanded Mesh.

B. Provide expanded metal enclosure in material, finish, style, size, thickness, weight, and type indicated or, if not indicated, as recommended by manufacturer for indicated applications and as needed to support indicated loads.

1. Aluminum Finish: Alloy, 5005, Mill finish, as fabricated.

2. Type: I, expanded.
3. Visual Open: 40 percent.
4. Mechanical Open: 72 percent.
5. Long way Diamond: 8 inches.
6. Short Way Diamond: 3.05 inches.
7. Weight: 1.09 lbls/sf
8. Material Thickness: 0.125 inch.

2.3 ENCLOSURE FRAMES AND SUPPORTS

A. Frames and Supports for Metal Enclosure: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive enclosure. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as enclosure.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, nuts, and, where indicated, flat washers; ASTM F593 for bolts and ASTM F594 for nuts, Alloy Group 1.

D. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

E. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

2.6 ALUMINUM

A. General: Provide alloy and temper recommended by aluminum producer for type of use indicated, with not less than the strength and durability properties of alloy, and temper designated below for each aluminum form required.

B. Extruded Bars and Shapes: ASTM B221, alloys as follows:

1. Alloy 6061-T6 or 6063-T6, for bearing bars of enclosure and shapes.
2. Alloy 6061-T1, for grating crossbars.

C. Aluminum Sheet: ASTM B209, Alloy 5052-H32.

2.7 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

C. Fit exposed connections accurately together to form hairline joints.

D. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure enclosure, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates for attaching in the field.
2. Toeplate Height: 4 inches unless otherwise indicated.

F. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with bars having a thickness not less than overall grating thickness at contact points.

G. Where enclosure are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8 inch thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.8 STEEL FINISHES

A. Finish enclosure, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Shop prime enclosure, frames, and supports not indicated to be galvanized unless otherwise indicated.

1. Shop prime with primers specified in Section 099600 "High-Performance Coatings" are indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Other Items: SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing enclosure to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing enclosure. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to enclosure by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLATION OF EXPANDED METAL ENCLOSURE

A. Comply with manufacturer's written instructions for installing enclosure.

B. Place units with straight edge of bond up and with long direction of diamond-shaped openings parallel to direction of span.

C. Attach removable units to supporting members by bolting at 6-inch intervals.

D. Attach nonremovable units to supporting members by welding unless otherwise indicated. Space welds at 6-inch intervals.

E. Attach aluminum units to steel supporting members by bolting at 6-inch intervals.

F. Butt edges parallel to long direction of diamond-shaped openings and weld at every second bond point. Place individual grating sections so diamonds of one piece are aligned with those of adjacent sections.

3.3 REPAIR

A. Repair Painting:

1. Wire brush and clean rust spots, welds, and abraded areas on prime-painted enclosure immediately after installation, and apply repair paint with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

B. Repair of Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055319

SECTION 074213.19 - INSULATED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Foamed-insulation-core metal wall panels.

B. Related Requirements:

1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Foamed-insulation-core metal wall panels.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E72:

1. Wind Loads: As indicated on Structural Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with

NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.

3. Radiant Heat Exposure: No ignition when tested in accordance with NFPA 268.
4. Potential Heat: Acceptable level when tested in accordance with NFPA 259.
5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
b. Density: 2.0 to 2.6 lb/cu. ft. when tested in accordance with ASTM D1622.
c. Compressive Strength: Minimum 20 psi when tested in accordance with ASTM D1621.
d. Shear Strength: 26 psi when tested in accordance with ASTM C273/C273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Basis of Design: CENTRIA, a Nucor Brand, Versawall H+.
b. Kingspan Insulated Panels, Inc.
c. Metl-Span; a Nucor Brand.

2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 22 gage, smooth.
b. Exterior Finish: Two-coat fluoropolymer.

1) Color: As selected by Architect from manufacturer's full range.

c. Interior Finish: Siliconized polyester.

1) Color: As selected by Architect from manufacturer's full range.

3. Backer Board: On back side of exterior facing.
4. Snap-on Batten: Same material, finish, and color as exterior facings of wall panels.
5. Panel Coverage: 30 inches nominal.
6. Panel Thickness: 2.0 inches.
7. Thermal-Resistance Value (R-Value): 16.7 in accordance with ASTM C1363.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, 1/4 inch thick unless otherwise indicated.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF METAL PANELS

A. General: Install metal panels in accordance with manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION OF INSULATION-CORE METAL WALL PANELS

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed

within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration in accordance with AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.6 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.19

SECTION 074800 – RAINSCREEN ATTACHMENT SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Provide a thermally broken, rainscreen attachment system for attachment of exterior cladding.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum board sheathing installed directly over steel framing.
2. Section 072100 “Thermal Insulation” for rigid insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Data: Submit manufacturer’s product literature and descriptions of testing performed on system components to indicate meeting or exceeding specified performance.

C. Shop Drawings:

1. Submit connection details to the cladding manufacturer, showing interface of rainscreen attachment system to substrate and panels with adjacent construction, signed and sealed by Professional Engineer.
2. Show system installation and attachment, including fastener size and spacing.

D. Structural Calculations:

1. Submit rainscreen attachment manufacturer’s comprehensive Structural Design analysis signed and sealed by a Professional Engineer.

E. Samples: Submit following material samples for verification:

1. Vertical Girts: Two (2) 12-inch long samples.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

C. Test Reports:

1. Test to the following standards and provide written test reports by a third party:

    a. AAMA TIR-A8-04: Structural Performance of Composite Thermal Barrier Framing Systems – Section 7.2
    b. ASTM E330
    c. ASTM E1233
    d. Gravity load test report, performed by IAS accredited third party

2. Comprehensive three-dimensional thermal modeling report indicating framing systems impact on exterior insulation rated R-value.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:

1. Minimum 5 years' experience specializing in the manufacturing of façade attachment/support framing similar to those specified.
2. Ability to demonstrate conformance to testing requirements.

B. Installer Qualifications:

1. Minimum of 3 years' documented experience or minimum of 5 completed projects of equivalent scope and quality and recommended by manufacturer to perform work of this Section.
2. Onsite superintendent or foreman overseeing installation on site during entire work of this Section with experience equivalent to installer and in good standing with the manufacturer.

C. Engineer Qualifications: Registered professional engineer experienced in the design of curtain wall systems, anchors, fasteners and licensed to practice engineering in the jurisdiction where Project is located.

D. Pre-Installation Meeting:

1. Discuss sequence and scheduling of work and interface with other trades.
2. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.

3. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for exterior wall assembly.

E. Mock-Ups: Coordinate mock-up materials and requirements with mock-up specified in Division 01 and exterior cladding specification.

1.6 QUALITY CONTROL

A. Single source responsibility:

1. Furnish engineered rainscreen attachment system components under direct responsibility of single manufacturer.

B. Field Measurements: Verify actual supporting and adjoining construction before fabrication.

C. Record field measurements on project record shop drawings.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials and components in manufacturers' original, unopened and undamaged containers or bundles, fully identified. Exercise care to avoid damage during unloading, storing and installation.

B. Store, protect and handle materials and components in accordance with manufacturer recommendations to prevent damage, contamination and deterioration. Keep materials clean, dry, and free of dirt and other foreign matter, and protect from damage due to weather or construction activities.

1.8 SEQUENCING

A. Ordering: Comply with manufacturers' ordering instructions and lead time requirements to avoid construction delays.

B. Coordinate construction to ensure that assemblies fit properly to supporting and adjoining construction; coordinate schedule with construction in progress to avoid delaying work.

1.9 WARRANTY

A. Manufacturer Warranties:

1. Attachment System: Ten (10) year Limited Warranty.

a. Covers components of the attachment system, including structural failure of components when all the materials and components are supplied and installed per manufacturer's requirements.
b. Includes labor and material for removal and replacement of defective material.
c. Includes labor to remove and reinstall façade finish panels, finish closures and façade finish accessories necessary to access defective material.

B. Contractor's Warranties: 2-year labor warranty, starting from Substantial Completion, to cover repair of materials found to be defective as a result of installation errors.

C. Limitation of Warranties: Exclude repairs, replacement, and corrective work to the substrate, primary structure, finish panels, and/or property – unless otherwise noted above. Warranties exclude mechanical damage due to abuse, neglect, primary structure failure, or forces of nature greater than normal weather conditions.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. System assembly shall include the following components from the substrate out:

1. Substrate: Wall framing assembly and sheathing].
2. Weather Resistant/Air Barrier.
3. Continuous insulation.
4. Thermally broken rainscreen attachment system.

B. Manufacturers: Subject to compliance with requirements, provide product by one of the following:

1. Knight Wall System, CI Systems Cladding.
2. ECO Cladding
3. EXO Wall Systems.
4. Advanced Architectural Products, Smartci.

C. Design Requirements:

1. Manufacturer is responsible for designing system, including anchorage to structural system and necessary modifications to meet specified requirements and maintain visual design concepts.
2. Employ registered professional engineer, licensed to practice engineering in jurisdiction where Project is located, to engineer each component of rainscreen attachment system.
3. Structural Design: Exterior-insulated rainscreen wall assembly capable of withstanding effects of load and stresses from dead loads, wind loads, ice loads (if applicable) as indicated on Structural General Notes on Structural Drawings, and normal thermal movement without evidence of permanent defects of assemblies or components.

a. Thermal Movements: Provide assemblies that allow for thermal movements resulting from the following maximum ambient temperatures by preventing overstressing of components and other detrimental effects:

1) Temperature Change (range): 120 degrees Fahrenheit (67 degrees C), ambient:

4. Support Framing/Attachment System:

a. No framing component may penetrate the layer of continuous exterior insulation other than thermally isolated fasteners.
b. Frequency and spacing of stiffened horizontal girts as indicated by manufacture in project specific engineering package.

D. Performance Requirements:

1. Rainscreen Attachment System Performance: Comply with ANSI/ASHRAE 90.1-2010 definition of continuous insulation (c.i.).
2. No thermal bridges other than fasteners and service openings.
3. Thermal Performance:

a. Full constructed assembly must have a minimum 95% EFFECTIVE R-value when compared to the exterior continuous insulations rated R-Value.
b. Continuous framing profiles (including C- or Z-shaped sections or furring) penetrating insulation not allowed.
c. Perform effective R-Value calculation or modeling in accordance with ASHRAE guidelines.
d. Wall Assembly effective R-Value (U-Factor): As indicated on Drawings.

4. Structural Performance:

a. Wind Load Performance – Attachment system must show the following results when tested in accordance with ASTM E330-02.

1) 90 pound per square foot negative and positive pressure held for 60 seconds, system components shall not experience failure or gross permanent distortion.
2) 135 pound per square foot negative and positive pressure held for 10 seconds, system components shall not experience failure or gross permanent distortion.

b. Wind cycling (air pressure cycling) performance – Attachment system must show conformance to the following results when tested in accordance with ASTM E1886-05.

1) A total of 4,500 air pressure cycles. Cycles must include 50 cycles at a maximum pressure of 90 pounds both positive and negative. Average cycle time must not be less than 3.25 seconds for both negative and positive cycles. Cladding weight supported during test

must be a minimum of 11.5 pounds per square foot. No damage or deformation must be seen at end of test.

c. Gravity load (dead load) performance – Attachment system must demonstrate resistance to deflection under shear loading, applied parallel to the wall assembly and directly to the attachment system. Testing must be conducted using calibrated equipment by an IAS accredited third party laboratory. Deflection not to exceed 0.050 inches at 150 pounds per square foot.

5. Framing Members:

a. Test framing components to AAMA TIR- A8-04 – Section 7.2 to determine structural performance and effective moment of inertia for each perforated component. Minimum Effective Moment of Inertia: 0.0066 in4.
b. Localized bending stress for eccentrically loaded framing members must be evaluated with the maximum effective length of resisting element not more than 12 inches.

6. Fasteners:

a. Minimum Safety Factor of 3 for both tension and shear values
b. Combined tension and shear shall be evaluated according to an interaction formula. Sum of terms shall not exceed 1.0.

E. Structural Performance: Provide system tested in accordance with ASTM E330/E330M and certified to be without permanent deformation or failure of structural members in accordance with design wind velocities for project location and potential for occurance based on data from wind velocity maps and other provisions of ASCE 7 and as approved by authorities having jurisdiction (AHJ).

1. Design Loads: As indicated on Drawings.
2. Measure performance of assembly using test loads equal to 1-1/2 times design wind loads indicated and with 10-second duration at maximum pressure.

F. System Thermal Design: Ensure that installed continuous insulation and CMH sub-framing support system, and cladding attachment does not have thermal bridging of fasteners or framing that creates a continuous metal path from exterior surface of insulation to interior face of insulation.

1. Verify that system thermal design meets or exceeds thermal design requirements in accordance with ASHRAE 90.1 and envelope performance requirements..
2. Thermal Performance Test: Provide thermal resistance (R-value) indicated, in accordance with ASTM C1363, corrected to 15 mph wind outside and still air inside, with installed condition including fasteners and joints.

a. Provide efficiency of no less than 93 to 98 percent, with a maximum temper-ature differential of 18 degrees F from interior wall surface to interior wall cavity and node locations with a 70 degrees F exterior to interior wall temperature delta.

b. Provide test unit with at least one insulation panel horizontal and vertical joint length and height of test chamber area.

G. Temperature Range: Comply with structural loading requirements within a temperature range of minus 55 degrees F to 180 degrees F.

H. Fire-Resistance Ratings: Provide CMH sub-framing support system with fire testing in accordance with ASTM E119 test methods and applied by approved testing agency acceptable to authorities having jurisdiction (AHJ).

1. Surface Burning Characteristics: Test in accordance with ASTM E84 test method for continuous insulation, composite metal hybrid (CMH) and interior surfaces as follows:
   c. Flame Spread Index (FSI): 25 or less.
   d. Smoke Developed Index (SDI): 450 or less.

2. Intermediate Scale Multistory Fire Test: Comply with NFPA 285 and/or IBC acceptance criteria for wall height above grade and fire separation distances when wall type and other noted conditions require such testing or compliance with requirements as indicated.

2.2 COMPOSITE METAL HYBRID (CMH) SUB-FRAMING SUPPORT SYSTEM

A. CMH Sub-Framing Support System: Provide CMH sub-framing support system consisting of polyester resin matrix with recycled materials, fire retardant additives and reinforced with integral continuous metal inserts the full length with pre-drilled holes to align with substrate fastening locations.

1. Length of CMH Support System: 96 inches long.
2. Depth of CMH Support System: As indicated on Drawings or as required for cladding system.
3. Grid Spacing of CMH Sub-Framing Supports for Substrate Attachments; Horizontally:
   a. Horizontal Spacing: 16 inches or on center.
4. Fastener Retention System: Provide continuous galvanized steel insert for engagement of fasteners, at least 16 gauge thick, with G90 galvanized coating in accordance with ASTM A653/A653M.
   a. Fasten CMH sub-framing support and other wall cladding support accessories through steel insert located within top and bottom of CMH sub-framing.
   b. Provide at least 3 inch overlap of metal inserts between CMH supports with 3/16 inch wide gap; sealant is not required.
5. Provide integral compression seal within CMH sub-framing to ensure insulation will not dislodge.
6. Provide integral anti-siphon grooves on exterior and interior flanges of CMH sub-framing.
7. Provide force distribution zones integrally designed into profile of CMH sub-framing.

8. CMH sub-framing is self-extinguishing in accordance with ASTM D635.
9. Visual defects in CMH sub-framing is classified in accordance with ASTM D4385.
10. Tensile Properties: Engineered lengthwise and crosswise tensile properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D638.
    a. Lengthwise 50,000 psi and crosswise 40,000 psi, minimum.
11. Compressive Properties: Engineered lengthwise and crosswise compressive properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D6641/D6641M.
    a. Lengthwise 50,000 psi and crosswise 30,000, minimum.
12. Flexural Properties: Engineered lengthwise and crosswise flexural properties of CMH sub-framing comply with performance loading criteria and specified safety factors in accordance with ASTM D790.
    a. Lengthwise 50,000 psi and crosswise 40,000 psi, minimum.
13. Modulus of Elasticity: CMH sub-framing is engineered to meet performance loading criteria and specified safety factors in accordance with ASTM D638.
    a. Lengthwise 29,000,000 psi and crosswise 3,300,000 psi, minimum.
14. Water Absorption: CMH sub-framing absorbs less than 0.46 percent by weight within 24 hours when tested in accordance with ASTM D570.
15. Relative Density: CMH sub-framing is within range of 0.062 to 0.070 lbs/cubic inch when tested in accordance with ASTM D792.
16. Coefficient of Linear Thermal Expansion: CMH sub-framing is at 7.0 x 10^{-6} inch/inch/degrees F when tested in accordance with ASTM D696.
17. Notched Izod Pendulum Impact Resistance, Lengthwise: CMH sub-framing is at 160 ft lbs/inch when tested in accordance with ASTM D256 within standard temperature range.
18. Notched Izod Pendulum Impact Resistance, Crosswise: CMH sub-framing is at 100 ft lbs/inch when tested in accordance with ASTM D256 within standard temperature range.

2.3 INSULATION

A. Mineral Fiber Board Insulation: Rigid or semi-rigid mineral fiber, in accordance with with ASTM C612 or ASTM C553.

1. Flame Spread Index (FSI), Unfaced: Zero (0) when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI), Unfaced: Zero (0) when tested in accordance with ASTM E84.
3. Board Size: As required to work with system..
4. Board Thickness: As indicated on Drawings..
5. Comply with fire-resistance requirements, as indicated on drawings, and as part of an exterior non-load-bearing exterior wall assembly, tested in accordance with NFPA 285.
6. Board Edges: Square.
7. Density: 8 pcf, minimum, when tested in accordance with ASTM C612 or ASTM C303.
8. Acceptable Products:

a. Johns Manville; Product MinWool Curtainwall 40 (www.jm.com).
b. Owens Corning; Product Thermafiber RainBarrier HD (www.thermafiber.com).
c. ROCKWOOL; Product Rockwool Plus MB (www.rockwool.com).
d. Substitutions: See Section 01 6000 – Product Requirements.

2.4 COMPOSITE METAL HYBRID (CMH) TRIM

A. CMH Trim: Provide nonstructural trim at rough openings to properly transition continuous insulation (CI) system.

1. Use angled and flat trim to enclose CI system and to provide thermally broken transitions within wall assemblies.
   a. Angled Trim: As indicated on drawings.
   b. Flat Trim: As indicated on drawings.

2. Use sealant and tapes as required to transition water-resistant barriers (WRB) from substrate onto trim.
3. Trim to provide 90 degree transition of CI substrate for water-resistant barriers (WRB) and exterior flashing.
4. Cover trim with exterior panel assembly and flashings.
5. Flame Spread Index (FSI): 25 or less when tested in accordance with ASTM E84.
6. Smoke Developed Index (SDI): 450 or less when tested in accordance with ASTM E84.
7. Comply with fire-resistance requirements, as indicated on drawings, and as part of an exterior non-load-bearing exterior wall assembly, tested in accordance with NFPA 285.

2.5 ASSEMBLY

A. Assemble CMH sub-framing support system in accordance with manufacturer's installation instructions and as necessary to comply with performance requirements indicated.

1. Comply with CMH sub-framing support system dimensional and structural requirements as indicated on drawings.
2. Install CMH sub-framing support system in acceptable sequence in accordance with manufacturer's written installation instructions.
3. Install spray foam sealant on backside of cantilevered fasteners that completely puncture insulation layer.

2.6 ACCESSORIES

A. Provide necessary accessories for complete installation of CMH sub-framing support system including metal closure trim transition angle strapping tie-in brackets, and other similar items.

B. Horizontal Hat Channels: Provide required height and width, at least 16 gauge thick, with G90 galvanized coating in accordance with ASTM A653/A653M.

C. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by CMH sub-framing support system manufacturer for CMH materials and other project applications.

1. Cladding to CMH: Use standard self-tapping metal screws.
2. CMH to Metal Stud Wall Framing: Use standard self-tapping metal screws.
3. CMH to Concrete or Concrete Masonry Units (CMU): Use standard masonry or concrete screw anchors in pre-drilled hole.
4. CMH to Wood Stud Wall Framing: Use standard wood screw anchors.
5. Use of powder, air, or gas-actuated fasteners or actuated fastener tools is not permitted.
6. Use of impact wrenches when fastening to or from CMH is not permitted.

D. Wall Sheathing: Glass mat-faced gypsum; square long edges and Type X fire-resistant in accordance with ASTM C1177/C1177M.

1. Refer to drawings for thickness and see Section 06 1000 for additional requirements.

E. Sealants: See Section 07 9200 for additional information.

B. Galvanic Protection: Utilize tapes and other methods as necessary to separate and prevent contact between dissimilar metals.

2.7 RIGID INSULATION

A. Refer to Section 072100 – Thermal Insulation.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 EXAMINATION

A. Examine substrates and conditions for compliance with manufacturer requirements for installation conditions affecting performance of the work.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. Ensure weather-resistant barrier (WRB) and rigid insulation is installed prior to installing rainscreen attachment system.
3. Ensure fenestration, transitions, discontinuities, sills, and ledgers are flashed and sealed to move moisture to the exterior of the building.

B. Field verify architectural details and mechanical and electrical requirements prior to commencing installation.

C. Commencement of installation constitutes acceptance of existing conditions and acceptance of responsibility for satisfactory performance.

3.3 RAINSCREEN ATTACHMENT SYSTEM INSTALLATION

A. Preparation:

1. Verify vertical girt does not cantilever past rigid insulation.

B. Installation

1. Install vertical girts in vertical orientation in strict accordance with manufacturer’s installation instructions.
2. Do not use shims to plumb the wall between the vertical girt and insulation.
3. Minimum length of installed cut girt is 24-inches and shall be attached with at least two (2) fasteners.
4. Mount girts, fastened up to 32 inches on center (as determined by the manufactures engineering calculations) over installed rigid insulation, using one wall anchor per pre-punched attachment hole at spacing indicated on engineering calculations.

a. Check plumb of vertical girts both parallel and perpendicular to the structure.
b. Tighten screws that attach vertical girt through insulation to substructure to a snug tight condition and not stripped. Do not over-torque beyond manufacturer’s recommendation. If installed using hand tools, verify for each installer at beginning of project using snug-tight criteria. Do not use stripped holes.
c. Where obstructions are present and unavoidable, use laser or chalk line to restart girt.
d. Locate vertical girt at jamb conditions and outside corner conditions.
e. Use shearing instruments (i.e. snips, nibbler, etc.) for cutting metal framing components. Saws are not recommended, as the sparks produced during cutting will damage the anti-corrosion coating. If sparks are generated

during cutting, be sure the portion of the component to be installed on the building is protected from sparks and that any stockpile near the cutting station is also protected.

f. The systems components should not be cut while installed on the building, unless using a shearing instrument.
g. Replace thermal isolator pieces that break during installation.
h. Provide a 3/8 inch – ½ inch gap between girts for expansion when multiple lengths of vertical girts are installed.

5. Attach secondary horizontal rails to vertical girts plumb, straight and square.

a. Tighten screws to a snug tight conditions and not stripped. Do not use stripped holes or screws.
b. Shims can be used between horizontal rail and vertical girt or cladding panel and horizontal rail (if approved by cladding manufacturer). Shims cannot be used between vertical girt and insulation.
c. Both flanges/edges of stiffened horizontal rail must be attached to vertical girt.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 084423 - STRUCTURAL-SEALANT-GLAZED CURTAIN WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-sided structural-sealant-glazed curtain-wall assemblies.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements LEEDv4 BD&C” for sustainable design requirements applicable to this project.
2. Section 084413 "Glazed Aluminum Curtain Walls" for conventionally glazed curtain walls and two-sided structural-sealant-glazed curtain walls.
3. Section 088000 "Glazing."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings: For structural-sealant-glazed curtain walls and doors and louvers integrated with the curtain wall. Include project specific plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of structural-sealant-glazed curtain walls, showing the following:

   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.
   f. Detailed sealant, fastener and accessories schedule.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

1. Perimeter seal to consist of a dual salant joint or similar, providing a primary and secondary seal at the interface with adjacent work.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Delegated-Design Submittal: For structural-sealant-glazed curtain walls, including analysis data signed and sealed by the qualified professional engineer licensed in the State of North Carolina responsible for their preparation.

1. Thermal (U-factor) Calculations.
2. Structural Calculations.
3. Condensation Resistance Calculations.

F. Firestopping Reports.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For curtain wall manufacturer, Installer and third party field testing agency.
2. For professional engineer's experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Product Test Reports: For structural-sealant-glazed curtain walls, for tests performed by a qualified third party testing agency. Test reports to demonstrate compliance with performance requirements specified herein and reports to be representative of project specific conditions.

C. Factor Installed Structural Sealant Quality-Control Program: Developed specifically for Project, including fabrication and installation, in accordance with recommendations in ASTM C1401. Include periodic quality-control reports.

D. Quality-Control Program: Developed specifically for Project, including fabrication and installation of curtain wall system and insulating glass units, including flied re-glazing procedures, according to recommendations in ASTM C1401. Include periodic quality-control reports.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranties: For warranties specified herein.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For structural-sealant-glazed curtain walls to include in maintenance manuals including glass replacement procedure.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed curtain walls to include in maintenance manuals. Include ASTM C1401 recommendations for postinstallation-phase quality-control program.

C. Record Drawings.

D. Warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AGM) contractors.

B. Testing Agency Qualifications: Qualified in accordance with ASTM E699 for testing indicated and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

D. Structural-Sealant Glazing: Comply with ASTM C1401 for design and installation of structural-sealant-glazed curtain-wall assemblies. All structural sealant glazing to be carried out in factory; field application of structural sealant not allowed.

1.6 MOCKUPS AND SAMPLE INSTALLATIONS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area, as shown on Drawings. Mockup to include curtainwall system including the curtain wall sill, jamb and stack joint. Minimum height of two stories.
2. Testing shall be performed on mockups in accordance with requirements in Part 3 "Field Quality Control" Article.

3. Approval of mockups and sample installations does not constitute approval of deviations from the Contract Documents contained in mockups and sample installations unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved sample installations may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to structural glazing sealant manufacturer, for testing indicated below, Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

1. Compatibility: Test materials or components using ASTM C1087.
2. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.
3. Submit no fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
6. Testing will not be required if data based on previous testing of current sealant products match those submitted and the sealant and finish chemistry has not changed, as confirmed in writing by the respective manufacturers.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of structural-sealant-glazed curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.
b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.
f. Glass breakage, inclusive of spontaneous breakage of fully tempered glass due to nickel-sulfide inclusions.
g. Air leakage exceeding specified limits.
h. Condensation excluding water that drains out to the exterior.
i. Failure to meet specified performance requirements in service.

2. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 20 years from date of Substantial Completion for exterior finishes, 10 year for interior finishes.

C. Glass Warranties: Refer to Section 088000 “Glazing”.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design structural-sealant-glazed curtain walls.

B. General Performance: Comply with performance requirements specified and the Building Code, as determined by testing of structural-sealant-glazed curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Structural-sealant-glazed curtain walls shall withstand movements of supporting structure, including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Refer to Drawings for all building movements.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Noise or vibration created by wind and thermal and structural movements.
c. Loosening or weakening of fasteners, attachments, and other components.

3. Provide curtain wall that accommodates the dimensional tolerances of building superstructure and other adjacent constructions, including structural steel framing and architecturally exposed structural steel framing supporting curtain wall, including accommodation of r all specified building superstructure and curtain wall movements.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Barrier Loads: 50 lbf per linear foot applied horizontally at 42 inches above finished floor elevation and 200 lbf applied horizontally on an area equal to 1 sq ft at 42 inches above finished floor elevation in the location which produces the greatest stress and deflections. These loads need not act concurrently or in combination with other specified loads for serviceability design; however should be combined with wind load for strength design.
4. Accidental Loads: All flat and near-flat surfaces with horizontal projections greater than or equal to 4 inches such as exterior sun control devices, trim, snap covers, etc. on the exterior and interior surface of the curtain wall to resist the following loads: 12.5 lbf per sq. ft. applied vertically and 300 lbf applied vertically on an area equal to 4 sq. in.in the location which produces the greatest stress and deflection. Accidental loads need not be assumed to act concurrently or in combination with other specified loads.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans of greater than 13 feet 6 inches.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.
3. Cantilever Deflection: Limited to 2l/175 at unsupported cantilevers.
4. Glass Center-pane Deflection: Refer to Section 088000 “Glazing”.

E. Structural: Test in accordance with ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10seconds.

F. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft.

G. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 15 lbf/sq. ft.
2. Maximum Water Leakage: In accordance with AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

H. Seismic Performance: Structural-sealant-glazed curtain walls shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. Refer to Structural Drawings for seismic design criteria.

I. Energy Performance: Certified and labelled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

    a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.373 Btu/sq. ft. x h x deg F as determined in accordance with NFRC 100 for a curtain wall module size of 4 ft-4inches wide by 9 ft 0 inches tall.

2. Solar Heat Gain Coefficient (SHGC):

    a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.34 as determined in accordance with NFRC 200.

3. Air Leakage:

    a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.when tested in accordance with ASTM E283.

4. Condensation Resistance:

    a. Curtain Walls: Engage a qualified independent testing agency to perform a computer thermal analysis of the system to determine the probability of condensation in accordance with NFRC 500. Analysis must successfully show that condensation does not occur on interior surfaces under the most onerous combination of environment design conditions as listed below including considerations of interior construction and finishes. Internal condensation and drainage systems must prevent uncontrolled condensation inboard of the vapor barrier plane. Analysis to utilize the latest version of THERM, computer software developed by Lawrence Berkley National Laboratory (LBNL), or approved equivalent:

        1) Outdoor Wintertime Design Conditions:

            a) Air Temperature: 20.4 deg-F.
            b) Wind Speed: 4.4 mph.

        2) Indoor Wintertime Design Conditions:

a) Air Temperature: 70 deg-F.
b) Relative Humidity: TBD.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested in accordance with AAMA 501.5.

   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
   b. Low Exterior Ambient-Air Temperature: -5 deg F.

K. Structural-Sealant Joints:

1. Designed to carry lateral loads of glazing.

L. Structural Sealant: ASTM C1184. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant shall occur before adhesive failure.

1. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind.
2. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.2 TWO-SIDED STRUCTURAL-SEALANT-GLAZED CURTAIN-WALL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kawneer North America.
2. Oldcastle Building Envelope (OBE); CRH Americas.
3. YKK AP America Inc.
4. **Tubelite Architectural Framing Systems.**

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Glazing System: Retained with structural sealant on two sides; captured by mullions on two sides. Refer to Drawings and Division 08 Section “Aluminum Framed Curtain Walls” for requirements.
2. Finish: High-performance organic finish, custom color as selected by Architect.
3. System: Unitized.

4. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
5. Steel Reinforcement: As required by manufacturer.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 GLAZING

A. Comply with Section 088000 "Glazing."

B. Glazing Gaskets:

1. ASTM C509 or ASTM C864. Manufacturer's standard, with factory-molded corners.

a. Color: Black.

2. Comply with Section 088000 "Glazing."

C. Glazing Sealants:

1. As recommended by manufacturer.
2. Comply with Section 088000 "Glazing."
3. Sealant shall have a VOC content of 250 g/L or less.
4. Sealant 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."

D. Structural Glazing Sealants: ASTM C1184, chemically curing silicone formulation that is compatible with system components with which it comes into contact, specifically formulated and tested for use as structural sealant and approved by structural-sealant manufacturer for use in structural-sealant-glazed curtain-wall assembly indicated.

1. Color: Black.

E. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 50; Uses NT, G, A, and O; +/- 50 percent movement capacity; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes into contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed curtain-wall manufacturers for this use.

1. Color: Match structural sealant.
2. Coordinate with Division 07 Section “Joint Sealants”.

2.4 BACKPAN

A. Back Pan: Provide G90 galvanized steel sheet, minimum 26 gage, reinforced to comply with structural loading indicated for the exterior skin of the building, fully sealed at the perimeter for air and water tightness. Reinforcing shall be galvanized angles.

7. Provide coated aluminum sheet when attached to curtain wall mullions.

B. Profile to allow for sealing of back pan into mullion opening and to seal around anchors or other obstructions.

2.5 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

F. Prefabricated silicone sheet to provide a perimeter seal at the interface between curtainwall and adjacent works.

1. Basis of Design: Dowsil STS or Dowsil 123 by DOW or Proglaze by Tremco.

2.6 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer. Provide custom anchors as shown on Drawings.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Spandrel Assemblies: Spandrel assemblies include shadow boxes which are glazed into the glazing systems system. All spandrel assemblies shall be vented and drained and pressure-equalized to the exterior, including the following components:

1. Metal Panels: Aluminum plate with high-performance coating.
2. Insulation; ASTM C612, Type IVB, nominal density of 8.0 lb/cu ft., unfaced mineral wool insulation. Provide Curtainrock 80 by Rockwool, Inc., or approved equal.
3. Metal Back Pan: Provide galvanized sheet metal back pan, mechanically fastened and sealed air and watertight to the back of mullions at perimeter at all spandrel assemblies.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.

2. Prepare surfaces that will contact structural sealant in accordance with sealant manufacturer's written instructions, to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
3. Seal joints watertight unless otherwise indicated.
4. Install structural glazing.

   a. Set glazing into framing in accordance with sealant manufacturer and framing manufacturer's written instructions and standard practice. Use a spacer or backer as recommended by manufacturer.
   b. Set glazing with proper orientation, so that coatings face exterior or interior as specified.
   c. Apply structural silicone sealant to completely fill cavity, in accordance with sealant manufacturers written instructions with the framing and glazing in a fully supported position.
   d. Brace or stiffen framing and glazing in such a manner to prevent undue stresses on the glass edge seal and structural joints or movement of the glazing, until sealant is fully cured in accordance with manufacturer's recommendations.
   e. After structural sealant has completely cured, insert backer rod between lites of glass as recommended by sealant manufacturer.
   f. Install weatherseal sealant to completely fill cavity, in accordance with sealant manufacturer's written instructions, to produce weatherproof joints.
   g. Clean and protect glass as indicated in Section 088000 "Glazing."
   h. Retain bracing or stiffening until erected to prevent racking of units during transportation and erection.

E. After fabrication, clearly mark components to identify their locations in Project in accordance with Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF AAMA 2605 Compliant: Fluoropolymer finish complying with and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: Dove Gray as confirmed by Architect.

2.9 SOURCE QUALITY CONTROL

A. Structural Sealant: Perform quality-control procedures complying with ASTM C1401 recommendations, including, but not limited to, assembly material qualification procedures, sealant testing, and assembly fabrication reviews and checks.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Coordinate tolerances of building superstructure, including structural steel framing and architecturally exposed structural steel framing supporting curtain wall, with all curtain wall tolerances.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF STRUCTURAL-SEALANT-GLAZED CURTAIN WALLS

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.

G. Seal joints watertight unless otherwise indicated.

H. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

I. Install components plumb and true in alignment with established lines and grades and specified tolerances.

3.3 ERECTION TOLERANCES

A. Install structural-sealant-glazed curtain walls to comply with the following maximum tolerances as defined in AAMA CWM-19 – Curtain Wall Manual:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inchwide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a third party qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of structural-sealant-glazed curtain walls or mockup.

    1. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in Part 2 "Performance Requirements" Article, shall not evidence water penetration.

C. Structural-Sealant Adhesion: Test structural sealant in accordance with recommendations in ASTM C1401, Destructive Test Method A, "Hand Pull Tab (Destructive)," Appendix X2.

    1. Test a minimum of four areas on each building facade.
    2. Repair installation areas damaged by testing.

D. Structural-sealant-glazed curtain walls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 084423

SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cement plaster base coat and finish coats.
2. Accessories.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Verification: For each type of factory-prepared finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

D. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

1.4 MOCKUPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.

   a. Size: 100 sq. ft. in surface area.

2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 FIELD CONDITIONS

A. Comply with ASTM C926 requirements.

B. Interior Plasterwork: Maintain room temperatures at greater than 40 deg F for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

C. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plaster materials from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

2.3 BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926 for applications indicated.

B. Base-Coat Mixes for Use over Low-Absorption Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

2.4 CEMENT PLASTER FINISH COATS

A. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Topcret, Microcemento.
b. Cement Design, Concret Wall WCR.

2. Color: As selected by Architect from manufacturer's full range.

2.5 ACCESSORIES

A. General: Comply with ASTM C1063, and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CEMCO; California Expanded Metal Products Co.
b. ClarkDietrich.
c. Flannery, Inc.

2. Cornerite: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
3. External- (Outside-) Corner Reinforcement: Fabricated from metal lath with ASTM A653/A653M, G60, hot-dip galvanized-zinc coating.
4. Cornerbeads: Fabricated from zinc-coated (galvanized) steel.

a. Smallnose cornerbead with expanded flanges; use unless otherwise indicated.

b. Smallnose cornerbead with perforated flanges; use on curved corners.
c. Smallnose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing unit masonry corners.
d. Bullnose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.

5. Casing Beads: Fabricated from zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
6. Control Joints: Fabricated from zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
7. Expansion Joints: Fabricated from zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
8. Two-Piece Expansion Joints: Fabricated from zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

2.6 PLASTER MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I.

1. Color for Finish Coats: White.

B. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

C. Lime: ASTM C206, Type S; or ASTM C207, Type S.

D. Sand Aggregate: ASTM C897.

1. Color for Job-Mixed Finish Coats: White.

2.7 MISCELLANEOUS MATERIALS

A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Bonding Compound: ASTM C932.

C. Sealer: As recommended by manufacturer.

D. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.3 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

3.4 INSTALLATION OF ACCESSORIES

A. Install according to ASTM C1063 and at locations indicated on Drawings.

B. Reinforcement for External (Outside) Corners:

1. Install cornerbead at interior locations.

C. Control Joints: Locate as approved by Architect for visual effect and as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft..
b. Horizontal and Other Nonvertical Surfaces: 100 sq. ft..

2. At distances between control joints of not greater than 18 feet o.c.
3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.
4. Where control joints occur in surface of construction directly behind plaster.
5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5 APPLICATION OF BASE-COAT CEMENT PLASTER

A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces when measured by a 10-foot straightedge placed on surface.
2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete substrates for direct application of plaster.

C. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having 3/8-inch thickness on masonry and 1/4-inch thickness on concrete, as follows:

1. Portland cement mix.

3.6 APPLICATION OF CEMENT PLASTER FINISH COATS

A. Plaster Finish Coats: Apply to provide float finish to match Architect's sample.

B. Concealed Interior Plasterwork:

1. Where plaster application is concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.
2. Where plaster application is concealed above suspended ceilings and in similar locations, omit finish coat.
3. Where plaster application is used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.7 REPAIR

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.8 CLEANING

A. Remove temporary protection and enclosure of other work after plastering is complete.

B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.

C. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. **Impact resistant board.**
4. **Partition gap closure.**

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.
2. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Flexible gypsum board.
3. Gypsum ceiling board.
4. Abuse-resistant gypsum board.
5. Impact-resistant gypsum board.
6. Mold-resistant gypsum board.
7. ~~Gypsum board, Type C.~~
8. ~~Acoustically enhanced gypsum board.~~
9. Glass-mat, water-resistant tile backing board.
10. Cementitious backer units.
11. Interior trim.
12. Aluminum trim.
13. Joint treatment materials.
14. Laminating adhesive.
15. Sound-attenuation blankets.
16. Acoustical sealant.
17. ~~Textured finishes.~~
18. **Partition gap closure.**

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

D. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.3 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.4 MANUFACTURERS

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. CertainTeed; SAINT-GOBAIN.
   b. Georgia-Pacific Gypsum LLC.
   c. Gold Bond Building Products, LLC provided by National Gypsum Company.
   d. USG Corporation.

2.5 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C1396/C1396M.

   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C1396/C1396M.

   1. Thickness: 1/2 inch.
   2. Long Edges: Tapered.

C. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

   1. Core: 5/8 inch, Type X.
   2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
   3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.

4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
7. **Coordinate with metal stud framing for minimum thickness required by manufacturer.**

D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. **Core: 5/8 inch (15.9 mm), Type X.**
2. **Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.**
3. **Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.**
4. **Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.**
5. **Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements according to test in Annex A1.**
6. **Long Edges: Tapered.**
7. **Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.**
8. **Coordinate with metal stud framing for minimum thickness required by manufacturer.**

E. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.6 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Core: 5/8 inch, Type X.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units at Showers: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Thickness: 1/2 inch.
2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
3. **Application: Shower walls or steam room walls.**

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
   a. Cornerbead.
   b. Bullnose bead.
   c. LC-Bead: J-shaped; exposed long flange receives joint compound.
   d. L-Bead: L-shaped; exposed long flange receives joint compound.
   e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
   f. Expansion (control) joint.
   g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flannery, Inc.
   b. Fry Reglet Corporation.
   c. Gordon Inc.
   d. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

C. Partition Gap Closure: Accessory for partitions meeting exterior wall vertical aluminum window mullions: Two- piece, adjustable aluminum extrusion profile, with manufacturer provided adhesive strips and partition extruded aluminum end caps.

1. Basis of Design Product: Gordon Inc Product Name: “Mullion Mate” Adjustable Partition Closure. An adjustable, spring-loaded 2 inch wide partition closure that provide trim between window and partition walls.
2. Aluminum partition closures shall be pre-assembled and spring loaded to provide a tight fit for vertical junctures of partitions and window walls. Mullion Mate is finished to match mullions in a spray applied water-borne cross-linked baked acrylic finish or Acrylic-Polyester hybrid powder coat paint finish or custom paints or anodized finish. They are sound tested to a 38 STC rating with optional acoustical batts for sound attenuation.
3. Performance Requirements:
   a. Provide metals free from surface blemishes where exposed to view in finished unit. Surfaces that exhibit pitting, seam marks, roller marks, stains, and discolorations, or other imperfections on finished units are not acceptable.
   b. Aluminum extrusions: 6063-T5 temper, tensile strength 31 KSI (ASTM B 221, ASTM B 221 M).
   c. Extrusion Lengths: Lengths up to 10', splicing vertical closures is not allowable.

d. **Surface Finish: Acrylic-Polyester hybrid powder coat paint finish custom colors to match color of the adjacent aluminum window extrusion, as approved by the Architect from range samples provided by the Contractor.**
e. **Insulation and Sound Attenuation: Mullion closures fitted with mineral wool batt insulation by Thermafiber Inc. or Roxul, Inc.**
f. **Filler Insulation Density: Not less than 4 lb/cu.ft. nominal density filling entire cavity of mullions when fitted in final set position.**
g. **Flame Spread: Maximum flame-spread and smoke-developed indexes of 25 and 50 respectively.**
h. **Sound Rating: not less than STC 38.**
i. **Closure Gasket to Partition: Manufacturer’s standard extrusion Gordons, Inc. “Final Form Series 911” to finish partition ends.**
j. **Compressible Fittings: UV resistant neoprene closure gaskets on both sides of vertical closures, adhesively attached, profile fitting depth, forming a tight-fitting, light-proof, durable closure.**

4. **Contractor shall follow the installation guidelines for closures as recommended by the manufacturer and as indicated on the Drawings.**

2.8 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

   a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.9 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Where required for fire-resistance-rated assembly and Vertical surfaces unless otherwise indicated.
2. Ceiling Type: Ceiling surfaces.

3. Abuse-Resistant Type: Corridors and where indicated on Drawings.
4. **Impact-Resistant Type: As indicated on Drawings.**
5. Mold-Resistant Type: Bathrooms and high humidity areas..

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers with screws; fasten face layers with adhesive and supplementary fasteners.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.

E. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.

2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

A. Apply panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.
2. Fasten with corrosion-resistant screws.

3.5 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated on Drawings to receive tile.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. Bullnose Bead: Use at outside corners.
3. LC-Bead: Use at exposed panel edges.
4. L-Bead: Use where indicated on Drawings.
5. U-Bead: Use at exposed panel edges.
6. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING OF GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

4. Level 5: Areas to receive wall covering, long corridors with exterior lighting and where indicated on Drawings.
   a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 APPLICATION OF TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

3.9 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 093000 - TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Trim Units
3. Tile backing panels.
4. Waterproof membrane.
5. Crack isolation membrane
6. Metal edge strips.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.
2. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
3. Section 092900 “Gypsum Board” for installation requirements and coordination of tile backing panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

D. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.

2. Full-size units of each type of trim and accessory for each color and finish required.
3. Metal edge strips in 6-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Waterproof membrane.
2. Crack isolation membrane.
3. Cementitious backer units.
4. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Basis-of-Design Product: The design for each tiling product is based on the products named in the schedule on the drawings or as specified herein. Subject to compliance with requirements, provide either the named product or a comparable product by one of the acceptable manufacturers as follows.

~~B. Acceptable Manufacturers:~~

~~1. Tile Manufacturers:~~

~~a. American Olean; a division of Dal-Tile Corporation.~~
~~b. Crossville, Inc.~~
~~c. Daltile.~~
~~d. GST.~~
~~e. Garden State.~~
~~f. Mutina Mews / Stone Source.~~
~~g. Marazzi.~~
~~h. Milestone.~~
~~i. Platform Surfaces.~~
~~j. Floor and Wall Solutions.~~
~~k. Iris U.S.~~

C. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.

1. Provide shapes as follows, selected from manufacturer's standard shapes:

a. Base Cove: Cove, module size same as adjoining flat tile.
b. Base Cap for Thinset Mortar Installations: Surface bullnose, module size same as adjoining flat tile.
c. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size same as adjoining flat tile.
d. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above it, same size as adjoining flat tile.
e. Internal Corners: Cove, module size same as adjoining flat tile.
f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A, in maximum lengths available to minimize end-to-end butt joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C-Cure.
b. Custom Building Products.
c. FinPan, Inc.
d. Georgia-Pacific Building Products.
e. USG Corporation.

2. Thickness: 5/8 inch Joint Compound for Tile Backing Panels:

a. Cementitious Backer Units: As recommended by backer unit manufacturer.

2. Application: Shower walls.

2.5 WATERPROOFING AND CRACK-SUPPRESSION MEMBRANES FOR THIN-SET & MEDIUM-BED TILE INSTALLATIONS

A. General: Manufacturer's standard product that complies with ANSI A118.10 and A118.12.

B. Waterproofing membrane:

1. Provide MAPEILASTIC HPG with MAPEI fiberglass mesh as manufactured by MAPEI (or approved equal).
2. Membrane to be self-bonding, liquid applied, 15 mil thick liquid rubber membrane capable of 1/8 inch crack suppression, applied per manufacturer’s recommendation, including substrate priming and pre-treatment of cracks where required.

2.6 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ardex Americas
b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. Custom Building Products

e. Laticrete International, Inc.
f. MAPEI Corporation.
g. TEC; a subsidiary of H. B. Fuller Company.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Latex-Portland Cement Mortar (Medium-Bed): Subject to compliance with ANSI A118.4, consisting of cement-based mix and acrylic-latex additive with non-sag and non-slump properties.

1. For large format tile applications,

a. Provide a non-slip, non-sag mortar to comply with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4 and ANSI 118.15.
b. Products: Subject to compliance with requirements, provide one of the following:

1) Custom Building Products - MegaLite
2) Laticrete 4-XLT
3) MAPEI Ultra Flex LFT
4) TEC Ultimate Large Tile Mortar Medium-Bed Mortar.

c. Use recommended trowel size as called out by manufacturer for each tile size to provide 100% coverage.

2.7 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or equal product by one of the following:

a. Custom Building Products.
b. Laticrete International, Inc.
c. MAPEI Corporation.
d. TEC; a subsidiary of H. B. Fuller Company – Power Grout.

2. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.

B. Water-Cleanable Epoxy Grout: ANSI A118.3.

1. Products: Subject to compliance with manufacturers, provide basis of design products or comparable by listed manufacturers:
a. Kerapoxy CQ:
1) Two component grout. Part A and B.
2) Great for high traffic areas needing stain or chemical resistance.

3) Good UV Protection and protects against mold and mildew

b. Kerapoxy IEG CQ- Industrial Grade Grout

1) 3 part- A, B, and C.
2) Sutied for Commercial kitchens that require daily cleaning with enzymatic cleaners.
3) Resistant to chemicals, stains, and high temps.
4) Application: Commercial kitchens.

2. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 and 212 deg F, respectively, and certified by manufacturer for intended use.

2.8 ELASTOMERIC SEALANTS

A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Section 079200 "Joint Sealants."

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; exposed-edge material finish as scheduled.

1. Basis-of-Design Product: The design for metal edge strip is based on the products named in the schedule on the drawings or as specified herein. Subject to compliance with requirements, provide either the named product or a comparable product by one of the acceptable manufacturers as follows.

a. Custom Building Products
b. Schluter Systems L.P.
c. Roppe.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Floor Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

3.4 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

      a. Tile floors in wet areas.
      b. Tile floors consisting of tiles 8 by 8 inches or larger.
      c. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Porcelain Tile: 1/4 inch.

H. Grout Joints:

1. For joints up to 1/8 inch use unsanded grout
2. For joints greater than 1/8inch use sanded grout.

I. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

J. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

K. Metal Edge Strips: Install at wall locations indicated and where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

L. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.5 TILE BACKING PANEL INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.6 WATERPROOFING/CRACK ISOLATION MEMBRANE INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.7 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.

2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.8 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.9 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. .Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F122; thinset mortar on waterproof membrane.

a. Thinset Mortar: Standard dry-set mortar (Medium-bed, modified dry-set at large format tile).
b. Grout: Polymer modified grout.

B. Interior Wall Installations, Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.

a. Thinset Mortar: Standard dry-set mortar (Medium-bed, modified dry-set at large format tile).
b. Grout: Polymer modified grout.

END OF SECTION 093000

SECTION 093015 – GAUGED PORCELAIN TILE PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Porcelain Tile Panels

B. Setting mortars and adhesives.

C. Grout for Porcelain Tile Panels.

1.2 RELATED SECTIONS

A. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

B. Section 09 30 00 - Tiling: Ceramic tile materials.

1.3 REFERENCES

A. ANSI A108 Series/A118 Series - American National Standards for Installation of Ceramic Tile.

B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.

C. TCNA (HB) - Handbook for Ceramic, Glass and Stone Tile Installation; Tile Council of North America.

D. ISO 13007 - International Standards Organization; classification for Grout and Adhesives.

E. ANSI A137.3 – American National Standard Specifications for Porcelain Tiles and Porcelain Tile Panels/Slabs

F. ANSI A108.19 Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar

G. ANSI A108.20 Exterior Installation of Vertical and Overhead Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method bonded with Improved Modified Dry-Set Cement Mortar

1.4 SUBMITTALS

A. Product Data: Manufacturer's technical information for each product specified.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Samples: Provide the following submittals before starting any work of this Section:

1. Samples for Selection: Submit one (1) sample 50mm x 175mm (2 " x 7") of each type of 3+ and/or 5.6 porcelain tile panels showing color.

D. Interior Installation Instructions: ANSI A108.19 and Manufacturer's printed Technical Manual / Guidelines.

E. Exterior Installation Instructions: Manufacturer's printed Technical Manual / Guidelines.

F. Care and Maintenance: Manufacturer's Care & Maintenance" Brochure

1.5 QUALITY ASSURANCE

A. Obtain each type and color of 3+ and/or 5.6 from single source.

B. To ensure compatibility of products; please provide all grout, setting materials, additives, accessories, and factory-prepared dry-set mortars from the same manufacturer.

C. Installer Qualifications:

1. Requiring references and a portfolio along with a bid or estimate is a good way to ensure the installer has successfully completed work of similar size, scope, and complexity.
2. Due to the unique material characteristics and unconventional installation techniques required of porcelain tiles and porcelain tile panels/slabs, this work requires installers who are equipped with the proper tools and have acquired sufficient product knowledge and installation experience through the completion of an Installer Qualification Program as listed in 10.2.
3. Installer Qualification Programs

a) Installer certified by Advanced Certification for Tile Installers (ACT) program for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs.
b) Installer completion of a comprehensive installation program provided by the manufacturer of gauged porcelain tiles or gauged porcelain tile panels/slabs or setting materials for gauged porcelain tiles and gauged porcelain tile panels/slabs.
c) Installer completion of a comprehensive installation program provided by the International Masonry Institute (IMI) tile layer programs or the National Tile Contractors Association (NTCA)

1.6 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this section

B. Require attendance of setting material manufacturer, tile supplier, tile installer and installers of related work.

C. Review installation procedures and coordination required with related work. Meeting agenda includes but is not limited to:
1. Surface preparation
2. Porcelain Tile Panel installation procedure
3. Grouting material and procedure
4. Cleaning products and maintenance

1.7 DELIVERY, STORAGE AND HANDLING

A. Follow tile manufacturer's written guidelines for handling as well as ANSI A108.19 for interior installations. Incorporate all necessary tools as detailed in the Manufacturer's Technical Manual / Guidelines
1. Handling of the crate – recommend 44" forks to handle the flat crate or A-frame from the side. Important to have 44" forks so they extend all the way across the crate or A-frame to catch the back runner.
2. Shipments of the 3+ and 5.6 flat crates or A-frames loaded with the narrow end of the crate or A-frame facing out will require a fork truck with a <u>minimum of 84" forks and 5000-pound lift</u> <u>capacity</u>.
3. To correctly lift and handle porcelain tile panels using a forklift, position the forks at a distance of at least 3.3 feet (1 meter) from each other, perpendicular to the long side of the pallet and at the center of the pallet.
4. Porcelain tile panels to be stored both upright and horizontal. If tile panels are placed on top of each other, ensure that each tile panel is clean and that the surface that the tiles are resting on is flat. If tile panels are stored in their vertical position, rest them on their long side. This side must be protected by wood, cardboard, or Styrofoam.
5. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Inspection of material for any shipping damage should be done at time of delivery. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes and in accordance with written manufacturer's recommendations.

1.8 EXTRA MATERIALS STOCK

A. Upon completion of the work of this section, deliver to the owner an appropriate amount of additional tile panels of each type, color, pattern and size used in the work, as well as extra stock of adhesives, mortars, grouts and other installation materials for the owner's use in replacement and maintenance. Extra stock is to be from same production run or batch as original tile and installation materials.

1.9 ENVIRONMENTAL REQUIREMENTS

Comply with requirements of referenced standards and recommendations of material manufacturers for environmental conditions before, during, and after installation.

A. For interior applications:

1. ANSI A108.19
2. Do not begin installation until building is completely enclosed and HVAC system is operating and maintaining temperature and humidity conditions consistent with "after occupancy" conditions for a minimum of 2 weeks.
3. Maintain continuous and uniform building temperatures of not less than 10°C (50°F) during installation.
4. Ventilate spaces receiving tile in accordance with material manufacturer's instructions.

PART 2 PRODUCTS

2.1 TILE MANUFACTURERS

A. Basis of Design: Provide the basis of design product indicated on the Drawings and Finish Schedule. Any proposed substitution must meet the basis of design product performance, pattern, color, size, format, and texture. Proposed substitution products will need to be approved by the design team and match Architect's basis of design sample prior to final approval.

2.2 WALL TILE MATERIALS

A. Meets the requirements of ANSI A137.3 Table 4 or 5 depending on thickness

B. Porcelain Tile Panel:

1. Size: As indicated on Finish Schedule.
2. Thickness:6 mm.
3. Surface: Smooth, without abrasive admixture.
4. Finish: Matte.
5. Tile Color and Pattern: As indicated by manufacturer's designations.

2.3 PERFORMANCE REQUIREMENTS

A. Materials Transparency – Material Ingredients: Provide copies of at least one current product disclosure:

1. Declare Label: Third-party verified.
2. Health Product Declaration (HPD): Third-party verified.

B. Materials Transparency – Environmental Product Declarations: Provide copy of current product disclosure:

1. Product-specific EPD: Third-party verified, cradle-to-grave scope, current, and specific to the product.

C. Embodied Carbon: Product-specific Environmental Product Declaration (EPD) documents Global Warming Potential (GWP) (A1-A3) for 1 m^2 declared unit: 7.27-10 kg CO_2-eq.

D. Low-Emitting Materials: Product is considered an inherently non-emitting source of VOCs resulting from its ceramic composition and lack of integral organic-based coatings.

E. Chemicals of Concern: Product does not contain any chemical ingredients from the following chemicals of concern lists:

1. Living Building Challenge (LBC) Red List.

2.4 INSTALLATION MATERIALS MANUFACTURER

A. Acceptable Manufacturers:

1. Custom Building Products
2. Laticrete International
3. MAPEI Americas U.S.A.,
4. TEC Specialty Products Inc.

2.5 SURFACE PREPARATION, MORTAR, GROUT, AND SEALANT MATERIALS

A. Refer to Manufacturer's Technical Manual / Guidelines for specific surface preparation, mortar, grout, and sealant selections or contact the manufacturers in section 2.4

B. For interior applications also reference ANSI A108.19.

C. Grout Color: As selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces to be covered with porcelain tile panels are:

1. Sound, rigid and conform to good design/engineering practices; Systems, including the framing system and panels, over which porcelain panels will be installed shall be in conformance with the International Residential Code (IRC) for residential applications, the International Building Code (IBC) for commercial applications, or applicable building codes (floor systems over which the tile will be installed should not exceed L/360 under live load).
2. Clean and free of dust, dirt, oil, grease, sealers, curing compounds, laitance, efflorescence, form oil, loose plaster, paint, and scale.
3. For thin-bed porcelain tile installations when a cementitious bonding material will be used, including large and heavy tile mortar: maximum allowable variation in the tile substrate is 1/8” in 10’ (3mm in 3m) from the required plane, with no more than 1/16” variation in 24” (1.5mm variation in 600mm) when measured from the high points in the surface. For modular substrate units, such as adjacent concrete masonry units, adjacent edges cannot exceed 1/32” (0.8mm) difference in height.
4. Examine substrates for compliance with requirements for conditions affecting performance of the work. Refer to ANSI A108.01; General requirements for sub-surfaces and preparations by other trades materials.
5. For Interior installations reference ANSI A108.19

B. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard and Manufacturer’s Technical Manual / Guidelines.

C. Tile contractor by commencing work assumes overall responsibility to assure that all components and parts shown or required within the installation comply with contract documents and are compatible with each other and with the conditions and expected use. Commencement of work signifies acceptance of substrate and installation conditions.

3.2 INSTALLATION

A. Install porcelain tile panels in accordance with:

1. Manufacturer’s Technical Manual / Guidelines for Porcelain Tile Panels.
2. For Interior installation install per ANSI A108.19

B. Install porcelain tile panels in accordance with applicable requirements of ANSI A108 Series for the materials being used.

C. Install expansion and control joints in accordance with TCNA method EJ171. Movement joints in the substrate must not be bridged with the thin porcelain tile.

D. Interior walls and floors:

1. For interior walls, install an 1/8-inch movement joint installed every 20 feet will accommodate the needed movement of the tile layer on grade, below grade, or above grade* (all other requirements such as perimeter joints etc. in EJ-171 should followed)

3.3 GROUTING

A. Grout joints in accordance with A108.19 or A108.20, manufacturer's instructions, and ANSI A108.10 or ANSI A108.6.

B. WALLS

1. 2mm to 3mm grout joint size is recommended based on wall flatness
2. For interior walls the use of commercially available sanded, unsanded or epoxy grout is acceptable, appropriate caulking material is also acceptable for wall installations. For exterior walls see section 3.2 (F).
3. Install and clean per manufacturer's instructions

3.4 PROTECTION

A. Protect installed porcelain tile panel work from damages by other trades and general abuse until substantial work completion and acceptance.

B. Refer to manufacturer's product data sheet for recommendations regarding protection.

END OF SECTION 093015

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

C. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch- square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.
3. Clips: Full-size hold-down clips.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension-system members.
2. Structural members to which suspension systems will be attached.
3. Method of attaching hangers to building structure.

    a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for acoustical panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:

    a. Lighting fixtures.
    b. Diffusers.
    c. Grilles.
    d. Speakers.
    e. Sprinklers.
    f. Fire Alarm Devices.
    g. Access panels.
    h. Perimeter moldings.

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E 1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. American Gypsum.
2. Armstrong World Industries, Inc.
3. CertainTeed Corporation.
4. Chicago Metallic Corporation.
5. United States Gypsum Company.

B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

C. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

~~D. Basis of Design Product ACT-01: Subject to compliance with requirements, provide Armstrong, Lyra PB 8361 or comparable product by listed manufacturers.~~

~~1. Classification: Provide panels complying with ASTM E 1264, Type XII, glass fiber with membrane-faced overlay; Form 2, water felted; E (lightly textured).~~
~~2. Color: White.~~
~~3. LR: Not less than 0.88.~~
~~4. NRC: Not less than 0.95.~~
~~5. AC: Not less than 200.~~
~~6. Edge Detail: Square Tegular.~~
~~7. Thickness: 1 inch.~~
~~8. Size: 24 by 24 inches.~~

~~E. Basis of Design Product ACT-02: Subject to compliance with requirements, provide Armstrong, Techzone with Lyra PB 8361 PB and 8346PB or comparable product by listed manufacturers.~~

~~F. Basis of Design Product ACT-03: Subject to compliance with requirements, provide Armstrong, Ultima Healthzone 1446, or comparable product by listed manufacturers.~~

~~1. Classification: Provide panels complying with ASTM E 1264, Type IV, mineral base with membrane-faced overlay; Form 2, water felted; E (lightly textured) G (smooth).~~
~~2. Color: White.~~
~~3. LR: Not less than 0.86.~~
~~4. NRC: Not less than 0.75.~~
~~5. CAC: Not less than 35.~~
~~6. Edge Detail: Beveled Tegular.~~
~~7. Thickness: 7/8 inch.~~
~~8. Size: 24 by 24 inches.~~

2.4 METAL SUSPENSION SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. United States Gypsum Company.

B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated in finish schedule.

C. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate -duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel.
5. Cap Finish: Painted to match color indicated by manufacturer's designation.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

a. Type: Postinstalled expansion or Postinstalled bonded anchors.
b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

a. Restricted use in designated laboratory areas.

B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- diameter wire.

C. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

D. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. Chicago Metallic Corporation.
4. Fry Reglet Corporation.
5. Gordon, Inc.
6. United States Gypsum Company.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.7 ACOUSTICAL SEALANT

A. Acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies in accordance with ASTM E90.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C834.

1. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.

2. Acoustical Sealant for Concealed Joints: Manufacturer's standard nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C 636/C 636M, and manufacturer's written instructions.

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.

5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.

1. Arrange directionally patterned acoustical panels as follows:

   a. As indicated on reflected ceiling plans.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

4. Install hold-down clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

   a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

   1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.

B. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

C. Prepare inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. ~~Epoxy~~ **Cementitious urethane** resinous flooring systems.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing according to ASTM D635.

2.2 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

~~a. Crossfield Products Corp.~~
b. Duraflex, Inc.
~~c. Neogard; a division of Jones-Blair, Inc.~~
d. Sherwin-Williams Company, General Polymers.
e. Stonhard, Inc.
~~f. Tennant Company.~~
~~g. Tnemec Inc.~~

B. Basis of Design: ~~Dur-a-gard SL~~ **Duraflex**, **Poly-Crete SLB**, or approved equivalent by listed manufacturers.

C. System Characteristics:

1. Color and Pattern: As indicated by product designation listed above.
2. Wearing Surface: Orange-peel texture.
3. Overall System Thickness:119 mils

D. Moisture-Vapor-Emission-Control Membrane/Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

1. Basis of Design: Dur-a-glaz MVP Primer.
2. Thickness: 16 mils.
3. Formulation Description: 100% Solids Chemically Enhanced Epoxy

E. Waterproofing Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

1. Formulation Description: 100 percent solids.

F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

G. Body Coats:

1. Resin: ~~Epoxy~~ **Cementitious Urethane with natural quartz aggregate.**
2. Formulation Description: 100 percent solids.
3. Type: Pigmented. Color as selected by Architect.
4. Application Method: Self-leveling slurry.
5. Number of Coats: One.
6. Thickness of Coats: As recommended by manufacturer
7. Quartz broadcast.

H. Topcoats: Sealing ~~or finish coats with grit~~.

1. Basis of Design: ~~Amortop, Urethane with grit~~.**DuraGlaze Novolac**
2. Resin: Urethane.
3. Formulation Description: 100 percent solids.
4. Type: Clear.
5. Number of Coats: One.
6. ~~Thickness of Coats: 3 mils.~~
7. Finish: Matte.
8. Grit: ~~Alpha Alumina~~.**Natural Quartz.**

I. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 10,500 psi minimum according to ASTM C579.
2. Tensile Strength: 1950 psi minimum according to ASTM C307.
3. Flexural Modulus of Elasticity: 2900 psi minimum according to ASTM C580.
4. Water Absorption: 0.04 percent maximum according to ASTM C413.
5. Indentation: 0.025 percent maximum according to MIL-D-3134J.
6. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134J.
7. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch according to MIL-D-3134J.
8. Abrasion Resistance: 35 mg maximum weight loss according to ASTM D4060.
9. Hardness: 70-80, Shore D according to ASTM D2240.
10. Critical Radiant Flux: 0.45 W/sq. cm or greater according to NFPA 253.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

   a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
   b. Comply with NACE No. 6/SSPC-SP13, with a Concrete Surface Profile (CSP) of 3 or greater in accordance with the International Concrete Repair Institute (ICRI) Technical Guideline No. 310.2R, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
    b. Relative Humidity Test: Use in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 INSTALLATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. MVP Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Waterproofing Membrane: Apply waterproofing membrane over entire substrate surface, in manufacturer's recommended thickness.

1. Apply waterproofing membrane to integral cove base substrates.

D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high **with stainless steel termination angle.**

E. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.

F. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 097713 - STRETCHED-FABRIC WALL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes site-upholstered wall systems with custom graphics.

1.2 DEFINITIONS

A. NRC: Noise Reduction Coefficient.

B. SAA: Sound Absorption Average.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include fabric facing, frame edge and trim, core material, and mounting indicated.

B. Shop Drawings: For each stretched-fabric system.

1. Include plans, elevations, sections, and installation and system details.
2. Include details at head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate frame-edge profile and core materials.
3. Include details at cutouts and penetrations for other work.
4. Include direction of fabric weave and pattern matching.
5. Show sewn-seam locations, types, and methods.

C. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

D. Samples for Verification: For the following products:

1. Fabric: Full-width by approximately 36-inch-long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
2. Frame System: 12-inch-square Sample(s) showing each edge profile and corner.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Elevations 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. Electrical outlets, switches, and thermostats.
2. Items penetrating or covered by stretched-fabric systems including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Alarms.
   e. Sprinklers.
   f. Access panels.

3. Show operation of hinged and sliding components covered by or adjacent to stretched-fabric systems.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of stretched-fabric system.

D. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For stretched-fabric systems to include in maintenance manuals. Include fabric manufacturer's written cleaning, stain-removal, restretching, and reupholstering instructions.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fabric: For each fabric, color, and pattern installed, furnish length equal to 5 percent of amount installed, but no fewer than 10 sq. yd., full width of bolt.
2. Framing and Related Installation Items: Furnish manufacturer's full-length units equal to 5 percent of amount installed, but no fewer than five units, including unopened adhesives.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.

1. Build mockup of typical wall area 48 inches wide by full height. Include intersection of wall and ceiling, corners, and perimeters.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and stretched-fabric system manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install stretched-fabric systems until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install stretched-fabric systems until a permanent level of lighting is provided on surfaces to receive stretched-fabric systems.

C. Air-Quality Limitations: Protect stretched-fabric systems from exposure to airborne odors such as tobacco smoke, and install systems under conditions free from odor contamination of ambient air.

1.10 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of stretched-fabric systems that fail in performance, materials, or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Acoustical performance.
    b. Fabric sagging, distorting, or releasing from panel edge.
    c. Warping of core.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain stretched-fabric wall systems specified in this Section from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Verify wall materials 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."

B. Fire-Test-Response Characteristics: Stretched-fabric wall systems are to comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency on systems prepared according to ASTM E2573. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

2.3 STRETCHED-FABRIC WALL SYSTEMS

A. Stretched-Fabric Wall System: Manufacturer's standard system consisting of facing material stretched tightly over a frame and core material and secured in the frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. FabriTrak Systems, Inc.
b. Fabricmate Systems, Inc.
c. SnapTex International LLC.
d. Basis of Design: Novawall with concealed square edges.

2. Core: Glass-fiber board.

a. Nominal Core Thickness: Match nominal frame thickness.

3. Core Overlay: Polyester batting Manufacturer's standard thickness.

4. Frame Edge: Square profile.

    a. Fabric-Insertion Point: Bottom load.
    b. Nominal Frame Thickness: 1 inch.

5. Frame Color: Natural.
6. Reveals between Panels: Flush reveals as selected by Architect from manufacturer's full range.
7. Facing Material: As indicated.
8. Acoustical Performance: Sound absorption NRC of 0.80 according to ASTM C423 for Type A mounting according to ASTM E795.

2.4 MATERIALS

A. Core Materials:

1. Glass-Fiber Board: ASTM C612; of type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.
2. Core Overlay: Flame-retardant, compressible, fiberfill, polyester batting.
3. Impact-Resistant, Acoustically Transparent, Copolymer Sheet for Face Layer: 1/16- to 1/8-inch-thick layer of perforated, noncombustible, copolymer sheet laminated to face of core.

B. Frame Construction: Manufacturer's standard, continuous, extruded plastic frame (track).
1. One (1) inch system.
2. NRC: 0.80.

C. Facing Material: Fabric from same dye lot; color and pattern as indicated by manufacturer's designations.

1. Color: As indicated on Drawings. Custom Graphic.
2. Fiber Content: 100 percent nonwoven polyester.
3. Width: 54 inches.
4. Applied Treatments: Stain resistance and flame retardant.
5. Lining Material: Manufacturer's standard fabric for each use indicated.
6. Trim Strip: As selected by Architect .

2.5 INSTALLATION MATERIALS

A. Installation Products: Concealed on back of system, recommended by stretched-fabric system manufacturer to support weight of system, fabric tension, and as follows:

1. Fasteners: Manufacturer's standard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fabric, materials, substrates, areas, and conditions, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of stretched-fabric systems.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each area and establish layout of panels and joints of uniform size with balanced borders at opposite edges within a given area.

B. Before installation, allow fabric to adjust and become stable in spaces where it will be installed according to stretched-fabric system manufacturer's written instructions. Acclimatize fabric for minimum of 24 hours at ambient temperature and humidity conditions indicated for spaces when occupied for their intended use.

3.3 INSTALLATION

A. Install stretched-fabric systems according to system manufacturer's written instructions.

1. Provide continuous perimeter frames of each profile indicated, designed to be inconspicuous when covered by fabric facing, with smooth edges, and with surface finish that will not telegraph through fabric facing.
2. Install framing around penetrations.
3. Tightly fit framing to adjacent construction and securely attach to substrate.
4. Install core material with full coverage, flush with face of stretched-fabric system frame.
5. Attach frame and core to substrate with adhesive or fasteners or both to support system and prevent deformation of components.
6. Install stretched-fabric systems level and plumb unless otherwise indicated, true in plane, and with fabric square to the grain.
7. Install jointed panels with butt joints as indicated.
8. Provide wood or plywood nailing strips and blocking as indicated on Drawings.

B. Fabric Installation: Apply fabric monolithically in continuous run over area, without joints or reveals, except where panel joints or midspan frames are indicated.

1. Fabric Direction: Run fabric up the bolt.
2. Fabric Sequence: Maintain sequence of fabric drops; match and level fabric pattern and grain.
3. Fabric Alignment: Install fabric with patterns or directional weaves so pattern or weave aligns with adjacent panels.

4. Fabric Seams:

   a. Sewn seams are not permitted.
   b. Flat standard sewn seams, straight and parallel; seam dimensions and locations as indicated on Drawings.

5. Core Overlay: Evenly stretch over core face and edges; free from puckers, ripples, wrinkles, and sags.
6. Stretch and secure fabric to frame edges and so frame and frame attachment method are concealed by fabric unless otherwise indicated.
7. Stretch fabric tightly and square without puckers, ripples, or distortions. Acclimatize and restretch if recommended by stretched-fabric system manufacturer. Repair distortions, wrinkles, and sagging.
8. Trim Strip: Back-wrap trim strip fabric from the fabric-insertion point over the exposed part of the frame edge where indicated, resulting in a contrasting fabric along the edge.

3.4 INSTALLATION TOLERANCES

A. Edge Straightness: Plus or minus 1/16 inch in 48 inches.

B. Variation from Level and Plumb: Plus or minus 1/16 inch in 48 inches, noncumulative.

C. Variation of Joint Width: Not more than 1/16 inch in 48 inches from hairline, noncumulative.

3.5 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 097713

SECTION 102600 - WALL AND DOOR 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:

1. Corner guards.
2. ~~Abuse-resistant wall coverings.~~

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

D. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

1. Corner Guards: 12 inches long. Include example top caps.
2. ~~Abuse-Resistant Wall Covering: 6 by 6 inches square.~~

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Corner-Guard Covers: Full-size plastic covers of maximum length equal to 2 percent of each type, color, and texture of cover installed, but no fewer than two, 48-inch- long units.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
~~2. Keep plastic materials out of direct sunlight.~~
3. Store ~~plastic wall- and~~ door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

a. Store corner-guard covers in a vertical position.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
    b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

A. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Babcock-Davis.
    b. Balco, Inc.
    c. Construction Specialties, Inc.
    d. InPro Corporation (IPC).
    e. Korogard Wall Protection Systems; a division of RJF International Corporation.
    f. WallGuard.com.

2. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0625 inch.
b. Finish: Directional satin, No. 4.

3. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Adhesive and mechanical fasteners, approved by Architect.
6. Height: 48 inches.

~~2.4 ABUSE-RESISTANT WALL COVERINGS~~

~~A. Abuse-Resistant Sheet Wall Covering : Fabricated from semirigid, thermoplastic sheet wall-covering material.~~

~~1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:~~

~~a. Construction Specialties, Inc.~~
~~b. InPro Corporation (IPC).~~
~~c. MDC Wallcoverings.~~

~~2. Size: As indicated.~~
~~3. Sheet Thickness: 0.080 inch.~~
~~4. Color and Texture: As indicated on Drawings.~~
~~5. Height: As indicated on Drawings.~~
~~6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.~~
~~7. Mounting: Adhesive.~~

2.5 MATERIALS

~~A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.~~

~~B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D 256, Test Method A.~~

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

2.6 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end and top caps as required to ensure tight seams.

~~C. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.~~

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 116623 - GYMNASIUM EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Safety pads.

B. Related Requirements:

1. Section 096466 "Wood Athletic Flooring" for game lines and markers.
2. Section 116623.13 "Basketball Equipment" for basketball goals.

1.3 DEFINITIONS

A. BWF: Badminton World Federation.

B. FIBA: Federation Internationale de Basketball (The International Basketball Federation).

C. FIVB: Federation Internationale de Volleyball (The International Volleyball Federation).

D. NBA: National Basketball Association.

E. NCAA: The National Collegiate Athletic Association.

F. NFHS: National Federation of State High School Associations.

G. WNBA: Women's National Basketball Association.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include assembly, disassembly, and storage instructions for removable equipment.

B. Shop Drawings: For gymnasium equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, and operational clearances.
3. Include transport and storage accessories for removable equipment.
4. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: For each type of gymnasium equipment.

D. Samples for Verification: For the following products:

1. Pad Fabric: Wall padding minimum 3 inches square, with specified treatments applied. Mark face of material.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:

1. Structural members to which overhead-supported gymnasium equipment will be attached.

B. Setting Drawings: For embedded items and cutouts required in other work.

C. Qualification Data: For Installer.

D. Product Certificates: For each type of gymnasium equipment.

E. Field quality-control reports.

F. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium equipment to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Basketball backboard failures, including glass breakage.
    b. Faulty operation of basketball backstops.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Revise articles below to suit Project. These include paragraphs that are examples of gymnasium equipment and are not intended to be all inclusive. Indicate individual equipment or assembled system dimensions and elevations on Drawings. Use these example paragraphs as guides for developing paragraphs for other types of gymnasium equipment.

2.2 SAFETY PADS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Draper, Inc.
2. IPI by Bison.
3. Performance Sports Systems.
4. Porter Athletic Equipment Company.
5. Spalding.

B. Source Limitations: Obtain from single source from single manufacturer.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. Pad Coverings: Provide safety pad fabric covering that is fabricated from puncture- and tear-resistant, PVC-coated polyester or nylon-reinforced PVC fabric, minimum 14-oz./sq. yd. and treated with fungicide for mildew resistance; with surface-burning characteristics indicated, and lined with fire-retardant liner.

E. Wall Safety Pads: Padded wall wainscot panels designed to be attached in a continuous row; each panel section consisting of fill laminated to backer board, with visible surfaces fully covered by seamless fabric covering, free of sag and wrinkles and firmly attached to back of backer board.

1. Backer Board: Minimum 3/8-inch-thick fire-retardant-treated plywood by pressure process according to AWPA U1, Use Category UCFA Fire Retardant Interior.
2. Fire-Resistive Fill: Multiple-impact-resistant foam minimum 2-inch-thick, fire-resistive neoprene, 6.0-lb/cu. ft. density.
3. Size: Each panel section 24 inches wide by minimum 72 inches long.
4. Number of Modular Panel Sections: As indicated on Drawings.
5. Installation Method: Concealed mounting Z-clips. Curved installation in some locations.
6. Fabric Covering Color: Custom color, red.

F. Cutout Trim: Manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.

1. Color: To match pads.

2.3 MATERIALS

A. Castings and Hangers: Malleable iron, according to ASTM A47/A47M; grade as required for structural loading.

B. Softwood Plywood: DOC PS 1, exterior.

C. Particleboard: ANSI A208.1.

D. Equipment-Mounting Board: Wood, transparent finish; size and quantity as required to mount gymnasium equipment according to manufacturer's written instructions.

E. Anchors, Fasteners, Fittings, and Hardware: Gymnasium equipment manufacturer's standard corrosion-resistant or noncorrodible units; concealed; tamperproof, vandal- and theft-resistant design.

F. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, according to ASTM C1107/C1107M, with minimum strength recommended in writing by gymnasium-equipment manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for court layout, alignment of mounting substrates, installation tolerances, operational clearances, and other conditions affecting performance of the Work.

1. Verify critical dimensions.
2. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions and competition rules for each type of gymnasium equipment.

B. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.

C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relationship to adjacent construction; and aligned with court layout.

D. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.

E. Connections: Connect electric operators to building electrical system.

3.3 INSTALLATION OF SAFETY PADS

A. Mount with bottom edge at 4 inches dimension indicated on Drawings above finished floor.

B. Cutout Trim: Limit cuts in face of padding so that cuts are securely and fully concealed behind trim-kit flange.

3.4 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly; free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range; and lubricate as recommended in writing by manufacturer.

END OF SECTION 116623

SECTION 126100 - FIXED AUDIENCE SEATING

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 fixed, chair-type seating and bench type seating with backs with the following:

1. ~~Floor~~ **Riser** mounting.
2. **Upholstered chairs**.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.
2. Refer to Section 126120 “Telescoping Audience Seating” for telescoping seating to match fixed audience seating.

1.3 COORDINATION

A. Coordinate layout and installation of electrical wiring and devices with seating layout to ensure that floor junction boxes for electrical devices are accurately located to allow connection without exposed conduit.

B. Coordinate layout and installation of diffuser pedestals with HVAC work and with properties of diffuser pedestals to ensure alignment, proper air diffusion, and correct seat locations.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of components, and finishes for fixed audience seating.
2. Include electrical characteristics of electrical components, devices, and accessories.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings:

1. Seating Layout: Show seating layout, aisle widths, aisle-end alignment or stepping, row-lettering and chair-numbering scheme, chair widths, and chair spacing in each row.
2. Include diagrams for power, signal, and control wiring.

D. Samples for Initial Selection: For each type of exposed color, finish, texture, and pattern indicated.

1. Include Samples of accessories involving color and finish selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Chair Unit: Full-size unit of each type and combination of finishes. Build sample chairs for each model required to demonstrate aesthetic effects and set quality standards for fabrication.
2. Molded Plastic: Manufacturer’s standard-size unit, not less than 3 inches square.
3. Baked-on Coating Finishes: Manufacturer’s standard-size unit, not less than 3 inches square.
4. Aluminum Finishes: Manufacturer’s standard-size unit, not less than 3 inches square.
5. **Upholstery Fabric: Full with long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.**
6. Row-Letter and Chair-Number Plates: Full-size units with letters and numbers marked.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fixed audience seating.

B. Material Certificates: For each type of flame-retardant treatment of upholstery fabric.

C. Field quality-control reports.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fixed audience seating to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Maintenance of self-rising seat mechanisms, folding armrests, and other operating components.
    b. Adjustment of self-rising seat mechanisms to align seats.
    c. Maintenance of electrical components, devices, and accessories.
    d. Methods for maintaining upholstery fabric.
    e. Precautions for cleaning materials and methods that could be detrimental to seating finishes and performance.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of fixed audience seating that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including standards, beams, and pedestals.
    b. Faulty operation of self-rising seat mechanism.
    c. Faulty operation of electrical components.
    d. Wear and deterioration of fabric and stitching beyond normal use.
    e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Periods: As follows, from date of Substantial Completion.

    a. Structural: Five years.
    b. Operating Mechanisms: Five years.
    c. Electrical Components: ~~Five~~ **One** years.
    d. Plastic, ~~Wood,~~ and Paint Components: Five years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of seating required, including accessories and mounting components, from single source from single manufacturer.

1. Upholstery Fabric: Obtain fabric of a single dye lot for each color and pattern of fabric required.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics of Upholstered Chairs:

1. Fabric and Padding:

a. **Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.**
b. **Padding: Comply with California Technical Bulletin 117-2000.**

B. Strength and Durability Performance: Chairs and components shall pass testing according to BIFMA X5.4.

2.3 FIXED AUDIENCE SEATING

A. Description: Assembly-space seating in permanent arrangement as indicated on Drawings.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hussey, Camatic Quantum SQ and Hussey XCS12 with backrest or comparable product by one of the following:

a. Hussey Seating Company.
b. Irwin Seating Company.
c. Navetta Design.

B. Chair Mounting Standards: ~~Floor~~ **Riser** attached of the following material:

1. Steel: One-piece, heavy-tube or reinforced sheet with welded mounting plate and welded connections for seat pivots, backs, armrests, and end panels.

C. Chair Mounting Beam: Steel horizontal beam mounted on ~~floor~~ **riser-**attached steel support pedestals spaced at intervals of 2 to 2-1/2 chair widths.

D. **Fabric Upholstered** Chairs:

1. Back: ~~Injection molded co-polymer polypropylene. Extends below the seating surface to provide foot protection.~~

a. **Padding Thickness: 2 inches.**
b. **Outer Back Surface: Polyethylene, with fasteners.**
c. **Top Corners: Rounded.**

2. Seats: **Seats shall be padded and upholstered on their top surface with an engineered polymer seat foundation. Seats shall self-rise to a uniform position when unoccupied. Two part top and bottom construction and as follows:** ~~Injection molded co-polymer polypropylene~~**.**

a. **Top Padding Thickness: Minimum 3 inches at front and rear edges.**
b. **Seat Bottom: Engineered polymer, strengthened by deep internal ribs and gussets, completely enclosing the self-rising hinge mechanism.**

3. Fabric: As selected by Architect from manufacturer's full range.

E. Chair Width: 19-23 inches, Vary chair widths to optimize sightlines and row lengths, with minimum chair width of 19 inches from center to center of armrests.

F. Back Height: 34 inches high from the floor.

   1. Back height and pitch shall be fixed as shown on seating layout drawings.

G. Back Pitch: **Fixed** ~~Variable, hinged (rocker~~).

   1. Back Angle: ~~18~~ **15** degrees. Coordinate with final rake of floors..
   2. ~~Chair Back Hinges: Self-lubricating type with noiseless mechanism that raises back to vertical position when chair is unoccupied.~~

H. Chair Seat Hinges: Self-lubricating, with noiseless self-rising seat mechanism passing ASTM F851, positive internal stops cushioned with rubber or neoprene, and requiring no maintenance.

   1. Self-Rising Seat Mechanism: Spring actuated, three-quarter fold.

I. Armrests/ Side Supports: Injection molded glass reinforced polyamide, black in color.

J. Accessible Seating:

   1. Provide removable chair for each wheelchair space unless otherwise indicated.
   2. Provide chairs with folding armrest on aisle side in locations indicated, but not less than 5 percent of aisle seats, dispersed through the audience seating area. Identify these seats with a sign or marker.

K. Row-Letter and Chair-Number Plates: Manufacturer's standard.

   1. Material: Aluminum with black embossed characters.
   2. Location: row letter on top of aisle armrest.
   3. Attachment: Manufacturer's standard method.

L. LED Aisle Light: **In quantity and arrangement per Drawings EL-102A through EL-102D and of the type indicated on Drawing E-008.**

   1. Mounting: Top center of the polypropylene aisle panels to provide illumination of the aisle panel and adjacent floor and/or steps.

M. Cup Holders: Provide chair mounted plastic cup holders unless seating layout doesn’t allow or railing impedes use of cup holder. Attach to back of chair assembly with concealed hardware.

N. Accessible Seating:

   1. Designated on the seating layout drawings and designed to allow an individual to transfer from a wheelchair to the chair. Equip aisle standard with an armrest capable of lifting to a position parallel with the support column, opening sideways access to the seat. Equip aisle standards with a label, displaying an easily recognizable "handicapped" symbol. Decorative requirements of aisle standards are waived for the handicapped access standards.

2.4 UPHOLSTERED CHAIRS

A. Description: Upholstered seating.

B. Ergonomic lumbar support.

C. Width: 21 inches.

D. Enclosed Back.

E. Fabric: As selected by Architect from manufacturer's full range.

2.5 BENCH SEATING WITH BACKRESTS

A. Provide bench seating with back rests where indicated on cast-in-place concrete.

B. Seat Systems:

1. **Provide plastic modular 18 inch individual seats in 12 inch deep models. Seating to be scuff resistant injection molded high density polyethylene plastic.**
2. **Seat heights shall be maintained at a minimum of 16 ¾ inches.**
3. **Color: As selected by Architect from Manufacturer's full range.**

C. Fold-Down Backrests.

1. **Provide molded contoured back rests, manually fold and store on the deck without the need for removal. Injection molded plastic backrest attached to a clear anodize d aluminum rail, using concealed fasteners.**

2.6 MATERIALS AND FINISHES

A. Molded Plastic: High-density polyethylene or polypropylene, blow or injection molded, with surface that is mar and dent resistant.

1. Provide with UV inhibitors to retard fading.
2. Color and Texture: As selected by Architect from manufacturer's full range.

B. Fabric: Manufacturer's standard 100 percent polyolefin with flame-retardant treatment if required to meet performance requirements.

1. **Weight: 18 oz./linear yd..**
2. **Color and Pattern: As selected by Architect from manufacturer's full range.**

C. Upholstery Padding: Flexible, cellular, molded or slab polyurethane foam.

D. Metal Finish: Finish exposed metal parts with manufacturer's standard baked-on coating.

1. Color: As selected by Architect from manufacturer's full range.

2.7 FABRICATION

A. Floor Attachments: Fabricate to conform to floor slope so that standards and pedestals are plumb and chairs are maintained at same angular relationship to vertical throughout Project.

B. Upholstery: Fabricate fabric-covered cushions with molded padding beneath fabric and with fabric covering free of welts, creases, stretch lines, and wrinkles. For each upholstered component, install pile and pattern run in a consistent direction.

C. Upholstered Chairs: Fabricate as follows:

1. Two-Part Upholstered Back: Padded cushion glued to a curved steel plywood or molded-plastic inner panel and covered with easily replaceable fabric; with curved steel or molded-plastic outer back shell that fully encloses upholstery edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine floors, risers, and other adjacent work and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install seating in locations indicated and fasten to substrates according to manufacturer's written installation instructions.

1. Install fixed audience seating with each chair capable of complying with performance requirements without failure or other conditions that might impair the chair's usefulness.
2. Install standards and pedestals plumb.
3. Install seating so moving components operate smoothly and quietly.

B. Install seating with end standards aligned or stepped as indicated from first to last row and with backs and seats varied in spacing to optimize sightlines.

C. Install riser-mounted standards and attachments to maintain uniform chair heights above floor.

D. Where seating is indicated in curved rows, install seating at a constant radius unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Inspect components, assemblies, and equipment, including connections, to verify proper, complete, and sturdy installation according to manufacturer's written instructions and product specifications.
2. Verify that self-rising seats return to uniform at-rest, raised position.

B. Fixed audience seating will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust chair backs so that they are at required angles and aligned with each other in uniform rows.

B. Adjust hardware and moving parts to function smoothly so they operate easily. Lubricate bearings and sliding parts as recommended in writing by manufacturer.

C. Adjust self-rising seat mechanisms so seats in each row are aligned when in upright position.

D. Repair minor abrasions and imperfections in finishes with coating that matches factory-applied finish.

E. Replace damaged and malfunctioning components that cannot be acceptably repaired.

F. Replace upholstery fabric damaged during installation or work of other trades.

END OF SECTION 126100

SECTION 126600 - TELESCOPING STANDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Telescoping stands **with upholstered folding chairs and bench seating**.

B. Related Requirements:

1. Section 018113 “Sustainable Design Requirements – LEEDv4HC” for sustainable design requirements applicable to this project.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design telescoping stands, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Telescoping stands shall withstand the effects of gravity loads and loads and stresses within limits and under conditions indicated according to ICC 300 and NFPA 102.

1. Uniformly Distributed Live Load: Not less than 100 lbs per sq. ft. of gross horizontal projection.
2. Seat Boards and Footrest: Live Load of not less than 120 lbs per linear ft.
3. Sway Force: 24 lbs per linear ft. parallel to the seats and 10 lbs per linear ft perpendicular to the seats. Sway forces not to be considered simultaneously applied.
4. Handrails shall be designed and constructed for:
   a. A concentrated load of 200 lbs. (890 N) applied at any point and in any direction.
   b. A uniform load of 50 lbs. per ft. (730 N/m) applied in any direction. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.
5. Guards shall be designed and constructed for:

a. **A concentrated load of 200 lbs. (890 N/m) applied at any point and in any direction along the top railing member and; a uniform load of 50 lbs. per ft. (730 N/m) applied horizontally at the required guardrail height and simultaneous uniform load of 100 lbs. per ft. (1460 N/m) applied vertically downward at the top of the guardrail. The concentrated and uniform loading conditions shall not be required to be applied simultaneously.**

C. **Fire-Test-Response Characteristics of Upholstered Chairs:**

1. **Fabric and Padding:**

a. **Fabric: Class 1 according to DOC CS 191 or 16 CFR 1610, tested according to California Technical Bulletin 117-2000.**
b. **Padding: Comply with California Technical Bulletin 117-2000.**

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for telescoping stands.

B. Sustainable Design Submittals: Refer to Division 01 Sections for sustainable design requirements for LEED documentation required under this section.

C. Shop Drawings: For telescoping stands in both stacked and extended positions. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

D. Samples for Initial Selection: For units with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Decking: 6-inch- square Samples of finished material.
2. Metal Components: 6-inch- square Sample of each color and finish indicated.
3. Seating: 6-inch- square Sample of each seating material, color, and finish indicated.
4. **Upholstery Fabric: Full with long section of fabric from dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.**

F. Delegated-Design Submittal: For telescoping stands indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

B. Welding certificates.

C. Product Certificates: For each type of fire-resistant construction, from manufacturer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," and AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Standard: Provide telescoping stands to comply with ICC 300 and NFPA 102.

E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings and construction contiguous with telescoping stands by field measurements before fabrication. Verify locations of walls, columns, and other construction that will interface with operating telescoping stands.

1.8 REFERENCE STANDARDS

A. American Institute of Steel Construction (AISC), American Iron and Steel Institute (AISI) and Aluminum Association (AA) design criteria shall be the basis for calculation of member sizes and connections.

B. Wood members shall be designed in accordance with National Forest Products Association, (NFOPA), and National Design Specification for Wood Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wood:

1. Lumber: Kiln dried, surfaced four sides; southern pine complying with SPIB's "Standard Grading Rules for Southern Pine Lumber" for B&B Finish (B and better) grade-of-finish requirements.
2. Plywood: APA-grade trademarked, DOC PS 1.

B. Steel:

1. Structural-Steel Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating designation.
3. Uncoated Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold-rolled commercial steel), or ASTM A 1011/A 1011M, Designation CS (hot-rolled commercial steel).
4. Tubing: ASTM A 500, cold formed; ASTM A 501, hot formed; or ASTM A 513, mechanical.

C. Extruded Aluminum: ASTM B 221, alloy as standard for manufacturer.

2.2 TELESCOPING STANDS

A. General: Operable systems of multiple-tiered seating on interconnected folding platforms that close, without being dismantled, into a nested stack for storing. Stand units permit opening and closing of adjacent rows, allow individual and collective rows to be locked open for use, and close with vertical faces of upper skirts on the same vertical plane.

B. Wall-Attached Telescoping Stands : Forward-folding system, in which the bleachers open in the forward direction by initially moving the front row away from the stack to the fully extended position, and the rear of bleacher understructure is permanently attached to wall construction.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hussey Maxim Plus and Courtside XCS12 or comparable product by one of the following:

    a. Irwin Telescopic Seating.
    b. Hussey Seating Company.

2. Row Spacing: As indicated on Drawings.
3. Row Rise: 9-5/8 inches.
4. Operation: Automatic, power assisted by electrically powered unit controlled by key switch.

    a. Limit Switches: Automatically stop integral power system when telescoping stands reach fully opened or closed positions.
    b. Motion Monitor: Flashing light with self-contained warning horn, rated at 85 dB at 10 feet, mounted under telescoping seating for audio and visual warning during integral power operation.
    c. Transformer: As required to coordinate current characteristics of motor and control station with building electrical system.
    d. Keyed wall switch, coordinate location with Architect

2.3 COMPONENTS

A. Benches: Seats and skirts with back rest.

1. Material: Molded plastic with contour surfaces .
2. Bench Height: Not less than 16 inches or more than 18 inches .
3. Bench Depth: 12 inches.
4. Color: As selected by Architect from manufacturer's full range.

B. Back Rest for Bench Seating: Folding backrests permanently attached to bench units.

1. Material: Molded plastic with contour support surface in color matching seat.
2. Operation: Semi-Automatic with foot release lever.
3. Location: Where indicated on Drawings.

C. Platform Chairs: Beam mounted.

1. Upholstered Seats: Cantilevered, self-centering, automatic three-quarters lift with over center retracting feature. Coordinate aesthetic with seating for fixed seating specified in Section 126100 "Fixed Audience Seating".

a. Upholstery shall be a complete self-retaining unit, welded to the seat and back surfaces using a hot plate welding technique.

2. Height: Minimum of 16-3/4 inches.
3. Backs: Textured one-piece gas-assist injection molded pigmented polypropylene shells; withstand evenly distributed front or rear static load of 450 lbs.
4. Armrests: Injection molded plastic, attached to the support structure with concealed fasteners. Include manufacturer's standard cup holders.
5. Color and Fabric: As selected by Architect from Manufacturer's full range to match fixed audience seating.
6. Chair Beam: Shall be constructed of extruded aluminum with polymer end caps and serve as the focal attachment and shall in turn transmit all forces to the beam support.
7. Beam support: Shall be cast steel support arms. Closed seam steel tube standards are unacceptable. Top of support arms shall be designed to capture and secure the beam in place. Support arms articulate from manual assist or semi-automatic operating mechanism.

D. Deck: ~~Plywood, 5/8 inch thick~~ .**3/4 inch Panelam surface.**

1. Finish: Transparent .
2. Nosing: One piece, formed 14 gage steel with a minimum of G-60 pre-galvanized finish.

E. Risers: Steel sheet with manufacturer's standard, rust-inhibiting coating or hot-dip galvanized finish.

F. Safety Rails: Structural steel **with cable infill**, finished with manufacturer's standard powder coat system.

1. Self-storing mid-aisle handrails located at centerline of each vertical aisle with seating on both sides.
2. End rails (guards) that are telescoping and self-storing.
3. Back rails (guards) along rear of units where required by referenced safety standard.
4. Fixed front rails (guards) along front of units where required by referenced safety standard.
5. Fixed rails around accessible seating cutouts and truncations.
6. Color: As selected by Architect .
7. **Basis of Design: Irwin VersaDeck Cable Rail.**

G. Understructure: Structural steel.

1. Finish: Manufacturer's standard rust-inhibiting finish.
2. Color: As selected by Architect .

H. Support Column Wheels: Nonmarring, soft, rubber-face wheel assembly under each support column.

1. Include wheels of size, number, and design required to support stands and operate smoothly without damaging the flooring surface, but no fewer than four per column or less than 3-1/2 inches in diameter and 1 inch wide.

I. Fasteners: Vibration proof, in manufacturer's standard size and material.

2.4 ACCESSORIES

A. Steps:

1. Slip-resistant, abrasive tread surfaces at vertical aisles.
2. Intermediate aisle steps, fully enclosed, at each vertical aisle.
3. Transitional top step, fully enclosed, at each vertical aisle where last row of telescoping stands is adjacent to a cross aisle.
4. Removable front steps, fully enclosed, at each vertical aisle, that engage with front row to prevent accidental separation or movement and are equipped with a minimum of four skid-resistant feet.

B. Closure Panels and Void Fillers:

1. Aisle closures at foot level that produce flush vertical face at aisles when system is stored.
2. End panels covering exposed ends of stands in the stored position.
3. Panels at cutouts and truncations for accessible seating.
4. Rear fillers including supports for closing openings between top row and rear wall of adjoining construction.
5. Gap fillers for closing openings between stand units or between stand units and adjoining construction.

6. Side Curtains on all exposed ends.

C. Signage:

1. Accessibility signs at each accessible space and accessible aisle seat.

2.5 FABRICATION

A. Fabricate understructure from structural-steel members in size, spacing, and form required to support design loads specified in referenced safety standard.

B. Weld understructure to comply with applicable AWS standards.

C. Round corners and edges of components and exposed fasteners to reduce snagging and pinching hazards.

D. Form exposed sheet metal with flat, flush surfaces, level and true in line, and without cracking and grain separation.

E. Seating Supports: Fabricate supports to withstand, without damage to components, the forces imposed by use of stands without failure or other conditions that might impair the usefulness of seating units.

1. Cantilever bench seat supports to produce toe space uninterrupted by vertical bracing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where telescoping stands are to be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install telescoping stands to comply with referenced safety standard and manufacturer's written instructions.

3.3 ADJUSTING AND CLEANING

A. On completion of installation, lubricate, test, and adjust each telescoping stand unit so that it operates according to manufacturer's written operating instructions.

B. Clean installed telescoping stands on exposed and semiexposed surfaces. Touch up shop-applied finishes or replace components as required to restore damaged or soiled areas.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain telescoping stands.

END OF SECTION 126600

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 Division 01 Specification Sections, apply to this Section. Refer to Division 01 Section “General Commissioning Requirements” for detailed explanation of commissioning work. Section also contains sample Construction Checklist and Functional Test.

1.2 SUMMARY

A. This Section lists plumbing systems to be commissioned. The commissioning process is described in detail in Division 01 Section “General Commissioning Requirements”).

1.3 SYSTEMS TO BE COMMISSIONED

A. The following systems and associated equipment/controls will be commissioned. Note all systems listed below are not included in this Bid Package.

1. Domestic and Domestic Hot Water systems
   a. Pumps
   b. Water Heaters
   c. Heat Exchangers
   d. Water Softeners
   e. Mixing Valves
   f. Use Points (Fixtures)
   g. Piping, fitting, valves, circuit setters, tanks, specialties
   h. Associated controls
2. Meters
3. Sewage Ejector Pumps interface to Building Automation System
4. Sump Pumps interface to Building Automation System
5. Backflow Preventers
6. Plumbing interface to Building Automation System
7. Response of the plumbing systems and associated controls to the loss of normal power and subsequent return of normal power as part of an Integrated Loss of Power Test.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 220800

SECTION 230800 – COMMISSIONING OF 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. Refer to Division 01 Section "General Commissioning Requirements" for detailed explanation of commissioning work. Section also contains sample Construction Checklist and Functional Test.

1.2 SUMMARY

A. This Section lists plumbing systems to be commissioned. The commissioning process is described in detail in Division 01 Section "General Commissioning Requirements").

1.3 SYSTEMS TO BE COMMISSIONED

A. The following systems and associated equipment/controls will be commissioned.
   1. All airside systems: supply, return and exhaust systems including not limited to
      a. Air Handling Units including preheat coils, chilled water-cooling coils, heat recovery, reheat coils, and humidifiers, etc.
      b. Dedicated Outdoor Air Units
      c. Make-up Air Fans with duct coils
      d. Energy Recovery Units
      e. Intake Hoods
      f. Exhaust systems including fans
      g. Relief systems including fans
      h. High Volume low speed fans
      i. Kitchen Hoods and exhaust fan systems
      j. Terminal boxes (100% checkout by contractor, 30% during functional testing plus full heat/cool for all)
      k. Chilled beams (100% checkout by contractor, 30% during functional testing plus full heat/cool for all)
      l. Unit heaters
      m. Air outlets and inlets
      n. Supply, return, and exhaust ductwork systems
   2. All hydronic water distribution systems including not limited to
      a. Heating Water system includes pumps, heat exchangers, expansion tanks, air separators, bag filter, specialties, distribution piping, preheat, reheat, fintube radiation, trench heaters.

   b. Chilled Water includes building pumps, meters, expansion tanks, air separators, bag filters, glycol feed, specialties, distribution piping.
   c. Chilled Beam system including pumps, mixing valves, distribution piping.
3. Steam and Condensate Systems
   a. Including Steam System, Pressure Safety Valves, Pressure Reducing valves, Flash Tank, metering, Condensate recovery tank, condensate pumps, condensate coolers, steam traps, specialties, piping, etc.
4. HVAC control systems
   a. Including Systems Sequencing, Control Points, Sensors, Damper and Control Valves, Graphics Interfaces, System Trending, and Alarms
5. Variable Frequency Controllers for pumps and fans
6. Testing and Balancing (TAB):
   a. The CxP shall verify the TAB by verifying the re-measuring of a representative sample of values (no more than 10%) reported for each type of component, equipment, subsystem, or system in the TAB reports. Re-measurement will be performed by the Test and Balance Contractor, witnessed by the CxP.
7. HVAC interface to Building Automation System
8. Response of the HVAC systems and associated controls to the loss of normal power and subsequent return of normal power as part of an Integrated Loss of Power Test.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 230800

SECTION 260800 – COMMISSIONING OF ELECTRICAL

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. Refer to Division 01 Section “General Commissioning Requirements” for detailed explanation of commissioning work. Section also contains sample Construction Checklist and Functional Test.

1.2 SUMMARY

A. This Section lists plumbing systems to be commissioned. The commissioning process is described in detail in Division 01 Section “General Commissioning Requirements”).

1.3 SYSTEMS TO BE COMMISSIONED

A. The following systems and associated equipment/controls will be commissioned.
   1. Electrical Checks for Mechanical and Plumbing Equipment
   2. Electrical power and distribution systems
      a. Service and Distribution Power including transformers, switchboards, power metering, distribution panels, motor control centers / variable frequency drives and controlled receptacles
      b. Emergency Power distribution including switchboards, generator, distribution panels, automatic transfer switches as applicable
      c. Interfaces to the Building Management System
   3. Lighting & Lighting Controls
      a. Devices including Lights, Switches, Daylighting Controls, Drivers, Occupancy Sensors (includes interface with BAS) (100% contractor checkout, sampling verification of 25% of floor area)
   4. Integrated Loss of Power Test
      a. Response of the electrical and other systems and associated controls to the loss of normal power and subsequent return of normal power as part of an Integrated Loss of Power Test.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260800

SECTION 280800 – COMMISSIONING OF ELECTRONIC SAFETY

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. Refer to Division 01 Section “General Commissioning Requirements” for detailed explanation of commissioning work. Section also contains sample Construction Checklist and Functional Test.

1.2 SUMMARY

A. This Section lists plumbing systems to be commissioned. The commissioning process is described in detail in Division 01 Section “General Commissioning Requirements”).

1.3 SYSTEMS TO BE COMMISSIONED

A. The following systems and associated equipment/controls will be commissioned.
   1. Fire Alarm interface with HVAC systems
   2. Integrated Loss of Power Test
      a. Response of the fire alarm and other systems and associated controls to the loss of normal power and subsequent return of normal power as part of an Integrated Loss of Power Test.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 280800

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IN128 - James T. Morris Arena

100% CD ENERGY PERFORMANCE ASSESEMENT

January 2025

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V1.0

Table of Contents

1 Executive Summary

This report provides a summary of the preliminary ASHRAE 90.1 Standard Appendix G performance analysis of the proposed IUI Athletics and Convocation Center. The analysis was conducted to develop a design package of Energy Conservation Measures (ECMs) in line with the project's energy performance goals. The preliminary ASHRAE 90.1-2010 Appendix H 'Building Performance Rating Method' was conducted using IES-VE version 2023 to assess the energy performance according to LEEDv4 BD+C. The project's key sustainability performance targets are listed below:

- LEED v4 BD+C New Construction: Silver Certification
- LEED v4 Optimize Energy Performance credit achievement of 10 percent annual energy cost reduction compared to the ASHRAE Standard 90.1-2010 baseline building
- Implement cost effective, energy efficient building systems that reduce the operational costs of the project.

To address these targets, detailed energy models were developed in order to assess the annual energy performance of the overall proposed building design. The proposed design includes a number of key ECMs that contribute to the overall performance:

- Solar shading devices
- High performance glazing
- Efficient fan design, including relief fans
- Exhaust air heat recovery to temper outside air
- Heat pipes to precondition supply air
- Supply air temperature reset strategies
- High efficiency LED fixtures
- Low-flow water fixtures
- Active chilled beams at the office spaces

Based on the proposed design package detailed within the main body of this report, the building design achieves the following:

Improvement based on energy performance [%]	34.3
Improvement based on energy cost [%]	34.9
No. of Optimize Energy Performance credit points	13

The 100% CD results indicate an EUI of 77.3 kBTU/sf-yr and 34.9 percent energy cost savings which correspond to 13 points under the LEEDv4 New Construction Optimize Energy Performance credit and therefore achieving the goals set by the design team.

It is important to note that due to the lack of information regarding the efficiency of the purchased steam and chilled water plants, the EUI calculations were performed using the default efficiencies prescribed in the LEED v.4 BD+C manual for closed steam and chilled water.

2 Energy Performance

2.1 Introduction

Dynamic thermal simulation of the proposed IUI Athletics and Convocation Center was conducted using IESVE version 2023 in order to assess the proposed building design performance using the 'Building Performance Rating Method' outlined in ASHRAE 90.1-2010 Appendix G. This report provides a summary of the assessment completed in0line with the requirements of LEED v4 BD+C: New Construction – Optimize Energy Performance credit which allows up to eighteen LEED points to be obtained by demonstrating an improvement in the performance rating of the proposed building compared to a "baseline" building through whole building simulation.

A three-dimensional model of the IUI Athletics and Convocational Center was created based on the DD phase building design documentation from all relevant disciplines.

- The proposed building model includes details of the proposed building geometry and orientation, building fabric, HVAC systems (including information on all heating and cooling plants, fans, and pumps), occupancy densities, lighting, process, and operational profiles in order to simulate the energy performance of the building. Details for all modeling specifications are depicted in the appendix section of this report.
- The baseline building model was developed in accordance with ASHRAE Standard 90.1-2010 Appendix G, which includes details regarding the baseline performance of the building fabric, HVAC systems, and lighting power density. Occupancy densities, other receptacle loads, and operational profiles were identical to those included in the proposed building model unless specified otherwise.

Figure 1 –

2.1.1 Treatment of District Energy Systems in LEEDv4

The LEEDv4 Reference Guide for Building Desing and Construction outlines three paths for projects served by District Energy Systems to demonstrate compliance with the EA Prerequisite Minimum Energy Performance and EA Optimize Energy Performance, through Option 1, Whole-building energy simulation:

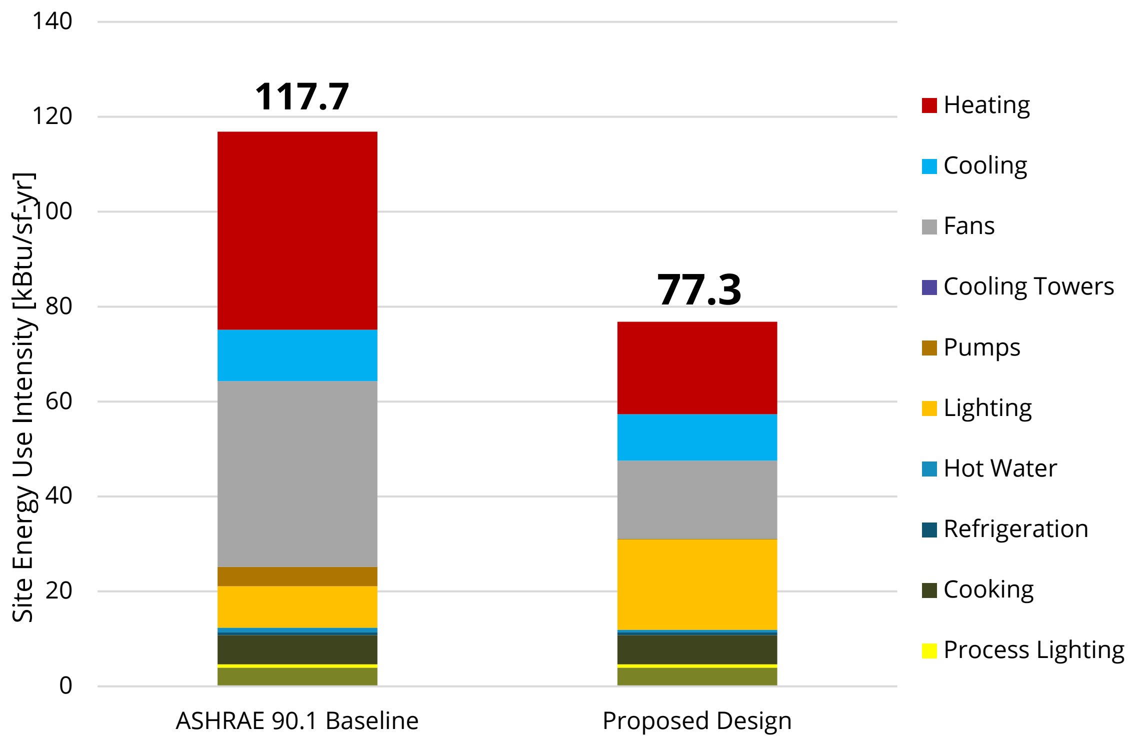
- Option 1, Path 1 – ASHRAE 90.1-2010, Appendix G: The baseline and proposed design are modeled using purchased chilled water and purchased heat according to ASHRAE 90.1-2010, Appendix G.
- Option 1, Path 2 – Full DES Performance Accounting: The energy modeling scope accounts for a smaller time step of the DES and requires the calculation of the district energy average efficiencies using either modeling or monitoring,
- Option 1, Path 3 – Streamlined DES Modeling: The energy model scope accounts for both downstream equipment and upstream equipment and requires calculation of the district energy average efficiencies using either modeling or monitoring.

Due to the lack of information for the DES serving the project, the performance assessment was conducted following Option 1, Path 1.

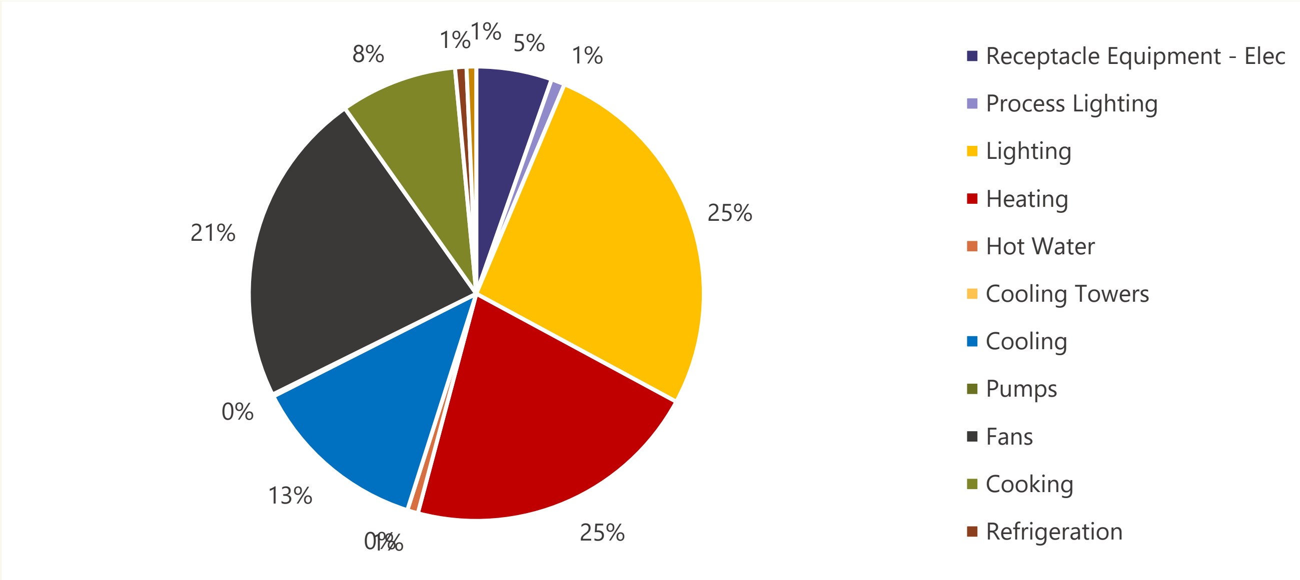
2.2 Analysis Results

Based on the modeled systems and equipment specified within the Appendix A of this report, the annual energy use and energy costs for the ASHRAE baseline and the proposed buildings were calculated. Annual energy use for each end use component is shown in the following tables and graphs in addition to the overall annual energy cost as compared to the ASHRAE baseline.

The preliminary analysis results indicated that the proposed design achieves an EUI of 77.3 kBTU/sf-yr and an improvement of energy costs if 29.2 percent compared to the ASHRAE Baseline building which correlates to 12 points under the Optimize Energy Performance credit. Based on the annual energy use the proposed design outperforms the ASHRAE baseline by 38.7 percent.



The largest energy end use components are heating (31 percent), distribution fans (24 percent), cooling (16 percent) and receptacle equipment (9 percent).



Based on the ECMs included in the proposed building, the analysis indicated that the largest energy savings are in heating loads (56 percent), interior lighting (31 percent) and distribution fans (12 percent).

As the proposed building design further develops, the energy model will be updated to reflect the more detailed and solidified design. It is anticipated that the EUI of the proposed building may increase as the design progresses and the building program is refined. Further details to the modeled systems and equipment in the proposed building energy model are located in Appendix A.

2.3 Discussion

The preliminary proposed building design demonstrates an improvement in energy costs compared to the ASHRAE baseline building.

The proposed design includes the following key ECMs:

- Solar shading devices
- High performance glazing
- Efficient fan design
- Decoupled Outside Air and space thermal control
- Exhaust air heat recovery to temper outside air
- Heat pipes to precondition supply air
- Supply air temperature reset strategy
- High efficiency LED fixtures
- Low-flow water fixtures
- Active chilled beams at the office spaces

2.3.1 Fan Efficiency

The proposed mechanical design includes efficient supply air fans at the air handling units and relief fans to distribute air in the building. Relief fans are located after the recirculation path of the air handling unit and are sized to overcome a lower pressure drop because of their placement, compared to the typical design of return fans that are located before the recirculation path. The energy savings of this design are attributed to the significantly smaller motors sizes required for the relief fans.

2.3.2 Decoupled Outside Air and space thermal control

The proposed design includes Dedicated Outside Air (DOAS) units that deliver tempered outside air to the spaces, while Air Handling Units (AHUs) recirculate indoor air as needed to maintain the space temperature setpoints. This configuration saves energy by separating the functions of ventilation and space conditioning. The DOAS units condition the minimum amount of outside air to meet the ventilation requirements, while the AHUs operate when needed to maintaining space temperatures by recirculating indoor air. This approach reduces the overall conditioning load, as the systems no longer need to treat the total volume of supply air. This decoupled approach allows for independent control of ventilation and space conditioning, optimizing energy efficiency while ensuring that both ventilation requirements and thermal comfort are met.

2.3.3 Heat Recovery Wheel

The proposed design DOAS include efficient heat recovery wheels to transfer thermal energy between the exhaust and outside air branches. Heat recovery wheels capture heat from the warm exhaust air and transfer it to the cooler incoming outside air during the winter, effectively preheating the supply air and reducing the load on the reheat coils. In the summer, the wheels transfer heat from the warmer outside air to the cooler exhaust air, pre-cooling the incoming air and reducing the cooling demand. This process significantly decreases the energy required for heating and cooling.

2.3.4 Wrap-Around Heat Pipes

The proposed design DOAS and AHUs include heat pipes to precondition the full volume of supply air, thereby reducing dehumidification, cooling and heating loads. In this configuration, the heat pipe's evaporator section pre-cools the incoming air before it reaches the cooling coil, effectively lowering the air's dew point and enhancing the dehumidification process. Following the cooling coil, the air is reheated by the condenser section of the heat pipe. This reduces the need for supplemental mechanical or external reheat energy. The energy savings result from the decreased cooling load and minimized reheat requirements, significantly improving overall system efficiency while also achieving humidity control.

2.3.5 Active Chilled Beams

The proposed design includes Active Chilled Beams (ACBs) at the tenant office spaces. Active Chilled Beams save energy compared to typical Variable Air Volume (VAV) systems by decoupling ventilation from space conditioning. In a VAV system, large volumes of air are conditioned and distributed throughout the space, requiring significant fan energy. In addition, water has a higher heat capacity than air, therefore ACBs is more efficient at heat transfer than air. The system delivers the minimum air required for ventilation, drastically reducing fan energy and improving overall efficiency and occupant thermal comfort.

3 Appendix A: Modeled Systems and Equipment

3.1 General Parameters

Project Name	**IUI Athletics and Convocation Center**
Location	Indianapolis, IN (Climate Zone 4A)
Building Type	Sports stadium
Building Conditioned Area [ft^2]	118,350
Modeling Software	IES Virtual Environment v2023
Weather File	TMYx | Indianapolis International Airport
Code Baseline Standard	ASHRAE 90.1-2010

3.2 Envelope Parameters

	ASHRAE 90.1-2010 Baseline	Proposed Design
Exterior Walls – above grade	Gross Area: 32,568 ft^2 Wall, steel-framed	
	Assembly U-0.064 Btu/hr-ft^2-°F [R-13+R7.5 ci.]	Ext Wall Assembly 1 U-0.051: Limestone veneer on Metal Studs [R-193 Ext Wall Assembly 2 U-0.051: Metal panel on metal studs GL-02 U-0.230: Ceramic coated spandrel
Exterior Walls – below grade	Gross Area: 12,323 ft^2 Wall, solid mass	
	Assembly U-0.181 No insulation	Assembly U-0.123 [R-4 c.i.]
Roofs	Gross Area: 78,707 ft^2 Roof, insulation entirely above deck	
	Assembly U-0.048 [R-20]	Assembly U-0.032 [R-30]
Window to Wall Ration	40%	41%
Vertical Fenestration	Gross Area: 13,027ft^2 Assembly U-0.50 | SHGC-0.40	Gross Area: 13,415ft^2 Assembly U-0.29 | SHGC-0.39
Shading	No external shading	Per design
Air leakage	0.10ACH	0.10ACH

3.3 Internal Load Parameters

3.3.1 Conditioned Spaces (1)

Space Type	Area [ft^2]	Occupant Density [ft^2/occ]	Total people/space	ASHRAE 90.1-2010 Baseline Lighting [W/ft^2]	Proposed Design Lighting [W/ft^2]	Equipment [W/ft^2]
Circulation	25,647	1000	28	0.66	0.44	0.20
Classroom (training)	575	30	20	1.24	1.17	1.50
Concessions	2,231	25	90	1.31	0.76	20.00
Electrical	345	-	-	0.95	0.45	3.50 (heat gain)
Fitness (exercise)	3,264	25	131	0.72	0.54	1.50
Fitness (playing)	7,661	33	230	1.20	0.82	0.50
Food prep	1,134	50	23	0.99	0.75	50.00
Laundry	272	-	-	0.63	0.45	45.00
Locker	3,562	-	-	0.75	0.43	-
Lounge	2,938	20	147	0.73	0.55	0.20
Mechanical	1,101	-	-	0.95	0.45	5.00 (heat gain)
Open office	17,355	200	87	0.98	0.56	1.50
Enclosed office	4,756	200	24	1.11	0.66	1.50
Restroom/ Shower	7,286	-	-	0.98	0.74	-
Sales (ticketing)	1,211	25	49	1.68	0.85	1.30
Sports arena (playing)	9,034	400	23	2.68	1.80	-
Sports arena (seating)	23,039	5.5	4189	0.43	0.27	-
Stairway	792	-	-	0.69	0.40	-
Storage	5,780	-	-	0.63	0.45	0.30
IT	365	-	0	0.95	0.45	22.00

3.3.2 Unconditioned Spaces (1)

Space Type	Area [ft^2]	Occupant Density [ft^2/occ]	Total people/space	ASHRAE 90.1-2010 Baseline Lighting [W/ft^2]	Proposed Design Lighting [W/ft^2]	Equipment [W/ft^2]
Circulation	1,880	1000	28	0.66	0.44	0.20
Mechanical	7,224	-	-	0.95	0.45	5.00 (heat gain)
Loading	2,826	-	-	0.19	0.19	0.20
Storage	76	-	-	0.63	0.45	0.30

(1) The proposed and baseline models have been modeled using the same space classifications and thermal blocks per Table G3.1

3.4 Ventilation and Thermostat Parameters

Space Type	Area [ft^2]	Cooling Setpoint/Setback	Heating Setpoint/Setback	ASHRAE 90.1-2010 Baseline Outside Air	Proposed Design Outside Air
Circulation	27,527	78/85	68/60	Same as proposed	0.06cfm/ft^2
Classroom (training)	575	78/85	68/60	Same as proposed	7.50cfm/occ + 0.06cfm/ft^2
Concessions	2,231	78/85	68/60	Same as proposed	exhaust rate 0.30cfm/ft^2
Electrical	345	80/80	-	Same as proposed	-
Fitness (exercise)	3,264	78/85	68/60	Same as proposed	20.00cfm/occ + 0.06cfm/ft^2
Fitness (playing)	7,661	78/85	68/60	Same as proposed	20.00cfm/occ + 0.06cfm/ft^2
Food prep	1,134	78/85	68/60	Same as proposed	exhaust rate 0.70cfm/ft^2
Laundry	272	78/85	68/60	Same as proposed	exhaust rate 1.00 cfm/ft^2
Loading	2,826	-	-	Same as proposed	exhaust rate 0.75cfm/ft^2
Locker	3,562	78/85	68/60	Same as proposed	exhaust rate 0.50cfm/ft^2
Lounge	2,938	78/85	68/60	Same as proposed	10.00cfm/occ + 0.18cfm/ft^2
Mechanical	8,325	80/80	-	Same as proposed	-
Open office	17,355	78/85	68/60	Same as proposed	5.00cfm/occ + 0.06cfm/ft^2
Enclosed office	4,756	78/85	68/60	Same as proposed	20.00cfm/occ + 0.06cfm/ft^2

Restroom/ Shower	7,286	78/85	68/60	Same as proposed	exhaust rate 70cfm/ fixture
Sales (ticketing)	1,211	80/80	68/60	Same as proposed	7.50cfm/occ + 0.12cfm/ft^2
Sports arena (playing)	9,034	78/85	68/60	Same as proposed	20.00cfm/occ + 0.18cfm/ft^2
Sports arena (seating)	23,039	78/85	68/60	Same as proposed	7.50cfm/occ + 0.06cfm/ft^2
Stairway	792	78/85	68/60	Same as proposed	-
Storage	5,856	78/85	68/60	Same as proposed	5.00cfm/occ + 0.12cfm/ft^2
IT	365	80/80	68/60	Same as proposed	-

3.5 Other Load Parameters

	Total No	ASHRAE 90.1-2010 Baseline	Proposed Design
LED Displays (each) [kW]	6	19.20	19.20
Scoreboards (each) [kW]	2	1.11	1.11

3.6 HVAC Parameters

3.6.1 General Parameters

Modeled Input Parameter	ASHRAE 90.1-2010 Baseline	Proposed Design
System Type Description	1) System 07 – VAV Reheat Fan Control: VAV Cooling: Purchased chilled water Heating: Purchased steam 2) System 03 – Packaged Rooftop air conditioner Fan Control: CAV Cooling: Purchased chilled water Heating: Purchased steam	1) DOAS with ERV and heat pipes 2) AHUs with ERV and heat pipes VAV reheat terminal units (decoupled ventilation provided by DOAS) 3) AHUs with ERV and heat pipes VAV reheat terminal units 4) AHU with ERV and economizer mode for OA and heat pipes preconditioning supply air, with CAV terminal units 5) DOAS with ERV and heat pipes and ACB 6) Ductless Hydronic Cassettes
Spaces Modeled	1) Event floor and concourse floor 2) Tenant office, commercial kitchen, MEP rooms, laundry room	1) Ventilation air to event level, commercial kitchen, storage spaces and ventilation ad thermal control for BOH spaces

		2) Event level, commercial kitchen, storage spaces, 3) Auxiliary gym 4) Bowl 5) Tenant office 6) MEP room
Total Cooling Capacity [ton]	610	395
Total Heating Capacity [MBH]	5,044	2,062
Outside Airflow	Same as proposed	63,205 (DCV: 34,506)
Specific Fan Power [W/cfm]	1) System 7: 1.40 2) System 3: 1.55	1) DOAS system: 0.90 2) AHU system: 0.90 3) Hydronic cassette: 0.25
Exhaust Air Sensible Energy Recovery	50%	75%
Heat Pipes Sensible Energy Recovery	-	65%

3.6.2 Evaluation Parameters

Purchased steam blended rate [$/therm]	Citizen Energy Group Rate 1 – 1.523
Purchased chilled water blended rate [$/ton-hr]	0.0568
Electricity Rate $/kWh	ASS SL Rate – 0.112

SECTION 33 42 00 - STORMWATER PUMPING STATIONS

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 two stormwater pumping stations with submersible pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Pressure Rating of Pumps and Discharge Piping Components: At least equal to pump discharge pressure, but not less than 200 psig. All piping in the wet wells shall be PC 350 (minimum) flanged ductile iron piping.

B. Pressure Rating of Other Piping Components: At least equal to system operating pressure.

C. Delegated Design: Design stormwater pumping stations, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Soil parameters and groundwater (anti-buoyancy) parameters for final design shall be as outlined by the Geotechnical Engineer and project geotechnical report.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Show fabrication and installation details for each pumping station. Detail equipment assemblies and indicate dimensions; shipping, installed, and operating weights; loads; required clearances; method of field assembly; components; electrical characteristics; and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

2. Pump information, pump curves, and on/off/alarm elevations shall be submitted to the Engineer for review. Engineer will review delegated-design shop drawing package for compliance with the stormwater models and calculations.

3. Shop drawings and product data for plug and check valves.

4. Shop drawings and product data for precast concrete wet well structures showing structure locations, structure elevations, and sizes and elevations of penetrations.

5. Shop drawings for aluminum access hatches with fall protection.

C. Buoyancy calculation: For each pump station, document that buoyancy is not a problem. Criteria for buoyancy calculations are as follows:
1. Minimum safety factor 1.2.
2. Surface friction of backfill materials shall not be included.
3. Submerged soil weight of 55 pounds per cubic foot where soil weight is used to help hold down the structure. Only soil directly above manhole or any anti-floatation devices may be included.
4. Water table at grade.
5. No water weight to be included inside structure.
6. Weights for castings, all precast components and any manufacturer-supplied fillets in bottom of structure may be included.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pump, signed by product manufacturer.

B. Qualification Data: For Installer.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units 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 UL 778, "Motor-Operated Water Pumps," for pumps. Pumps shall be provided with explosion proof motors.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged pumping stations that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including shell.
    b. Faulty operation of sewage pumps, controls, or accessories.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period for Wet Wells: 3 years from date of Substantial Completion.
3. Warranty Period for Stormwater Pumps and Controls: 3 years from date of Substantial Completion.
4. Warranty Period for Accessories: 3 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRECAST WET WELL PUMPING STATIONS

A. Stormwater Pump Station #1 (Precast Wet Well Pumping Stations with Submersible Pumps):

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product.

2. Description: Precast factory fabricated, assembled, and tested wet well with submersible stormwater pumps.

3. Capacities and Characteristics:

    a. Diameter or Dimensions of Wet Well: minimum 48 inches
    b. Height of Wet Well Base Section: as indicated on drawings
    c. Pumping Station, Inlet Pipe Size: as indicated on drawings
    d. Pumping Station, Discharge Pipe Size: as indicated on drawings
    e. System Discharge Rate
        1) Design Flow (minimum): 100 gpm
        2) Design Head (Feet): 25 feet

f. Pumps: Two required (alternating). Basis of design product: AMS336-200/2,.8T/C explosion-proof submersible pump as manufactured by HOMA. Pumps will convey stormwater and shall include a screening device upstream of pump that is accessible for maintenance and cleaning.

g. Each Pump:

1) Capacity (minimum): 100 gpm
2) Total Dynamic Head: 25 feet
3) Discharge Size: as indicated on drawings
4) Motor Size: 2.8 hp.
5) Pump On Elevation: as indicated on the drawings
6) Pump Off Elevation: as indicated on the drawings
7) Electrical Characteristics:

a) Volts: 230/460 V
b) Phases: Three

h. Pumping Station shall include backup power by connection to the on-site emergency generator. Coordinate with electrical drawings.

i. Motors: FM Rated

B. Stormwater Pump Station #2 (Precast Wet-WellPumping Stations with Submersible Pumps:

1. <u>Basis-of-Design Product</u>: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product.

2. Description: Precast factory fabricated, assembled, and tested wet well with submersible stormwater pumps.

3. Capacities and Characteristics:

a. Diameter or Dimensions of Wet Wall: minimum 72 inches
b. Height of Wet Well Base Section: as indicated on drawings
c. Pumping Station, Inlet Pipe Size: as indicated on drawings
d. Pumping Station, Discharge Pipe Size: as indicated on drawings
e. System Discharge Rate
   1) Design Flow: 800 gpm
   2) Design Head (feet): 39 feet
f. Pumps: Two required (alternating). Basis of design product: AMS646-340 15.3PC explosion-proof submersible pump as manufactured by HOMA. Pumps will convey

stormwater and shall include a screening device upstream of pump that is accessible for maintenance and cleaning.

g. Each Pump:

1) Capacity: 800 gpm
2) Total Dynamic Head: 39 feet
3) Discharge Size: as indicated on drawings
4) Motor Size: 15.3 hp.
5) Pump On Elevation: By Delegated Design Professional
6) Pump Off Elevation: By Delegated Design Professional
7) Electrical Characteristics:

a) Volts: 230/460 V
b) Phases: Three

h. Pumping Station shall include backup power by connection to the on-site emergency generator. Coordinate with electrical drawings.

i. Motors: FM Rated

2.2 CONTROLS

A. Control Sequence of Operation: Cycle each stormwater pumps on and off automatically to maintain wet well levels. Automatic control operates both pumps in parallel if wet well level rises above starting point of low-level pump, until shutoff level is reached. Automatic alternator, with manual disconnect switch, changes sequence of lead-lag pumps at completion of each pumping cycle.

B. Control Panel: Enclosure complying with UL 508A with separate compartments and covers for controllers, circuit breakers, transformers, alternators, and single-phase controls. Include 20-A duplex receptacle in NEMA WD 1, Configuration 5-20R mounted on exterior of control panel.

1. Mounting: Outside, on pedestal, at grade.
2. Enclosure: NEMA 250, Type 4X.

C. Install labels on panel face to identify switches and controls.

D. Wiring: Tin-copper wiring.

E. Pump system to be connected to building backup power supply. Refer to electrical plans and specifications for additional information.

2.3 ACCESSORIES

A. High-Water Alarm: Include visual alarm light mounted to control panel.

2.4 MISCELLANEOUS MATERIALS

A. Grout: ASTM C 1107, Grade B, nonshrink cement grout.

1. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

B. Concrete: Concrete is specified in Section 033000 "Cast-in-Place Concrete."

2.5 PUMPING STATION FABRICATION

A. Fabricate precast concrete wet well and base per manufacturer recommendations for stormwater use.

1. Walls: as required by applicable codes.
2. Provide rebar reinforcement in concrete base below pumps as recommended by manufacturer.

B. Access Hatch: Aluminum access hatch with fall protection, sized per pump supplier to ensure proper installation and removal of pumps.

C. Air Vent: Duct fabricated from corrosion-resistant material, extended to above grade, outlet turned down, and with insect screen in outlet.

D. Piping between unit components.

1. Use piping material and fittings as indicated on drawings and as recommended by manufacturer for stormwater use.

E. Piping Connections: as indicated on drawings and recommended by manufacturer for stormwater use.

F. Valves: Plug valve and check valve as indicated on drawings, per applicable AWWA and ASTM standards.

G. Wiring: Tin-coated copper.

2.6 SOURCE QUALITY CONTROL

A. Test and inspect pumps according to HI 1.6, "Centrifugal Pump Tests." Include test recordings that substantiate correct performance of pumps at design head, capacity, suction lift, speed, and horsepower.

B. Test accessories and controls through complete cycle. Include test recordings that substantiate correct performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine piping systems to verify actual locations of piping connections before packaged pumping station installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

3.3 INSTALLATION

A. Install pumping station components where indicated, according to specific equipment and piping arrangement indicated.

B. Install per manufacturer's recommendations.

3.4 CONNECTIONS

A. Storm sewer piping installation requirements are specified in Section 33 41 00 "Storm Utility Drainage Piping." Drawings indicate general arrangement of piping.

3.5 IDENTIFICATION

A. Install identifying labels permanently attached to equipment.

B. Install operating instruction signs permanently attached to equipment or on pumping station wall near equipment.

C. Arrange for installing detectable warning tape over outside edges of underground packaged sewage pumping stations. Tape materials and their installation are specified in Section 312000 "Earth Moving."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform field tests and inspections and prepare test reports.

B. 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.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing packaged pumping stations and after electrical circuitry has been energized, test for compliance with requirements. Furnish water required for pump tests.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
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.

E. Remove and replace pumping station components that do not pass tests and inspections and retest as specified above.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Adjust pump, accessory, and control settings, and safety and alarm devices.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sewage pumping stations.

END OF SECTION 33 42 00