



ADDENDUM NO. 3

FROM: Barganier Davis Sims Architects Associated
624 South McDonough Street
Montgomery, Alabama 36104

TO: Plan Holders

DATE: July 20, 2017

RE: Goodwill Hall – Renovation & Band Rehearsal Hall Addition
For Auburn University
AU Project No: 15-255
ABC Job No: 2016 – 111

GENERAL:

1. Contractor shall include in their price, an allowance of \$20,000 for the furnishing and installation of the landscaping irrigation system.
2. As part of this project, accessible parking specs are being removed. Contractor to include in his bid an allowance of \$10,000 for the relocation of accessible spaces to an existing adjacent or nearby parking lots.

CHANGES TO SPECIFICATIONS:

1. Refer to attached SECTION – 014339 MOCK-UP. This section shall become a part of the Project Manual.
2. Refer to SECTION – 033000 CAST IN PLACE CONCRETE, Part 3 Execution, paragraph 3.6 JOINTS, B- Construction Joints. Add sealant at sidewalk construction joints. Sealant shall be a 2 part component sealant to match the “ochre” colored concrete.
3. Refer to SECTION 04810-UNIT MASONRY ASSEMBLIES
 - a. Under 2.10 MISCELLANEOUS MASONRY ACCESSORIES add the following:
 - E. Mortar Net: Provide Mortar Net as indicated on the drawings.
 1. Mortar Net Wall Defender.
 2. HM Mortar Net.
 3. MASONPRO ProNet.
4. Add to SECTION 05 51 33.13-METAL STAIRS AND LADDERS (attached) for specification for roof ladder and ladder security door.

5. Refer to attached SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY which will be part of the Project Manual.
6. Refer to SECTION 064023 – INTERIOR ARCHITECTURAL WOODWORK. The following are approved manufacturers:
 - a. Phipps Cabinets, Inc. – Dothan, AL
 - b. House of Cabinetry – Dothan, AL
7. Refer to SECTION 072726- FLUID-APPLIED MEMBRANE AND VAPOR AIR BARRIERS. Prosoco is an acceptable manufacturer, for the following products.
 - a. Prosoco Spray Wrap MVP
 - b. Prosoco joint and seam filler for painting up material
8. Refer to SECTION 078123 INTUMESCENT FIREPROOFING included with Addendum No. 2. Delete this section in its entirety. Replace with attached Section 078100 APPLIED FIREPROOFING. Fireproofing of beams required at hatched area on Basement Floor Life Safety Plan.
9. Refer to SECTION 083323 - FIRE RATED OVERHEAD COILING DOORS.
 - a. Delete this section in its entirety and insert the attached Section 083323.
10. Refer to SECTION 083326 – ROLLING COUNTER FIRE SHUTTER:
 - a. Under 2.2 operation change the Operation type from Hand Crank to Electric Tube Motor-operated door, orient the drive from the left-hand side when facing the reference side of the door (side with hood exposed).
 - b. Manufacturer Product Designation: Equal to Raynor Fire Eclipse Tube Motor.
 1. Type: Tube Motor
 2. Electrical Requirements: Two Button constant pressure “open-close”.
 - c. Refer to 2.5 Counterbalance System.
 1. Under C. Change to read: Counterbalance shall be Counterbalanced by Tube Motor Operation tied into and initiated by Fire Alarm System
 - d. Under 2.7 Release System.
 1. Under a Release Type: Change, 1. Fusible Links to Fire Alarm System.
11. Refer to attached, revised SECTION 087100 – DOOR HARDWARE
 - a. For hardware set 008, revise door No. 104B to 104B.1.
 - b. For hardware set 021, revise door No. 104A to read 104A.1.
 - c. See added LCN 4642 ADA door operators with wall mount WIK activators to doors 001A and 103A only. These doors have been moved to new hardware set AL-02.
 - d. New exterior mechanical room pair doors 105 was added to the project in Addendum No.2 - Hardware set is 022.
 - e. Product numbers for wall mounted card readers added to hardware sets 003, 004, 005, 006, 007, 009, 011, 012, 014, AL-01 and AL-02.
12. Refer to SECTION 098100- BLACK ACOUSTIC INSULATION. The following shall be accepted as an approved equal to the Black Acoustical Insulation at the ceiling.
 - a. K13 spray-on acoustical insulation (3”thick). Color to be black.

- b. Monoglass (3"thick). Color to be charcoal.
- 13. Refer to SECTION 211100 –FIRE PROTECTION SYSTEMS. Delete in its entirety and replace with attached Section 211100.
- 14. Refer to SECTION 235719 - PLATE AND FRAME HEAT EXCHANGERS. "Polaris" is an accepted manufacturer.
- 15. Refer to SECTION 238219- FAN COIL UNITS, PART 2 – PRODUCTS. Paragraph 2.1.A. Add Enviro-tec as an approved manufacturer.
- 16. Refer to DIVISION 22. Delete in its entirety and replace with attached Division 22.
- 17. Refer to DIVISION 23. Delete in its entirety and replace with attached Division 23.
- 18. Refer to attached SECTION 329200 – LANDSCAPING which will be a part of the Project Manual.

CHANGES TO DRAWINGS:

- 1. Refer to Drawing A1.0:
 - a. See revision to Janitor's Closet and New Water Heater Closet.
 - b. Partial Floor Plan Alternate, 2/A1.0. As part of this Alternate, apply 1" furring channels at 16" O.C. with 1" rigid insulation between channels, from floor to 8" above ceiling with 5/8" gypsum board painted, attached. This is to go over the concrete walls on the east and north elevations.
- 2. Refer to Drawing A2.1. Sheet title shall be revised to read, "East and South Elevations".
- 3. Refer to Drawing A2.1. Sheet title shall be revised to read, "North and West Elevations".
- 4. Refer to Drawing A3.4. See clarification to foundation waterproofing system.
- 5. Refer to Drawing A4.1
 - a. Add walkpads at ladder as indicated.
 - b. See details for ladder and ladder security door. Ladder and door equal to Precision Ladders, LLC.
 - c. See added fall protection (see attached cut sheet for fall protection).
- 6. Refer to Drawing A5.4, See modification to Detail 6/A5.4.
- 7. Refer to Drawing A6.1:
 - a. See 3/A6.1 and 9/A6.1 for modifications to the H.C. toilet stall doors.
 - b. See revisions to 1/A6.1.
- 8. Refer to Drawing A6.2. All exposed gypsum board on walls to be painted.

9. Refer to Drawings A6.2 and A6.3. Provide motorized roller shades at all windows in rehearsal hall 100 as per specifications.
10. Refer to Drawing A6.4 for revisions, (shelf on top of casework delete).
11. Refer to Drawings A6.5 and A6.7. See revisions to Section 7/A6.7.
12. Refer to Drawing A6.7. See modification to anchorage of steel support system to floor.
13. Refer to attached Drawing A6.9, not included in original set.
14. Refer to Drawing A7.0. See Reflected Ceiling Plan modifications of Janitor's closet area.
15. Refer to Drawings A7.0 and A8.3. Add window pocket over doors 001A.
16. Refer to Drawing A8.1, Door Schedules. Provide signage for toilets as per spec. Spec. Section 101400 – Signage, paragraph 2.1 F for “women” and “men”.
17. Refer to Drawings A8.2 and A8.4 for door detail modifications. Drawing A8.2, details 1 and 2/A8.2 and on Drawing A8.4, details 7 and 8/A8.4.
18. Refer to Drawing A9.1, General Note 1. Add Architectural Surface, Inc; “Woodgrille III – Dowel Rail Support with cherry finish as an approved equal”.
19. Refer to Drawing AR5.0.
 - a. Refer to door 107, frame and door elevations.
20. Refer to Sheet MO.2, Electric Steam Humidifier Schedule. Add “Nortec” as an approved manufacturer.
21. Refer to Drawing S0.1, GENERAL NOTES, Basement Shoring Notes, No. 4.
 - a. Replace with, “Excavation shoring may be designed with the use of permanent tiebacks.”
22. Refer to attached Drawings S0.2, S1.1, S1.2 and S2.2 for revisions.

END OF ADDENDUM

SECTION 014339 - MOCK UP

GENERAL

1.1 SUMMARY

- A. This Section includes the construction of a site built Mock Up.
- B. Review the documents for coordination with additional requirements and information that apply to work under this Section.
- C. Scope of Mock Up is as indicated on the Drawings.
- D. Mock Ups shall be complete in all respects and shall represent the final complete wall assembly, including metal studs, sheathing. Mortar net, applied air barrier membrane, brick veneer and anchorage systems, etc.
- E. Construct Mock Up in location and orientation at Project Site approved by the Owner.
- F. Do not place orders for wall components or materials, and do no fabrication until Mock Up is approved.
- G. Where review of Mock Up may require revisions, Architect shall provide such revisions in writing to General Contractor.
- H. Do not install Mock Up components or materials in the completed Project.
- I. Mock Up shall remain in place until work on Project is complete, unless otherwise directed by the owner or specified otherwise. At Project completion, remove and dispose of Mock Up.
- J. Design and provide structural framework assemblies necessary to support and display Mock Up.
- K. Approximate Mock Up size is 4' x 8'.

PART 2 - PRODUCTS: NOT USED.

PART 3- EXECUTUION: NOT USED.

END OF SECTION 014339

SECTION 05 51 33.13 – METAL STAIRS AND LADDERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum fixed vertical ladders.

1.2 RELATED SECTIONS

- A. Section 05120 – Structural Steel: Roof structure and opening support.
- B. Section 05550 – Metal Fabrications: Miscellaneous metal supports.
- C. Section 06100 – Rough Carpentry: Roof framing and opening support.
- D. Section 05120 – Structural Steel: Roof framing and support.
- E. Section 07400 - Membrane Roofing: Roof curb flashing.

1.3 REFERENCES

- A. ANSI A14.3: Ladders – Fixed – Safety Requirements.
- B. OSHA 1910.27: Fixed Ladders.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01300.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- A. Shop Drawings for Ladders:
 - 1. Plan and section of ladder installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.

- B. Store products until installation inside under cover. If stored outside, under a tarp or suitable cover.

1.6 WARRANTY

- A. Limited Warranty: Five years against defective material and workmanship, covering parts only, no labor or freight. Defective parts, if deemed so by the manufacturer, will be replaced at no charge, freight excluded, upon inspection at manufacturer's plant which warrants same.

PART 2 PRODUCTS

2.1 MANUFACTURER

Acceptable Manufacturer: Precision Ladders, LLC, which is located at: P.O. Box 2279; Morristown, TN 37816-2279; Toll Free Tel: 800-225-7814; Tel: 423-586-2265; Email: info@PrecisionLadders.com; Web: www.PrecisionLadders.com

2.2 ALUMINUM FIXED VERTICAL LADDER

- A. Aluminum Fixed Vertical Ladder and Components: Ladder, roof mounting brackets, security door, walk-thru, and side rails.
 - 1. Model: Aluminum Fixed Vertical Ladder as manufactured by Precision Ladders LLC.
 - 2. Capacity: Unit shall support a 1500 lb (680 kg) loading without failure, and individual treads shall withstand a 3,000 lb (1361 kg) loading without failure.
 - 3. Performance Standard; Units designed and manufactured to meet or exceed ANSI A14.3 and OSHA 1910.27.
- B. Components:
 - 1. Ladder Stringer: 2-1/2 inch by 1-1/16 inch by 1/8 inch (64 mm by 27 mm by 3 mm) extruded 6005-T5 aluminum channel. Pitch: 90 degrees.
 - 2. Ladder Tread: 2-1/4 inch by 3/4 inch by 1/4 inch (57 mm by 19 mm by 6 mm) extruded 6005-T5 aluminum with deeply serrated top surface.
 - 3. Ladder Mounting Bracket: 8-1/2 inch by inch by 3 inch by 1/4 inch thick (216 mm by 51 mm by 76 mm by 6 mm) aluminum angle.
 - 4. Walk-Thru:
 - a) Hand Rails: 1-1/4 inch (32 mm) aluminum square tube with rounded edges.

- b) Mounting Brackets: 4 inch by 4 inch by ¼ inch (102 mm by 102 mm by 6 mm) aluminum.
 - c) Side Rails: 42 inch (1067 mm) side rail extension for through ladder exits.
- 5. Security Door: 0.125 inch (3 mm) 3003-H14 aluminum panel 84 inches (2134 mm) tall with padlock provision.
 - 6. Security Gate: Hinged gate at bottom of cage with padlock provision.
 - 7. Floor Brackets: Floor bracket at foot of each stringer, 3 by 2 by ¼ inch (76 by 51 by 6 mm).
 - 8. Finishes:
 - a) Finishes
 - 1. Powder Coated – Color by Architect

2.3 FABRICATION

- A. Completely fabricate ladder ready for installation before shipment to the site.
- B. Completely fabricate handrail components and ship to site ready for field assembly and attachment to ladder.

PART 3 EXECUTION

3.1 EXAMINATION

- A. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- B. Examine materials upon arrival at site. Notify the carrier and manufacturer of any damage.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.3 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

Move your mouse over image or click to enlarge



S-Anchor
WITH SWIVEL TOP.

Hover to zoom

Move your mouse over image or click to enlarge

Premium Swivel Top?	No Swivel NO SWIVEL W/SWIVEL TOP	Part #:
Worker Capacity Range	130-420 lbs.	00690
Material	Galvanized steel	
Min. Breaking Strength	5,000 lbs.	

Weight: 48 lb

ADD TO CART

+	1	-
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FULL DESCRIPTION

TECHNICAL DATA

DOWNLOADS

Part of our CB Anchor Series, the S-Anchor is perhaps one of the most proven fall protection anchors on the market. Intended for permanent applications, the S-Anchor is designed for either fall protection or suspension/tie-back work. The S-Anchor functions to extend through roofing so that it is accessible both during and after roof construction, and is composed of durable, galvanized steel. It is an excellent choice for fall protection or window washing applications!

Equal to:
GUARDIAN Fall Protection LLC
 KENT WA.
 1-800-466-6385

SAFETY PRODUCTS

Self-Retracting
 Lifelines
 Lanyards
 Anchor Points

CUSTOM ESG SYSTEMS

Custom Engineering Solutions

FIRST CHOICE TRAINING

Training Schedule

FALL PROTECTION RESOURCES

Fall Protection 101

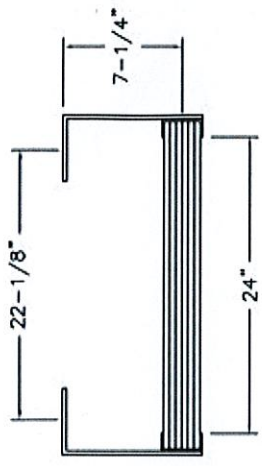
ABOUT GUARDIAN

Vision & Mission
 The Guardian Promise

BLOG

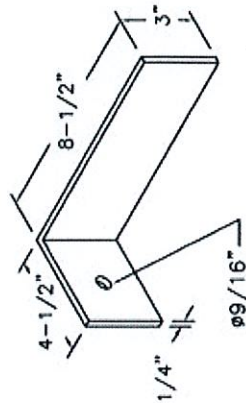
GF Team Blog
 Product Announcements
 Blog

FIXED LADDER WITH PARAPET PLATFORM & ROOFSIDE RETURN



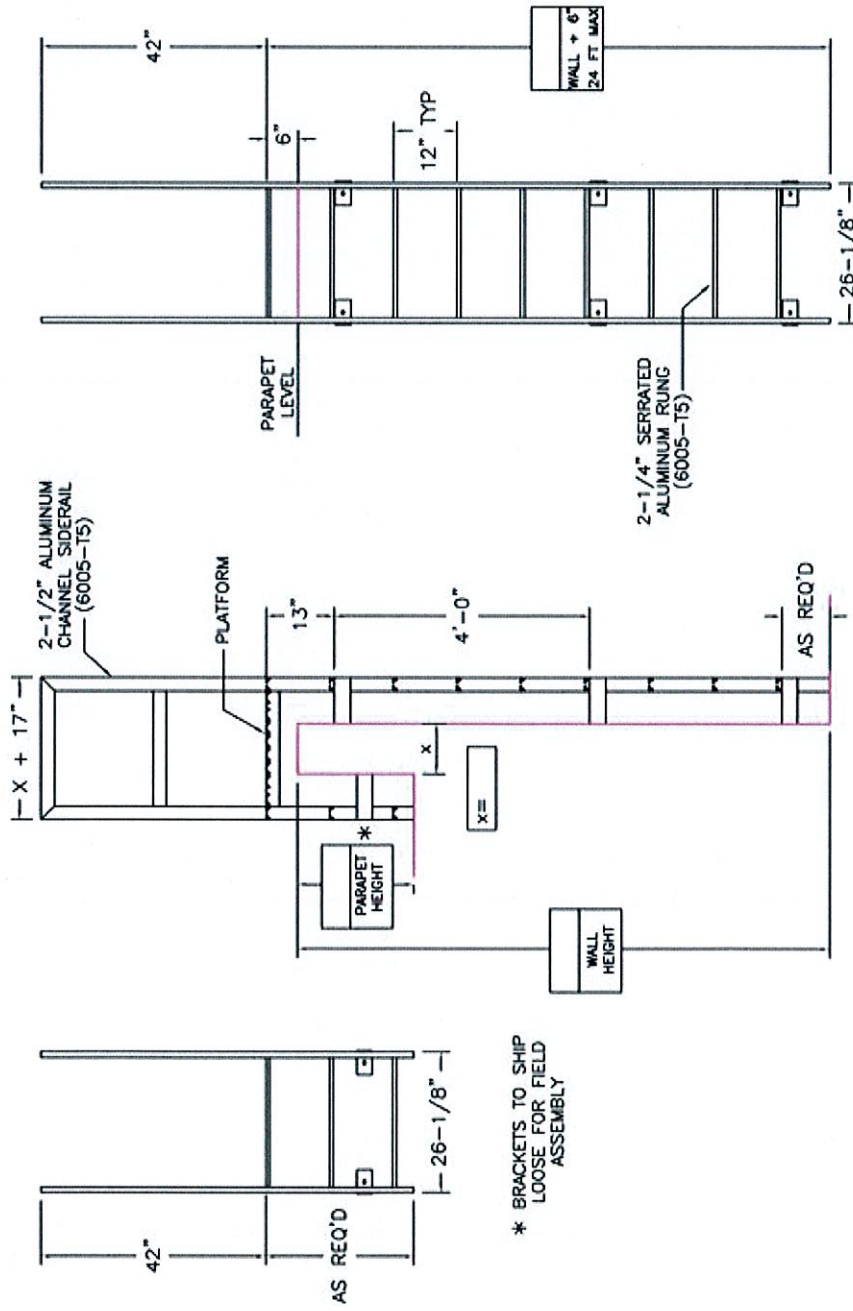
PLAN

(PARAPET PLATFORM & RETURN LADDER ARE OMITTED FOR CLARITY)



BRACKET DETAIL

NOTE:
ALL BOLTS/FASTENERS
NECESSARY TO ANCHOR
LADDER ARE BY OTHERS.



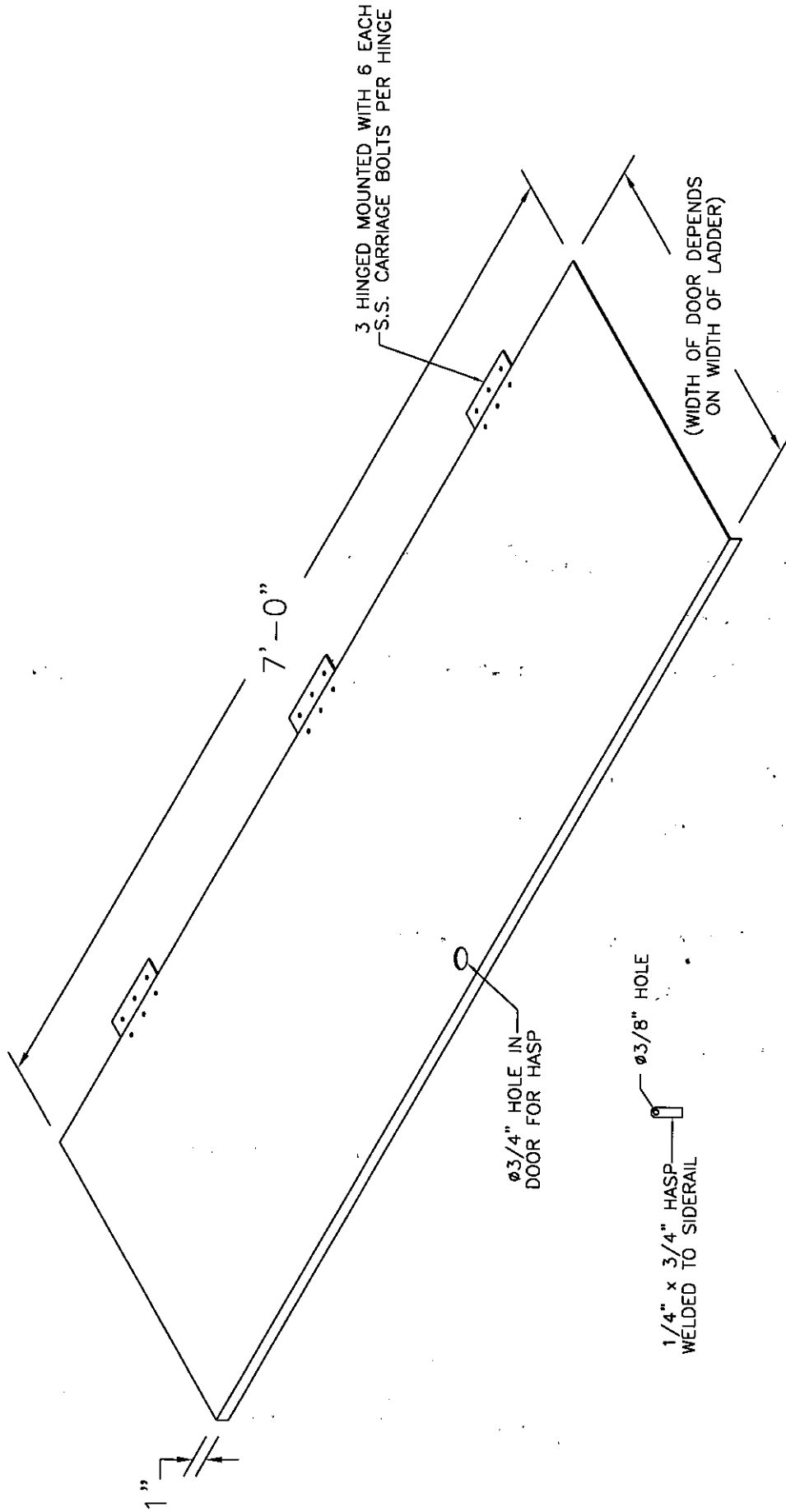
**FACTORY FINISH
ALUMINUM-MILL FINISH**
FL-06

LADDERS MANUFACTURED BY PRECISION LADDERS, LLC COMPLY WITH OSHA 1910.23 AND ANSI 14.3		INDIVIDUAL RUNG TESTED AT 3,000 LBS WITHOUT FAIL PROJECT		LADDER RATED AT 1,500 LBS PRECISION RFP	
ARCHT OR ENGR	PURCHASE ORDER	REVISION	PURCHASER	SERIAL#	
DWG. CHECK	DRAWN BY: DNH	DATE: 4/4/17	MODEL#	FL-	
BUILT BY:	CHECKED BY:	QTY.			
Precision Ladders, LLC P.O. BOX 2279 Morristown, TN 37816-2279 Ph: (423) 586-2265 Fax: (423) 586-2081 www.PrecisionLadders.com					

OR APPROVED EQUAL

ALUMINUM SECURITY DOOR

1/8" thick ALUMINUM



STANDARD-HINGED ON LEFT SIDE

FACTORY FINISH
ALUMINUM-MILL FINISH

NOT TO SCALE

SD-01

Precision Ladders, LLC
 P.O. BOX 2279 Morristown, TN 37816-2279
 Ph: (423) 586-2265 Fax: (423) 586-2091
 www.PrecisionLadders.com

DWG. CHECK		ARCHT OR ENGR.		PROJECT		PRECISION REP	
BUILT BY:	PURCHASE ORDER	REVISION	PURCHASER	DATE	MODEL#	SERIAL#	
CHECKED BY:	DRAWN BY: DNH	DATE	10/8/15	SECURITY DOOR		QTY.	

OR APPROVED EQUAL

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Plywood backing panels.
 - 2. Wood Blocking in walls.
 - 3. Miscellaneous Pressure Treated Wood Nailers/ Blocking.

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NHLA: National Hardwood Lumber Association.
 - 3. NLGA: National Lumber Grades Authority.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWSA: Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.
- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Fire-retardant-treated wood.
 2. Power-driven fasteners.
 3. Powder-actuated fasteners.
 4. Expansion anchors.
 5. Metal framing anchors.

1.5 QUALITY ASSURANCE

- A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
1. Dimension lumber framing.
 2. Miscellaneous lumber.
 3. Interior wood composite trim.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.

3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood).
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Use Exterior type for exterior locations and where indicated.
 3. Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
 4. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
 1. For exposed lumber indicated to receive a stained or natural finish, omit marking and provide certificates of treatment compliance issued by inspection agency.
- C. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.
- D. Application: Treat items indicated on Drawings, and the following:
 1. Concealed blocking.
 2. Roof construction.
 3. Plywood backing panels.
 4. Plywood Sheathing on Exterior Second Floor Porches.

2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 1. Blocking.
 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of any species.
- C. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content and any of the following species:
 1. SYP No. 2.
 2. Spruce-pine-fir (south).

- D. For exposed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine, No. 1 grade; SPIB.
- E. For concealed boards, provide lumber with 15 percent maximum moisture content and [any of]the following species and grades:
 - 1. Mixed southern pine, No. 2 grade; SPIB.
- F. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- G. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- H. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 INTERIOR WOOD TRIM

- A. General: Provide kiln-dried finished (surfaced) material without finger-jointing, unless otherwise indicated.
- B. Hardwood Lumber for Transparent (Stain or Clear) Finish: Grade A Finish Cherry Wood.

2.5 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.7 METAL FRAMING ANCHORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. Harlen Metal Products, Inc.
 - 3. KC Metals Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. Southeastern Metals Manufacturing Co., Inc.
 - 6. USP Structural Connectors.

2.8 MISCELLANEOUS MATERIALS

- A. Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to a high-density, polyethylene film to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preserved-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
- H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- I. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and

miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

1. Match color and grain pattern across joints.
2. Install trim after gypsum board joint-finishing operations are completed.
3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads and fill holes.
4. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.6-mm) maximum offset for reveal installation.

3.4 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 078100 - APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes SFRMs applied to surfaces that are concealed from view behind other construction when the Work is completed. All structural steel framing must be coated with applied fireproofing spray to meet the IBC protection requirements as shown on the Life Safety drawings. Fireproofing was omitted from some details for clarity.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show extent of sprayed fire-resistive material for each construction and fire-resistance rating, applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction, and minimum thicknesses.
- C. Product certificates.
- D. Compatibility and adhesion test reports.
- E. Research/evaluation reports.
- F. Field quality-control test and special inspection reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer approved by SFRM manufacturer to install manufacturer's products. A manufacturer's willingness to sell its SFRM to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.
- B. SFRM Testing: By a qualified testing and inspecting agency engaged by Contractor or manufacturer to test for compliance with specified requirements for performance and test methods.
 - 1. SFRMs are randomly selected for testing from bags bearing the applicable classification marking of UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Testing is performed on specimens of SFRMs that comply with laboratory testing requirements specified in Part 2 and are otherwise identical to installed fire-resistive materials, including application of accelerant, sealers, topcoats, tamping, troweling, rolling, and water overspray, if any of these are used in final application.

3. Testing is performed on specimens whose application the independent testing and inspecting agency witnessed during preparation and conditioning. Include in test reports a full description of preparation and conditioning of laboratory test specimens.
- C. Compatibility and Adhesion Testing: Engage a qualified testing and inspecting agency to test for compliance with requirements for specified performance and test methods.
1. Test for bond per ASTM E 736 and requirements in UL's "Fire Resistance Directory" for coating materials. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
 2. Verify that manufacturer, through its own laboratory testing or field experience, has not found primers or coatings to be incompatible with SFRM.
- D. Fire-Test-Response Characteristics: Where indicated, provide products identical to those tested for fire resistance per ASTM E 119 by a testing agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
 2. Identify products with appropriate markings of applicable testing and inspecting agency.
- E. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
- F. Mockups: Apply mockups to verify selections made under sample submittals and to set quality standards for materials and execution.
1. Extent of Mockups: Approximately 100 sq. ft. (9 sq. m) of surface for each product indicated.
- G. Preinstallation Conference: Conduct conference at Project site.

1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply SFRM when ambient or substrate temperature is 40 deg F (4 deg C) or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of SFRM. Use natural means or, if they are inadequate, forced-air circulation until fire-resistive material dries thoroughly.
- C. Sequence and coordinate application of SFRM with other related work specified in other Sections to comply with the following requirements:
1. Provide temporary enclosure as required to confine spraying operations and protect the environment.

2. Provide temporary enclosures for applications to prevent deterioration of fire-resistive material due to exposure to weather and to unfavorable ambient conditions for humidity, temperature, and ventilation.
3. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
4. Do not apply fire-resistive material to metal roof deck substrates until concrete topping, if any, has been completed. For metal roof decks without concrete topping, do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
5. Do not apply fire-resistive material to metal floor deck substrates until concrete topping has been completed.
6. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
7. Defer installing ducts, piping, and other items that would interfere with applying fire-resistive material until application of fire protection is completed.
8. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, and tested and corrections have been made to defective applications.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Contractor and by Installer, in which manufacturer agrees to repair or replace SFRMs that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Cracking, flaking, spalling, or eroding in excess of specified requirements; peeling; or delaminating of SFRM from substrates.
 - b. Not covered under the warranty are failures due to damage by occupants and Owner's maintenance personnel, exposure to environmental conditions other than those investigated and approved during fire-response testing, and other causes not reasonably foreseeable under conditions of normal use.
 2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCEALED SFRM

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Concealed Cementitious SFRM:
 - a. Carbolite Co., Fireproofing Products Div.; Pyrolite 15 High Yield.

- b. Grace, W. R. & Co. - Conn., Construction Products Div.; Monokote Type MK-6 MK-6/HY and MK-6s.
 - c. Isolatek International Corp.; Cafco 300.
 - d. Southwest Vermiculite Co., Inc.; Type 5.
 2. Concealed Sprayed-Fiber Fire-Resistive Material:
 - a. Isolatek International Corp.; Cafco Blaze-Shield II.
- B. Material Composition: Manufacturer's standard product, or either of the following:
 1. Concealed Cementitious SFRM: Factory-mixed, dry formulation of gypsum or portland cement binders, additives, and lightweight mineral or synthetic aggregates mixed with water at Project site to form a slurry or mortar for conveyance and application.
 2. Concealed Sprayed-Fiber Fire-Resistive Material: Factory-mixed, dry formulation of inorganic binders, mineral fibers, fillers, and additives conveyed in a dry state by pneumatic equipment and mixed with water at spray nozzle to form a damp, as-applied product.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property as follows:
 1. Dry Density: 15 lb/cu. ft. (240 kg/cu. m) for average and individual densities, or greater if required to attain fire-resistance ratings indicated, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
 2. Thickness: Minimum average thickness required for fire-resistance design indicated according to the following criteria, but not less than 0.375 inch (9 mm), per ASTM E 605:
 - a. Where the referenced fire-resistance design lists a thickness of 1 inch (25 mm) or more, the minimum allowable individual thickness of SFRM is the design thickness minus 0.25 inch (6 mm).
 - b. Where the referenced fire-resistance design lists a thickness of less than 1 inch (25 mm) but more than 0.375 inch (9 mm), the minimum allowable individual thickness of SFRM is the greater of 0.375 inch (9 mm) or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistance designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft. (240 kg/cu. m).
 3. Bond Strength: 150 lbf/sq. ft. (7.2 kPa) minimum per ASTM E 736 based on laboratory testing of 0.75-inch (19-mm) minimum thickness of SFRM.
 4. Compressive Strength: 5.21 lbf/sq. in. (35.9 kPa) minimum per ASTM E 761. Minimum thickness of SFRM tested shall be 0.75 inch (19 mm) and minimum dry density shall be as specified but not less than 15 lb/cu. ft. (240 kg/cu. m).
 5. Corrosion Resistance: No evidence of corrosion per ASTM E 937.
 6. Deflection: No cracking, spalling, or delamination per ASTM E 759.
 7. Effect of Impact on Bonding: No cracking, spalling, or delamination per ASTM E 760.

8. Air Erosion: Maximum weight loss of [0.025 g/sq. ft. (0.270 g/sq. m)] <Insert value> in 24 hours per ASTM E 859. For laboratory tests, minimum thickness of SFRM is 0.75 inch (19 mm), maximum dry density is 15 lb/cu. ft. (240 kg/cu. m), test specimens are not prepurged by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Fire-Test-Response Characteristics: Provide SFRM with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - a. Flame-Spread Index: 10 or less.
10. Fungal Resistance: No observed growth on specimens per ASTM G 21.

2.2 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with SFRM and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide primer that complies with one or more of the following requirements:
 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of SFRM per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of SFRM.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistance designs indicated and fire-resistive material manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive SFRM.
- E. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by manufacturer of SFRM.
- F. Sealer for Sprayed-Fiber Fire-Resistive Material: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by manufacturer of sprayed-fiber fire-resistive material.
 1. Product: Subject to compliance with requirements, provide "Cafco Bond-Seal" by Isolatak International Corp.
- G. Topcoat: Type recommended in writing by manufacturer of each SFRM.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of work. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, incompatible paints, incompatible encapsulants, or other foreign substances capable of impairing bond of fire-resistive materials with substrates under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
 - 5. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that concrete work on steel deck has been completed.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work are completed.
- D. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application.
- F. Clean substrates of substances that could impair bond of fire-resistive material, including dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, and incompatible primers, paints, and encapsulants.
- G. Prime substrates where recommended in writing by SFRM manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive SFRM.
- H. Install metal lath and reinforcing fabric, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath and fabric to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by SFRM manufacturer. Attach accessories where indicated or required for secure attachment of lath and fabric to substrate.
- I. Coat substrates with bonding adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by SFRM manufacturer for material and application indicated.

- J. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by SFRM manufacturer, install body of fire-resistive covering in a single course.
- K. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by SFRM manufacturer.
- L. Where sealers are used, apply products that are tinted to differentiate them from SFRM over which they are applied.
- M. Apply concealed SFRM in thicknesses and densities not less than those required to achieve fire-resistance ratings designated for each condition, but apply in greater thicknesses and densities if specified in Part 2 "Concealed SFRM" Article.
- N. Apply water overspray to concealed sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating.
- O. Cure concealed SFRM according to product manufacturer's written recommendations.
- P. Apply sealer to concealed SFRM where required.
- Q. Apply topcoat to concealed SFRM where required.
- R. Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- S. Repair or replace work that has not successfully protected steel.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Tests and Inspections: Testing and inspecting of completed applications of SFRM shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with application of SFRM for the next area until test results for previously completed applications of SFRM show compliance with requirements. Tested values must equal or exceed values indicated and required for approved fire-resistance design.
 - 1. Thickness for Floor, Roof, and Wall Assemblies: For each 1000-sq. ft. (93-sq. m) area, or partial area, on each floor, from the average of 4 measurements from a 144-sq. in. (0.093-sq. m) sample area, with sample width of not less than 6 inches (152 mm) per ASTM E 605.

2. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
3. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 605 or AWCI Technical Manual 12-A, Section 5.4.5, "Displacement Method."
4. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: For each 10,000-sq. ft. (929 sq. m) area, or partial area, on each floor, cohesion and adhesion from one sample of size indicated for determining thickness of each type of construction and structural framing member, per ASTM E 736.
 - a. Field test SFRM that is applied to flanges of wide-flange, structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
 - b. If surfaces of structural steel receiving SFRM are primed or otherwise painted for coating materials, perform series of bond tests specified in UL's "Fire Resistance Directory." Provide bond strength indicated in referenced UL fire-resistance criteria, but not less than 150 lbf/sq. ft. (7.2 kPa) minimum per ASTM E 736.
5. If testing finds applications of SFRM are not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
 - C. Remove and replace applications of SFRM that do not pass tests and inspections for cohesion and adhesion, for density, or for both and retest as specified above.
 - D. Apply additional SFRM, per manufacturer's written instructions, where test results indicate that thickness does not comply with specified requirements, and retest as specified above.

END OF SECTION 078100

SECTION 083323 FIRE-RATED OVERHEAD COILING DOOR

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coiling fire doors.

1.2 RELATED SECTIONS

- A. Section 05 50 00 - Metal Fabrications.
- B. Section 28 31 00 - Life Safety System.

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM) A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- B. American Society for Testing and Materials (ASTM) A 240 Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, Strips.

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Provide drawings indicating guide details, head and jamb conditions, spring shafts, anchorage, accessories, finish colors, patterns and textures, operator mounts and other related information.
 - 2. Regulatory Requirements and Approvals: Provide shop drawings in compliance with local Authority Having Jurisdiction (AHJ).
- D. Certifications:
 - 1. Submit manufacturer's certificate that products meet or exceed specified requirements.
 - 2. Submit installer qualifications.
- E. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, represent actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Utilize an installer having demonstrated experience on projects of similar size and complexity, and trained and authorized by the door dealer to perform the work of this section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Raynor, which is located at: 1101 East River Rd. P. O. Box 448 ; Dixon, IL 61021-0448; Toll Free Tel: 800-4-RAYNOR; Tel: 815-288-1431; Fax: 888-598-4790; Email: [request info](#); Web: www.raynor.com
- B. Approved Manufacturers: Overhead Door Company, C.H.I. Overhead Doors, Cookson Company, Wayne Dalton Company.
- C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.2 OVERHEAD COILING DOORS

- A. FireCoil as manufactured by Raynor Garage Doors: Basis of Specification
 1. Doors:
 - a. Operation:
 - 1) Provide doors designed for electric motor operation tied into the Fire Alarm System.
 - b. Drive Orientation: Orient the drive from the following side when facing the side of the door that has the counterbalance or hood exposed:
 - 1) Right-hand.
 - c. Mounting: Door guide mounting configuration.
 - 1) To face of wall on each side of door opening.
 - d. Jamb Construction:
 - 1) Steel jambs with self-tapping fasteners.
 - e. Fire Resistance Rating:
 - 1) 3/4-hour rating, listed by Factory Mutual (FM).
 2. Curtain: Interlocking roll-formed slats as specified below. Endlocks shall be attached to each of alternate slat to prevent lateral movement.
 - a. Slat Type(s):
 - 1) Flat slat 20 gauge steel (0.036 inch minimum thickness).

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- b. Material:
 - 1) Commercial quality hot-dipped galvanized (G-90) steel in accordance with ASTM A-653.
- c. Color and Finish:
 - 1) ArmorBrite Powdercoat finish.
 - a) Color: To be selected by Architect from manufacturer's standard color selection.
- 3. Endlocks: Zinc-plated malleable cast iron endlocks fastened with two zinc-plated steel rivets.
- 4. Bottom Bar: Two structural angles, minimum 2 inches by 2 inches by 3/16 inch (50.8 mm x 50.8 mm x 4.8 mm).
 - a. Material and finish:
 - 1) Structural steel angle bottom bar to receive one coat of ArmorBrite Powdercoat finish.
 - a) Color: To be selected by Architect from manufacturer's standard color selection.
- 5. Guide Assemblies: Three structural angles, minimum 3 inches by 2 inches by 3/16 inch (76 mm by 50.8 mm by 4.8 mm) and fitted with removable curtain stops.
 - a. Material and Finish:
 - 1) Structural steel to receive ArmorBrite Powdercoat finish.
 - a) Color: To be selected by Architect from manufacturer's standard color selection.
- 6. Guide Smoke Seals: Seals to inhibit smoke infiltration between the guide and the curtain.
 - 1) Brushseal with an aluminum retainer attached to the guide assembly.
- 7. Counterbalance:
 - a. Barrel: Minimum 4-1/2 inches (114.3 mm) O.D. and 0.120 inch (3.1 mm) wall thickness structural steel pipe. Deflection of pipe under full load shall not exceed 0.03 inch (0.8 mm) per foot of span.
 - b. Counterbalance: Provide counterbalance mechanism with helical torsion springs, grease packed and mounted on a continuous steel torsion shaft.
 - 1) Standard 10,000 cycles.
- 8. Brackets: 3/16 inch (4.8 mm), minimum, steel plate, attached to wall angle of guide assembly with 1/2 inch (12.7 mm) diameter class 5 case hardened bolts. Inside of drive bracket fitted with sealed ball bearing.
 - a. Finish:
 - 1) Provide brackets with one coat of ArmorBrite Powdercoat finish.
 - a) Color: To be selected by Architect from manufacturer's standard color selection.
- 9. Enclosures:
 - a. Hood Type:
 - 1) Square Hood.
 - b. Bracket Covers: Covers to enclose door mechanisms.
 - c. Material:
 - 1) 24 gauge steel (0.022 inch minimum thickness) commercial quality hot-dipped galvanized (G-60) steel in accordance with

ASTM A-653.

- d. Color and Finish:
 - 1) ArmorBrite Powdercoat finish.
 - a) Color: To be selected by Architect from manufacturer's standard color selection.
 - e. Flame Baffle: Provide flame baffle to comply with listing agency.
- 10. Automatic Closing Device: Automatic closing of rolling fire door under a fire condition to be initiated by the following:
 - a. Fire Alarm System.
- 11. Detection Type: Device used in conjunction with the automatic closing device type to initiate the automatic closing of a rolling fire door shall be the following:
 - a. Photoelectronic with heat sensor detector.
- 12. Header Smoke Seal: Provide a "Z" shape brushseal to inhibit smoke infiltration between the header and the curtain.
- 13. Locks: Furnish door system with the following:
 - a. Cylinder Lock for Motor Operated Doors: Provide interlock switch with cylinder lock.

2.3 ELECTRIC OPERATORS

- A. FireHoist as provided by Raynor Garage Doors:
 - 1. Model:
 - a. Raynor FSE model:
 - 1) Type: Jackshaft with automatic closure by fire alarm system. Allows automatic closing without loss of door spring tension thus allowing for ease of resetting of door after testing or alarm. Operates as a standard rolling door operator when not in a fire situation.
 - 2) Electrical Requirements: 115 volt single phase.
 - 3) Duty Cycle: Restricted duty cycles.
 - b. Control Wiring: 24 volt control with provisions for connection of a monitored reversing device.

PART 2 EXECUTION

2.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. Verify that site conditions are acceptable for installation of doors, operators, controls and accessories. Ensure that openings are square, flush and plumb.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

2.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving

the best result for the substrate under the project conditions.

2.3 INSTALLATION

- A. General: Install door, guides and operating equipment complete with all necessary accessories and hardware according to shop drawings, manufacturer's instructions.
- B. Lubricate bearings and sliding parts and adjust doors for proper operation, balance, clearance and similar requirements.

2.4 PROTECTION

- A. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance. Remove and legally dispose of construction debris from project site.
- B. Remove temporary coverings and protection of adjacent work areas. Repair or replace installed products damaged prior to or during installation.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Hardware for wood and hollow metal doors.
- B. Thresholds
- C. Weatherstripping.

1.2 REFERENCES

- A. ANSI A117.1 - Specifications for Making Buildings and Facilities Accessible to and Useable by Physically Handicapped People.
- B. ANSI/NFPA 80 - Fire Doors and Windows.
- C. AWI - Architectural Woodwork Institute.
- D. BHMA - Builder's Hardware Manufacturers Association.
- E. DHI - Door and Hardware Institute.
- F. NAAMM - National Association of Architectural Metal Manufacturers.
- G. NFPA 101 - Life Safety Code.
- H. SDI - Steel Door Institute.

1.3 COORDINATION

- A. Coordinate work of this Section with other directly affected Sections involving manufacturer of any internal reinforcement for door hardware.

1.4 QUALITY ASSURANCE

- A. Hardware Supplier: Company specializing in supplying commercial door hardware with three years documented experience. **Hardware supplier must be a direct distributor of all products furnished.**
- B. Hardware Supplier Personnel: Must have in full time employment a certified Architectural Hardware Consultant (AHC) to assist in the work of this Section.

1.5 REGULATORY REQUIREMENTS

- A. Conform to NFPA 80 code for requirements applicable to fire rated doors and frames.
- B. Conform to the applicable sections of Chapter 5 of NFPA 101.

1.6 CERTIFICATIONS

- A. Architectural Hardware Consultant shall provide hardware schedule and inspect complete installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions.
- B. Provide two copies of certifications to Architect.

1.7 SUBMITTALS

- A. Submit five copies of the schedule, shop drawings, and product data. All schedules shall be signed by an AHC who is employed full time by the finish hardware supplier.
- B. Provide product data on specified hardware.
- C. Submit manufacturer's parts lists, templates, and installation instructions.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site, store and handle as per manufacturer's recommendations.
- B. Package hardware items individually, label and identify package with door opening code to match hardware schedule.
- C. Protect hardware from theft by cataloging and storing in a secure area.

1.10 WARRANTY

- A. Provide one-year warranty from the Date of Substantial Completion, except door closers shall be warranted for ten years.

1.11 MAINTENENCE SUPPLIES

- A. Provide special wrenches and tools applicable to each different or special hardware component.
- B. Provide maintenance tools and accessories supplied by hardware component manufacturer.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Hinges:
 - Ives
 - McKinney
 - Hager

- B. Locks: Stanley Best 45H Series, 06H Design
Note: – No substitution allowed per Auburn University Standard
- C. Exit Devices: Von Duprin 98 Series – No substitution allowed per Auburn University Standard
- D. Closers: LCN 4000 Series – No substitution allowed per Auburn University Standard
- E. Flat Goods and Stops: Ives
Trimco
Rockwood
- F. Weather Stripping and Thresholds: Zero
National Guard
Pemko
- G. Continuous Gear Hinges: Ives
Select Products
Markar

G. All the above listed manufacturers and product numbers are those which are acceptable and approved for use on this project. Where allowed by the owner, substitute products will be considered provided that requests for substitution are made in writing to the Architect no less than 10 days prior to the original project bid date.

2.2 KEYING

- A. All lock cylinders shall be keyed into the owner's existing Best master key system. Permanent cores shall be Stanley Best 7-pin key removable core. Furnished brass temporary construction use cores for all locks. Match existing key ways. The general contractor shall be responsible for removal of construction use cores and for the install of permanent cores. Brass construction cores shall be returned to the door hardware supplier by the general contractor. General contractor shall reimburse hardware supplier for construction use cores not returned.
- B. Supply keys in the following quantities: (stamp all keys with key symbol)
 - 5 each - Master keys per group
 - 3 each - Cut keys per cylinder
 - 2 ea – control keys
 - 12 each - Construction Master keys
 - 2 each – construction control keys
- C. Permanent cores and keys are to be shipped directly to owner using certified mail.

2.3 FINISHES

- A. Finishes are identified in Schedule at end of this Section.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that doors and frames are ready to receive work and dimensions are as required.
- B. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and requirements of ANSI/NFPA 80, BHMA and DHI.
- B. Use the templates provided by hardware item manufacturer.
- C. Conform to ANSI A117.1 for positioning requirements for the handicapped.
- D. All door closers shall be installed away from the corridor side of door to the maximum extent possible.

3.3 HARDWARE SETS

HW SET: 001

DOOR #(S):
008B

EACH TO HAVE:

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	FIRE EXIT HARDWARE	98-L-F-06	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4041 DEL EDA	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 002

DOOR #(S):
104A-SGL

EACH TO HAVE:

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	PANIC HARDWARE	98-L-BE-06	626	VON
1	EA	SURFACE CLOSER	4041 DEL EDA	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 003 - CARD READER

DOOR #(S):
004A

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
1	EA	GASKETING	8144S-BK	S-BK	ZER
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	65A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
2	EA	WIRE HARNESS	CON-12P		VON
2	EA	WIRE HARNESS	CON-192P		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

MULLION REMOVABLE BY KEY.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. NO EXTERIOR TRIM. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR. DOGGING BY HEX KEY, LOCKS DOWN THE PUSHBAR OR CROSSBAR SO THE LATCHBOLT REMAINS RETRACTED.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. DOGGING BY HEX KEY, LOCKS DOWN THE PUSHBAR OR CROSSBAR SO THE LATCHBOLT REMAINS RETRACTED.

SELF-CLOSING. TEMPLATING ALLOWS SPRING CUSH ARM TO STOP THE DOOR'S SWING BETWEEN 85 AND 110 DEGREES. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 004 - CARD READER

DOOR #(S):
100A

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-DT-F-CON	626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-NL-F-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES

2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
1	EA	GASKETING	8144S-BK	S-BK	ZER
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	8655A-E-V3-226	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
2	EA	WIRE HARNESS	CON-12P		VON
2	EA	WIRE HARNESS	CON-192P		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

MULLION REMOVABLE BY KEY.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. DUMMY TRIM, ENTRANCE BY TRIM WHEN LATCHBOLT IS IN RETRACTED POSITION. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

SELF-CLOSING. TEMPLATING ALLOWS SPRING CUSH ARM TO STOP THE DOOR'S SWING BETWEEN 85 AND 110 DEGREES. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 005 - CARD READER

DOOR #(S):

104B-SGL

EACH TO HAVE:

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER
1	EA	GASKETING	475AA	AA	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	8655A-E-V3-226	A	ZER
1	EA	WIRE HARNESS	CON-12P		VON
1	EA	WIRE HARNESS	CON-192P		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL

CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR. SELF-CLOSING. TEMPLATING ALLOWS SPRING CUSH ARM TO STOP THE DOOR'S SWING BETWEEN 85 AND 110 DEGREES. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.
HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 006 - CARD READER

DOOR #(S):
100C

EACH TO HAVE:

1	EA	CONT. HINGE	224XY	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-NL-F-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-BK	ZER
1	EA	GASKETING	475AA	AA	ZER
1	EA	DOOR SWEEP	8192AA	AA	ZER
1	EA	THRESHOLD	8655A-E-V3-226	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	WIRE HARNESS	CON-12P		VON
1	EA	WIRE HARNESS	CON-192P		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR. SELF-CLOSING. TEMPLATING ALLOWS SPRING CUSH ARM TO STOP THE DOOR'S SWING BETWEEN 85 AND 110 DEGREES. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.
HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 007 - CARD READER

DOOR #(S):
008A

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION	KR4954	689	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-DT-F-CON	626	VON
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-NL-F-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
2	EA	ARMOR PLATE	8400 36" X 1 1/2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S-BK	S-BK	ZER
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	8655A-E-V3-226	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
2	EA	WIRE HARNESS	CON-12P		VON
2	EA	WIRE HARNESS	CON-192P		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

MULLION REMOVABLE BY KEY.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. DUMMY TRIM, ENTRANCE BY TRIM WHEN LATCHBOLT IS IN RETRACTED POSITION. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

SELF-CLOSING. TEMPLATING ALLOWS SPRING CUSH ARM TO STOP THE DOOR'S SWING BETWEEN 85 AND 110 DEGREES. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 008

DOOR #(S):

100B 104B.1 104C

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
1	EA	KEYED REMOVABLE MULLION	KR4954	689	VON
2	EA	FIRE EXIT HARDWARE	98-L-F-06	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
2	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
2	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE

1	EA	MULLION SEAL	8780N	N	ZER
2	EA	SILENCER	SR64	GRY	IVE

HW SET: 009 - CARD READER

DOOR #(S):

002A

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	1461 DEL EDA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	WIRE HARNESS	CON-12P		VON
1	EA	WIRE HARNESS	CON-192P		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR. SELF-CLOSING.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 010

DOOR #(S):

005A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	STOREROOM	45H7D 15H	626	BES
1	EA	SURFACE CLOSER	1461 DEL EDA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 011 - CARD READER

DOOR #(S):

009A

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELECTRONIC LOCK	45HM7DEU15MS IDH MAX	626	BES
1	EA	SURFACE CLOSER	1461 DEL EDA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

LOCK POWER SUPPLY PROVIDED BY ACCESS CONTROL VENDOR.

HW SET: 012 - CARD READER

DOOR #(S):

012A

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELECTRONIC LOCK	45HM7DEU15MS IDH MAX	626	BES
1	EA	SURFACE CLOSER	1461 DEL FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

LOCK POWER SUPPLY PROVIDED BY ACCESS CONTROL VENDOR.

HW SET: 013

DOOR #(S):

101B 101C 102A 108 109

EACH TO HAVE:

6	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	DEADLOCK	48H7K	626	BES
2	EA	PUSH PLATE	8200 4" X 16"	630	IVE
2	EA	PULL PLATE	8303 8" 4" X 16"	630	IVE
2	EA	SURFACE CLOSER	1461 DEL SHCUSH FC TBSRT	689	LCN
2	EA	ARMOR PLATE	8400 36" X 1 1/2" LDW B-CS	630	IVE
2	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

HW SET: 014 - CARD READER

DOOR #(S):

016A

EACH TO HAVE:

3	EA	HW HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	ELEC FIRE EXIT HARDWARE	RX-LC-EL-98-NL-F-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	SURFACE CLOSER	1461 DEL EDA FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE
1	EA	WIRE HARNESS	CON-12P		VON
1	EA	WIRE HARNESS	CON-192P		VON
1	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY	CARD READER LNL-2010W	BLK	LSI

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

SELF-CLOSING.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: 015

DOOR #(S):

009B 101A

EACH TO HAVE:

ALL HARDWARE PROVIDED BY DOOR SUPPLIER

HW SET: 016

DOOR #(S):

010A 011A 014A 015A

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE	45H7A 15H	626	BES
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 6" X 2" LDW B-CS	630	IVE

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08710-11

1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 017

DOOR #(S):
101

EACH TO HAVE:

EXISTING HARDWARE TO BE RE-USED

HW SET: 018

DOOR #(S):
104D 110 114

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE	45H7A 15H	626	BES
1	EA	SURFACE CLOSER	1461 DEL REG OR PA AS REQ FC TBSRT	689	LCN
1	EA	KICK PLATE	8400 6" X 1" LDW B-CS	630	IVE
1	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS401/402CCV	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HW SET: 019 - STC RATED DOORS

DOOR #(S):
103

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ENTRANCE	45H7A 15H	626	BES
1	EA	WALL STOP	WS401/402CCV	626	IVE
1			SEALS BY DOOR SUPPLIER		

HW SET: 020 - STC RATED DOORS

DOOR #(S):
102 105A 105B

EACH TO HAVE:

3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	CLASSROOM	45H7R 15H	626	BES
1	EA	WALL STOP	WS401/402CCV	626	IVE
1			SEALS BY DOOR SUPPLIER		

HW SET: 021

DOOR #(S):

104A.1

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
2	EA	FIRE EXIT HARDWARE	9827-L-F-LBR-06-499F	626	VON
2	EA	RIM CYLINDER	1E72	626	BES
2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
2	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1			SEALS BY DOOR SUPPLIER		

COORDINATE HARDWARE WITH DOOR MFG TO MAINTAIN STC RATING.

HW SET: 022 - NEW HOLLOW METAL DOORS X EXISTING HOLLOW METAL FRAME

DOOR #(S):

105

EACH TO HAVE:

2	EA	CONT. HINGE	224XY	628	IVE
1	EA	KEYED REMOVABLE MULLION KR4954		689	VON
1	EA	PANIC HARDWARE	98-EO	626	VON
1	EA	PANIC HARDWARE	98-NL	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	SURFACE CLOSER	4041 DEL SCUSH	689	LCN
2	EA	KICK PLATE	8400 8" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	8144S-BK	S-BK	ZER
1	EA	MULLION SEAL	8780N	N	ZER
1	EA	MEETING STILE	328AA	AA	ZER
2	EA	DOOR SWEEP	8198AA	AA	ZER
1	EA	THRESHOLD	560A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER

HARDWARE SUPPLIER TO PROVIDE PRIME PAINTED STEEL HINGE FILLERS FOR USE WITH EXISTING FRAME HINGE PREPARATIONS. FIELD VERIFY EXISTING HINGE SIZES.

HW SET: AL-01 - CARD READER

DOOR #(S):

BDS/2010-128

08710-13

EACH TO HAVE:

2	EA	CONT. HINGE	112XY	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION KR4954		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-NL-OP-110MD-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES
2	EA	90 DEG OFFSET PULL	8190HD 12" O	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4041 DEL TBSRT (TOP JAMB MOUNT)	689	LCN
2	EA	FLUSH CEILING MTG PLT	4040-18G	689	LCN
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	381A	A	ZER
1	EA	THRESHOLD	546A-E-226	A	ZER
2	EA	WIRE HARNESS	CON-12P		VON
2	EA	WIRE HARNESS	CON-192P		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY CARD READER LNL-2010W		BLK	LSI
1		SEALS BY DOOR SUPPLIER			

MULLION REMOVABLE BY KEY.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. NO EXTERIOR TRIM. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY OPTIONAL TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

SELF-CLOSING. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

HW SET: AL-02 - CARD READER AND ADA OPERATOR

DOOR #(S):

001A 103A

EACH TO HAVE:

2	EA	CONT. HINGE	112XY	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	KEYED REMOVABLE MULLION KR4954		689	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-EL-98-NL-OP-110MD-CON	626	VON
1	EA	RIM CYLINDER	1E72	626	BES
1	EA	MORTISE CYLINDER	1E74	626	BES

2	EA	90 DEG OFFSET PULL	8190HD 12" O	630	IVE
2	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4041 DEL TBSRT (TOP JAMB MOUNT)	689	LCN
1	EA	SURF. AUTO OPERATOR	4642 WMS	689	LCN
1	EA	FLUSH CEILNG MTG PLT	4040-18G	689	LCN
2	EA	ACTUATOR	I36-3'	US32D	WIK
1	EA	MULLION SEAL	8780N	N	ZER
2	EA	DOOR SWEEP	381A	A	ZER
1	EA	THRESHOLD	546A-E-226	A	ZER
2	EA	WIRE HARNESS	CON-12P		VON
2	EA	WIRE HARNESS	CON-192P		VON
2	EA	WIRE HARNESS	CON-6W		VON
1	EA	MULTITECH READER	MT11	BLK	SCE
1	EA	POWER SUPPLY	PS914 900-4RL	LGR	VON
1	EA	ELECTRONIC ACCESSORY CARD READER LNL-2010W		BLK	LSI
1			SEALS BY DOOR SUPPLIER		

MULLION REMOVABLE BY KEY.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. NO EXTERIOR TRIM. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

FREE EGRESS AT ALL TIMES. PRESSING PUSH BAR RETRACTS LATCHBOLTS. TRIM ALWAYS LOCKED, ENTRANCE BY OPTIONAL TRIM WHEN KEY RETRACTS LATCHBOLT FROM PULL SIDE. CONTROL CONTACT ELECTRICALLY RETRACTS THE LATCHBOLT, EITHER FOR MOMENTARY UNLATCHING, OR FOR EXTENDED PERIODS OF TIME. ONE INTERNAL SPDT SWITCH MONITORS THE DEPRESSION OF THE PUSHBAR OR CROSSBAR.

SELF-CLOSING. DELAYS CLOSING FROM MAXIMUM OPENING TO APPROXIMATELY 70 DEGREES. 1 MINUTE MAXIMUM DELAY TIME.

DUAL CARD READERS AT THIS OPENING FOR ADA HANDICAP ACCESS.

ACCESS CONTROL INTEGRATOR TO COORDINATE AUTO OPERATOR FUNCTION WITH CARD ACCESS AND ELECTRIC LOCKING.

HARNESS WITH CONNECTORS AND PINS.

HARNESS WITH CONNECTORS AND STRIPPED LEADS.

END OF SECTION

SECTION 329200 LANDSCAPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground covers.
 - 4. Plants.
 - 5. Lawns.
 - 6. Topsoil and soil amendments.
 - 7. Fertilizers and mulches.
 - 8. Stakes and guys.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 2 Section "Site Clearing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.
 - 2. Division 2 Section "Earthwork" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.
- C. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.
 - 1. Analysis of imported topsoil.
- D. Planting schedule indicating anticipated dates and locations for each type of planting.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- B. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
- C. Topsoil Analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for growth of applicable planting material. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce satisfactory topsoil.
- D. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees up to 4-inch caliper size, and 12 inches above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Sod: Harvest, deliver, store, and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing."
- C. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.
 - 1. Immediately after digging bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- D. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
 - 1. Heel-in bare-root stock. Soak roots in water for 2 hours if dried out.

2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.6 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

1.8 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
 1. Trees.
 2. Shrubs.
 3. Ground covers.
 4. Plants.
- C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.
- D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

1.9 TREE AND SHRUB MAINTENANCE

- A. Maintain trees and shrubs by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings. Maintain trees and shrubs for the following period:

- 1. Maintenance Period: 30 days following Substantial Completion.

1.10 GROUND COVER AND PLANT MAINTENANCE

- A. Maintain ground cover and plants by watering, weeding, fertilizing, and other operations as required to establish healthy, viable plantings for the following period:

- 1. Maintenance Period: 30 days following Substantial Completion.

1.11 LAWN MAINTENANCE

- A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:

- 1. Sodded Lawns: 30 days after date of Substantial Completion.

- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn.

- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches.

- 1. Water lawn at the minimum rate of 1 inch per week.

- D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

- E. Postfertilization: Apply fertilizer to lawn after first mowing and when grass is dry.

- 1. Use fertilizer that will provide actual nitrogen of at least 1 lb per 1000 sq. ft. of lawn area.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.
- D. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

2.2 SHADE AND FLOWERING TREES (If Indicated on Landscape Plan)

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required.
 - 1. Branching Height: 1/3 to 1/2 of tree height.
- B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as follows:
 - 1. Form: Single stem.
 - 2. Form: Multistem, clump, with 3 or more main stems.
- C. Provide container-grown trees.
- D. Provide balled and burlapped trees dug with firm, natural ball of earth in which they were grown.

2.3 DECIDUOUS SHRUBS(If Indicated on Landscape Plan)

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
- B. Provide container grown deciduous shrubs.

2.4 CONIFEROUS EVERGREENS(If Indicated on Landscape Plan)

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.
- B. Form and Size: Specimen-quality, exceptionally heavy, tightly knit, symmetrically shaped coniferous evergreens.

- C. Provide container grown coniferous evergreens.
- D. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS(If Indicated on Landscape Plan)

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.
- B. Provide container grown broadleaf evergreens.

2.6 GROUND COVERS AND PLANTS

- A. Provide ground covers and plants established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.

2.7 GRASS MATERIALS

- A. Sod: Certified turfgrass sod complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, and mowed height, and free of weeds and undesirable native grasses. Provide viable sod of uniform density, color, and texture of the following turfgrass species, strongly rooted, and capable of vigorous growth and development when planted.
 - 1. Species: 419 Bermuda.

2.8 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 inch or larger in any dimension, and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 inches deep; do not obtain from bogs or marshes.

2.9 SOIL AMENDMENTS

- A. Lime: ASTM C 602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 percent passing a No. 60 sieve. Apply to lawn areas at a rate of 50 pounds per 1,000 square feet.
 - 1. Provide lime in the form of dolomitic limestone.
- B. Aluminum Sulfate: Commercial grade, unadulterated.
- C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.

- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
- F. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
- G. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
 - 1. When site treated, mix with at least 0.15 lb of ammonium nitrate or 0.25 lb of ammonium sulfate per cu. ft. of loose sawdust or ground bark.
- H. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- I. Herbicides: EPA registered and approved, of type recommended by manufacturer.
- J. Water: Potable.

2.10 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Apply to sod areas at a rate of 3-5 pounds per 1,000 square feet or greater if recommended in Soils Report.
- D. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency. Apply to landscape planting areas at recommended rate.

2.11 MULCHES

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of the following:

- 1. Type: Shredded bark (dark in color).

2.12 WEED-CONTROL BARRIERS

- A. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz. Per sq. yd. minimum.

2.13 STAKES AND GUYS

- A. Anchors: Aluminum-alloy triangular arrowhead anchors (4 inches by 3-3/4 inches) with 1/2 inch by 3/4 inch round opening at top.
- B. Guy Lines: Flat woven, UV resistant, 3/8 inch by 15 feet polypropylene guy line with 600-pound break strength.
- C. Tension Bar: Adjustable tension bar with round openings at each end.

2.14 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, and secure Architect's acceptance before the start of planting work. Make minor adjustments as may be required.

3.3 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.

- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.
 - 1. A "Planting Soil Amendments Schedule" for landscape planting areas is included at the end of this Section.
- C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 - 1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
 - 2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

3.4 SOD PLANTING PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 4 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.
- C. Spread topsoil to minimum of 4" depth and as required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
 - 1. Place approximately 1/2 the thickness of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
 - 2. Allow for sod thickness in areas to be sodded.
- D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
 - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 - 2. Till surface soil to a depth of at least 6 inches. Apply required 4" topsoil and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 - 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
 - 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Grade sod areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations.

- F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

3.5 GROUND COVER AND PLANT BED PREPARATION

- A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous materials.
- B. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
- C. Till soil in beds to a minimum depth of 8 inches and mix with specified soil amendments and fertilizers.
- D. Remove soil to a minimum depth of 8 inches and replace with prepared planting soil mixture.

3.6 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation.
 - 1. Bare-Root Trees: Excavate at least 12 inches wider than root spread and deep enough to allow setting of roots on a layer of planting soil and with collar set at same grade as in nursery, but 1 inch below finish grade, unless otherwise indicated.
 - a. Setting Layer: Allow 6 inches of planting soil.
 - 2. Container-Grown Trees and Shrubs: Excavate to container width and depth, plus the following setting-layer depth:
 - a. Setting Layer: Allow 6 inches of planting soil.
 - 3. Balled and Burlapped Trees: Excavate approximately 1½ times as wide as ball diameter and equal to ball depth, plus the following setting layer depth:
 - a. Setting layer: Allow 6 inches of planting soil.
- B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch diameter holes into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

3.7 PLANTING TREES AND SHRUBS

- A. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 1. Carefully remove containers so as not to damage root balls.
 2. Place stock on setting layer of compacted planting soil.
 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- B. Set bare-root stock on cushion of planting soil. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots. Remove injured roots by cutting cleanly; do not break.
 1. Set collar 1 inch below adjacent finish grades, unless otherwise indicated.
- C. Set balled and burlapped stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
 1. Place stock on setting layer of compacted planting soil.
 2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- D. Dish and tamp top of backfill to form a 3-inch- high mound around the rim of the pit. Do not cover top of root ball with backfill.

3.8 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Architect, do not cut tree leaders;

remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

3.9 TREE AND SHRUB GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2-inch through 4-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip-out. Use a minimum of 3 arrowhead anchors to penetrate at least 12-inches to 18-inches below bottom of backfilled excavation. Set anchors and space to avoid penetrating balls or root masses. Support trees with 3 strands of guy line wrapped around the tree trunk just above the lowest established branch. Secure each guy line through a tension bar (one per guy line) and pull taut for any slack. Allow enough slack to avoid rigid restraint of tree.
- B. Guying and Staking: Guy and anchor trees exceeding 14 feet and more than 3-inch caliper unless otherwise indicated. Securely install no fewer than 3 anchors and 3 guy lines pulled taut through 3 tension bars.

3.10 PLANTING GROUND COVER AND PLANTS

- A. Space ground cover and plants as indicated.
- B. Space ground cover and plants not more than 24 inches apart.
- C. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

3.11 MULCHING

- A. Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.
- B. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
 - 1. Thickness: 3 inches.

3.12 SODDING

- A. Lay sod within 24 hours of stripping. Do not lay sod if dormant or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

- C. Saturate sod with fine water spray within 2 hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below the sod.

3.13 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 - 1. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

3.14 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

3.16 PLANTING SOIL AMENDMENTS SCHEDULE

- A. Tree Pits or Trenches: Provide soil amendments in not less than the following quantities:
 - 1. Ratio of loose peat humus to topsoil by volume: 75% Topsoil – 25% Peat or other approved organic material.
- B. Ground Cover and Planting Beds: Provide soil amendments in not less than the following quantities:
 - 1. Ratio of loose peat humus to topsoil by volume: 75% Topsoil – 25% Peat or other approved organic material.

END OF LANDSCAPING

SECTION 21 11 00 - FIRE PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This section describes the basic materials and installation methods for the fire protection system. Comply with other Division 22 & 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- B. Furnish and install all components of the fire protection system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.02 DESCRIPTION OF WORK

- A. Work Included: Provide a complete fire protection sprinkler system, including pipe, tube fittings, and appurtenances as indicated, in compliance with these Specifications and as required by local code agencies. The system shall serve the new addition per the plans and shall tie into existing fire protection systems within the building.
- B. Applications: Application of the fire protection system shall include, but are not limited to, the systems as listed below:
 - 1. Supply mains, valves, risers, and drains.
 - 2. Flow switches.
 - 3. Hydraulically designed sprinkler system.
- C. Quality Assurance:
 - 1. Materials shall be installed in accordance with NFPA 13(2007). Valves, fittings, sprinkler heads, and equipment shall be UL listed and FM approved
 - 2. Coordination Drawings: The following supplements, and does not replace, the provisions for submittals called for in Section 23 01 00, "Basic Mechanical Requirements", of this Specification.
 - a. Before starting fabrication or installation of equipment, the Contractor shall submit to Architect, for his consideration, three sets of Shop Drawings noted as reviewed by the Owners Insurance Company for insurance rate making purposes only.
 - b. After Contract award and prior to releasing any equipment orders for fabrication, six sets of Shop Drawings showing dimensions, weights, performance data, structural details, and physical appearance of fire pump, jockey pump, valves, and controls shall be submitted to the Architect for review and approval.
 - 3. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications:
 - a. Sprinkler Equipment
 - 1) Viking Corporation
 - 2) Tyco Fire Protection Products
 - 3) Victaulic Corporation
 - 4) Reliable Automatic Sprinkler Company

- D. Pipe Hangers and Supports: Support fire protection pipe with UL-listed and FM approved hangers and support devices. Provide any special hangers or supports that may be required. The design, selection, spacing, and application of horizontal pipe hangers, supports, restraints, anchors, and guides shall be in accordance with the NFPA 13 .
- E. Sprinkler System:
1. Install a sprinkler system throughout the Lounge addition.
 2. Completely sprinkler the building addition as noted on the plans.
 3. System piping shall be hydraulically designed throughout areas in accordance with the rules and regulations of NFPA 13, using design densities of:
 - a. Light hazard areas: 0.10 gpm per 1,500 square feet with maximum Sprinkler head spacing of 225 square feet per sprinkler head.
 - b. All ordinary hazard group I: 0.15 gpm per 1,500 square feet with maximum sprinkler head spacing of 130 square feet.
 4. Cross main pipe sizes shall be a minimum of 2" diameter for loop systems and 2 1/2" for single main (non-loop) systems. Generally, provide coverage at the rate required by NFPA and applicable state and local codes and the contract documents.
 5. Sprinkler heads, valves, alarms, and similar items shall be as manufactured by Viking, TYCO, or other approved manufacturer. Sprinkler heads shall be plain brass, up-right type in unfinished areas and concealed pendent sprinklers in areas with ceilings. Material and equipment used in the installation of the sprinkler systems and standpipes shall be listed and approved by the Underwriters' Laboratories, Inc., and shall be the latest design of the manufacturer.
- F. Valves: Valves shall be UL-listed and FM approved for the pressures at which they are installed.
1. Check valves shall be swing type with iron body, bronze trim, cast iron disc, bolted cover, and screwed or flanged ends. Check valves in the pump discharge may be spring loaded, quiet type, and shall be UL-listed and FM approved. Swing check valves may be installed in horizontal pipe only.
 2. Gate valves 2" and smaller shall be bronze body, OS&Y, and screwed ends. 150 psig valves shall have bronze trim, single disc, screwed bonnet, and bronze seats. 300 and 400 psig valves shall have bronze wedge disc, union bonnet, and bronze body seat rings.
 3. Gate valves over 2" shall be iron body, OS&Y, bolted bonnet, bronze seats, ANSI 16.1, flanged ends. 150 psig valves shall have double or single disc, and bronze trim. 300 and 400 psig valves shall have wedge disc and brass stem.
 4. Butterfly valves 2" and larger shall be grooved type. Furnish with built-in supervisory switches.
 5. Supervised valves shall include valve tamper switches. Valve tamper switches shall be double-pole single-throw type with cast aluminum housing and tamperproof cover. Switch rating shall be at least 7 amperes at 125/250 volts.

PART 2 - PRODUCTS

2.01 PIPING

- A. Pipe: Standpipe and sprinkler piping shall be ASTM A135, Schedule 40 black steel for pipe sizes 2" and smaller. Thin-wall pipe (schedule 10), ASTM A135, may be

used for sprinkler piping larger than 2". All code approvals shall be secured before shop drawing submittal to Architect.

- B. Fittings: Fittings shall be cast iron threaded sprinkler fittings ANSI B16.4 or grooved ends fittings joined by grooved couplings Victaulic Firelock or equal or welded fittings, ANSI B16.9. Flanges shall be screwed or welded neck type ANSI B16.5.

2.02 EQUIPMENT

- A. Water Flow Switch: Include water flow switch, with adjustable retard feature in supply pipe to each floor of each riser for remote alarm. Switch shall be double-pole single-throw type and shall be rated at least 7 amperes at 125/250 volts.
- B. Sight Flow Connection: Sight flow connection in test lines.
- C. Sprinkler Heads: Brass up-right or pendant heads as required with ordinary temperature rating, except in specially designated areas of high-temperature where heads shall be rated per NFPA 13. Heads in areas with ceilings shall be concealed pendent with flat cover plate installed at finished ceiling height. Verify color of sprinkler cover plate with Architect. Pendent heads exposed to weather or freezing conditions shall be dry pendant type. Furnish spare heads equal to 1% of total number of heads installed. The heads shall be representative of, and in proportion to, the number of each type and temperature rating of heads installed. Furnish spare head cabinet and wrench for each riser. Locate cabinets as directed by Architect.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPING SYSTEMS

- A. General: Comply with the requirements of the piping section of this Specification, NFPA 13 and NFPA 14 for installation and testing of piping system and per local code.
 - 1. Piping shall be concealed, except in mechanical equipment rooms, stairwells, or where otherwise required.
 - 2. Grade piping to eliminate traps and pockets. Where air pockets or water traps cannot be avoided, provide hose bibs for drainage.
 - 3. The Sprinkler Contractor shall arrange with the General Contractor to notch or pre-drill the occasional beam in order to maintain the sprinkler mains as high as possible.
 - 4. All required sprinkler heads shall be individually dropped from the main to the ceiling. Provide each drop with a horizontal swing arm type branch run to allow future movement of the head.
 - 5. All sprinkler heads in areas to be finished shall be installed at finished ceiling height only where the ceiling is to be installed at this time such as elevator lobbies and restrooms. In future tenant spaces, install upright heads at a maximum of 100 square feet per sprinkler head, pending development of the areas. Also, in future tenant spaces, a 1" outlet shall be provided with a temporary 1" nipple and 1" x 1/2" reducer and a temporary sprinkler head. Coordinate locations to ensure sprinkler heads are centered in ceiling tiles.

6. Sprinkler piping shall be installed and coordinated with the duct and other mechanical and electrical services in the ceiling cavities by this Contractor, to provide the clearances for lighting fixtures as required.
 7. Sprinkler piping shall be installed so as not to impede access to mechanical, electrical, or plumbing equipment.
 8. Refer to Section 22 05 53, "Identification for Piping" for painting, nameplates, and labeling requirements. Painting is not part of this contract scope unless otherwise specified within the contract documents.
 9. Sprinkler piping shall be flushed to remove excess oils and contaminants that support the growth of microorganisms.
 10. Sprinkler systems shall not be drained/flushed on finished surfaces such as sidewalks and parking lots.
 11. Install a ½" Weld-o-let with plug in the main sprinkler line, on the down stream side (building side) of the flow switch for introduction of micro biocides by the Owner at a later date.
- B. Protection during Construction: Provide necessary fire protection during construction and initial occupancy in accordance with NFPA and Local Codes. Provide active sprinkler systems in areas requiring sprinklers during this period before tenant finish-out. If specifically approved for this Project by the local inspector, this Contractor may install active sprinklers only in areas designated as storage areas, in public areas to be finished with the base building, mechanical spaces, and limited other areas required by the inspector during construction. Coordinate these areas with the General Contractor.
- C. Inspections and Tests: All inspections, examinations, and tests required by the authorities and/or agencies specified hereinbefore shall be arranged and paid for by this Contractor, as necessary, to obtain complete and final acceptance of the system as installed. The certificates of inspection shall be in quadruplicate, and shall be delivered to the Architect for distribution.
- D. Underground Fire Protection Piping: Material for pipe cushion shall comply with local codes and or the geo-technical report. In absence of local code requirements or geo-technical report, the cushion shall be bank sand or select backfill material approved by the Architect. Any material used shall pass a one-inch screen.

END OF SECTION 21 11 00

22 01 00 - GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide the necessary interface with other Divisions to provide a complete project. Carefully check the Documents of this Division with those Documents of other Divisions. Determine the requirements of any interfacing materials or equipment being furnished and/or installed by those Sections and Divisions, and provide proper installation and required interface.
- B. No deviation from the Contract Documents shall be made without the written consent of the Architect and Engineer.
- C. All Specifications and Drawings are to be considered together as the Contract Documents. Any work shown in one and not the other, or is implied by either, shall be provided to make a complete project. Should conflicts exist between the Specifications and Drawings or there is an item shown or noted for which is not clearly defined, immediately submit a request for clarification. Under no circumstance will conflicts between the Specifications and Drawings be grounds for additional cost to the Contract after the Contract is established.
- D. The Drawings are schematic and are not intended to show the exact location of piping, equipment, etc.
- E. Dimensions and information regarding accurate locations of equipment, and structural limitations and finish shall be coordinated and verified with other Divisions of Work. Be prepared to furnish dimensions and information regarding the Work of this Division to other trades.
- F. The right is reserved to relocate any device (receptacle, switch, fire alarm, audio/visual, junction box, outlet, etc.) a maximum of 10'-0" before it is permanently installed without incurring additional cost to the Contract.

1.2 REFERENCE STANDARDS

- A. All work shall comply with the most recently revised versions of all local, state and federal codes, ordinances of the authority having jurisdiction, laws, rules and regulations. Any modifications required by any of the above shall be made without any additional cost to the Owner. Where requirements between governing Codes and Regulations vary, the more restrictive provision shall apply.
- B. Nothing contained in the Contract Documents shall be construed as authority or permission to disregard legal requirements and regulations. The Contractor shall thoroughly review the Documents and bring any such conflicts to the attention of the Architect and Engineer prior to Installation.
- C. All materials, installation, and workmanship shall comply standards and/or codes of the following:
 - 1. International Building Code – 2015 edition
 - 2. International Mechanical Code - 2015 edition

3. International Plumbing Code - 2015 edition
4. International Fuel Gas Code - 2015 edition
5. International Fire Prevention Code – 2015 edition
6. ASHRAE Standard 90.1 – Energy Standard – 2010 Edition
7. National Electrical Code
8. National Fire Protection Association
9. ANSI - American National Standards Institute
10. ASTM - American Society of Testing and Materials
11. NEMA - National Electrical Manufacturer's Association
12. OSHA - Occupational Safety and Health Act
13. UL - Underwriter's Laboratories
14. ASHRAE - American Society of Heating and Air Conditioning Engineers
15. SMACNA - Sheet Metal and Air Conditioning Contractors' Nat'l Assoc.

D. All materials shall be new and shall bear the label of UL.

1.3 EXISTING CONDITIONS

- A. Where work is to be performed in an existing facility, the contractor shall visit the site prior to bid and be familiar with all existing conditions. Special attention shall be given to work to be performed above an existing ceiling.
- B. Where existing slabs are to be cut or core drilled, the contractor shall x-ray the existing slabs to avoid cutting or disrupting existing conduits, cables, plumbing or structural members.
- C. HVAC systems, plumbing systems, and electrical service to the building shall not be interrupted without written consent of the building owner.
- D. No allowance will be made for lack of knowledge of existing conditions.
- E. At the completion of the project, all work under this Division shall be completely integrated with the existing systems and left in perfect operating condition.
- F. Where work under this Division disrupts the continuity of any existing to remain electrical circuit or feeder, the Contractor shall repair/replace as necessary to return to a perfectly functional and safe operating condition.
- G. Prior to any demolition or construction the Contractor shall have the existing conditions inspected by an EPA, OSHA certified asbestos abatement agency to identify the presence of asbestos. Should any asbestos be found it shall be brought to the immediate attention of the Architect and Owner and specifically identified in writing.

1.4 DEFINITIONS

- A. Provide: to furnish, install and connect.
- B. Furnish: to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
- C. Install: to join, unite, fasten, link, attach, set-up or connect together, complete, tested, and ready for normal satisfactory operation.
- D. Engineer: the Engineer of record.

- E. Contract Documents: the complete set of Specifications and Drawings of all Divisions.
- F. Work: labor, materials, equipment, accessories, controls and other items required for a complete installation.
- G. Concealed: embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.
- H. Exposed: not installed underground or concealed.
- I. Equal: equal in quality, workmanship, materials, weight, size, design and efficiency of the specified product, conforming with manufacturers.
- J. Supply: to purchase, procure, acquire and deliver complete with related accessories.
- K. Authority Having Jurisdiction (AHJ): applicable local, state and federal authorities having jurisdiction over any part of the Scope within this Division and other Divisions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's names and catalog numbers specified in the Contract Documents are intended to describe the material and set the standard of quality. All bids shall be based on material specified. Request for approval of material not specified shall be considered if the request is in written form and submitted to the Architect no later than fourteen (14) days prior to the bid date. All requests shall conform to the provisions of the general and supplementary conditions.
- B. When specific names are not stated, only the best available quality of material or equipment shall be submitted for review and used in the installation.

2.2 BASIS OF DESIGN

- A. Where a product is designated as "BASIS OF DESIGN", the Contractor is notified that mechanical, electrical, structural, architectural, space conditions and/or other features of the overall project design have been based on the requirements of the "BASIS OF DESIGN" product.
- B. Where a product is substituted for a "BASIS OF DESIGN" product, the Contractor is notified that changes in project design may be mandatory in order to permit use and installation of the substitute product. Shop drawing submittal for a substitute product shall include a complete schedule of changes in project design, if any, which must be made in order to permit use and installation of the substitute product. The Contractor shall bear all expenses related to the use of a substitute product.

2.3 SHOP DRAWINGS AND PRODUCT DATA

- A. The Contractor shall obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all Division 22 Subcontractors, for all materials and equipment as specified herein in various Sections of the Specifications, and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the shop drawings, product data and samples to the

- Architect and Engineer, the Contractor shall thoroughly review the shop drawings, product data and samples and certify they are in compliance with the Contract Drawings. Further, the Contractor shall check all materials and equipment upon their arrival on the Project site and verify their condition and compliance with the Contract Documents. Any Work which proceeds prior to receiving reviewed shop drawings shall be modified as required to comply with the Contract Documents and the shop drawings. A minimum period of ten (10) working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or sample is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his Work. The initial shop drawing review for equipment and materials may be expedited through the mutual consent of the Contractor, Architect, Engineer, and Owner providing the Contractor agrees to submit complete, certified, documented, and coordinated shop drawings for review in accordance with the requirements of the Contract Documents.
- B. The review of shop drawings, product data, and samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions or errors that may be contained therein, or for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error.
- C. All shop drawings and product data/submittals shall be submitted in compliance with the requirements of the general and supplementary conditions. No more than four (4) copies of submittal data will be reviewed. Any additional copies will be returned unmarked. The responsibility of copying review comments on any additional copies will rest solely with the Contractor.
- D. All product data/submittals shall bear the name of the manufacturer to be used.
- E. All shop drawings and submittals shall include a stamped indication signifying that the submittal has been reviewed for compliance with the Contract Documents by the Contractor. This stamped indication also represents the fact that the Contractor has checked this submittal for its interaction with all other Divisions and certifies by his signature or initials that all coordination has taken place. The stamp shall include the date, name of the Contracting Firm, the signature of the Contractor, certification of compliance and approval. This stamp shall be on the submittal before the Engineer will review it.
- F. The Engineer will review an individual submittal not more than twice. If the submittal is rejected again on the second review, the Contractor will bare all responsibility for paying for the Engineer's time for additional reviews. Such payments to the Engineer shall be withheld from the next monthly pay application.
- G. Shop drawings and/or product data shall be submitted for the following for review:
1. Plumbing piping system layouts. These drawings must include associated equipment, drawn to scale based on submittals for that equipment, must be dimensioned, and must include piping and equipment elevation tags (distance above finished floor to bottom).
The Contractor is encouraged to develop their own shop drawings, without having had the Engineer's CAD files (as previously stated, the Engineer's drawings are schematic/diagrammatic in nature). Should the Contractor insist on using the Engineer's CAD files in the procurement of shop drawings, the Contractor must pay the Engineer \$150.00 per sheet for the CAD files.

The Contractor shall give the Engineer a written release, acceptable to the Engineer, signed by a corporate officer of the Contractor. This release shall also include a copyright statement indicating that these drawings or electronic data contained will not be used on any other project. The release and payment for the files must be received PRIOR to delivery of the CAD files.

2. Equipment, including but not limited to: water heaters, plumbing fixtures, booster systems, lift stations, heat tracing, insulation, piping specialties, etc

2.4 AS-BUILT DRAWINGS

- A. The Contractor shall maintain on a daily basis at the Project site a complete set of "Record Drawings". The "Record Drawings" shall consist of a set of black-line or blue-line prints or AutoCAD files of the Contractor Coordination Drawings for this Division. The prints shall be marked or the AutoCAD file electronically updated to show the precise location of all work and equipment, and all changes and deviations in the work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite instructions from the Architect or Engineer. The continuously updated coordination drawings (shop drawings previously described) shall be used to produce the final "Record Drawings" which shall be delivered to the Owner in AutoCAD electronic format (CD) upon Project completion.
- B. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitably identified by at least two dimensions to permanent structures.
- C. The Contractor and Subcontractor shall mark all "Record Drawings" on the drawings with a rubber stamp impression or an AutoCAD image that states such.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with the Code requirements and the requirements of the local Authorities having jurisdiction, and the equipment manufacturer's recommendations.
- B. In the preparation of Drawings, a reasonable effort to accommodate acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with the Contractor.
- C. Physical dimensions and arrangements of equipment to be installed shall be subject to the Architect's and Engineer's review.
- D. The General Contractor and all Subcontractors shall coordinate the installation of ductwork, conduit, busway, piping, cable trays, etc., installation with lighting fixtures, special ceiling construction, air distribution equipment, and the structure. Provide additional rises, drops and offsets as required. If after installed, new ductwork, conduit, busway, piping or cable is found to be in conflict with the architecture, structure, or other trade Work which is either existing or shown on the Contract Documents, the ductwork, conduit, busway, piping or cable shall be relocated without additional cost to the Owner.

- E. Accessibility and Clearance:
 - 1. Piping, etc. shall be installed in accessible locations, avoiding obstructions, preserving headroom, and keeping openings and passageways clear.
 - 2. Minor adjustments in the locations of equipment shall be made where necessary, providing such adjustments do not adversely affect functioning of the equipment.
- F. Scaffolds and staging for installation of plumbing work shall be provided under the work of this Division.

3.2 STRUCTURAL FITTINGS

- A. Furnish and install the necessary sleeves, inserts, hangers, anchor bolts, and related structural items. Install at the proper time.
- B. Openings may have been indicated on the Architectural and Structural drawings. Should any additional openings or holes be required, the same shall be provided at no additional cost to the Owner.
- C. Location: At a time in advance of the work, verify openings shown on the Architectural and Structural drawings, and coordinate any additional openings.
- D. If the work of this Section requires modification of the Architectural or Structural drawings, furnish new instructions as to requirements for these openings. Submit for review and coordination to Architect.
- E. Sleeves shall be supplied for mechanical piping passing through walls or slabs and shall be placed before concrete is poured.
- F. Equipment supports for mechanical work shall be fastened to the structure by inserts, anchor bolts, bolting to drilled and tapped structural members, or be welded to the structure.
 - 1. Welding shall be done by the electric arc method with fully competent welders. Supporting members shall be shop coated with a suitable primer.
 - 2. Surfaces damaged by installation of supports shall be touched up with primer to match shop coat. Any drilling of structural members shall be approved by the Architect.
- G. Flashing:
 - 1. Wherever piping passes through the roof or outer walls, base flashing and counter-flashing shall be provided.
 - 2. Such flashing shall be properly installed by skilled workmen, and shall include grouting, mastic or tar application, or other means to insure a permanent, waterproof, neat and workmanlike installation.
 - 3. Insofar as possible, flashing shall comply with and be similar to requirements for flashing in General Construction Work.
- H. Anchor bolts and inserts shall be galvanized and of adequate size and strength for installation of electrical work and shall be placed in forms before concrete is poured.

1. Placement of bolts in bases shall be done under other Division. Furnish detail drawings, templates, and anchor bolts for bases to the General Contractor in time to avoid delaying work schedules.
 2. Expansion shields shall only be used with specific approval of the Architect. Wooden or soft metal plugs shall not be used.
- I. Cutting and patching:
1. All additional cutting, patching and reinforcement of construction of building, subject to review by the Architect, shall be performed under this Section.
 2. Refer to appropriate Division for requirements.

3.3 WEATHERPROOF EQUIPMENT

- A. Plumbing devices or equipment located in damp, semi-exposed areas shall be weather-resistant. Enclosures shall comply with NEMA Type 3R requirements.
- B. Air distribution devices located in damp areas outside shall be weather-resistant (aluminum, etc.).

3.4 CLEANING

- A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
- B. Painted exposed work soiled or damaged: Clean and repair to match adjoining work before final acceptance.
- C. Remove dust and debris from inside and outside of material and equipment.

3.5 TESTS AND DEMONSTRATIONS

- A. All systems shall be tested in the presence of the Owner or an Owner designated representative upon completion of the Work and demonstrates that the installation is in accordance with the Contract Documents.
- B. All motors shall be checked and adjusted for correct direction of rotation.
- C. Any work found not to be in compliance with the Contract documents shall be repaired or replaced without incurring additional cost to the Contract price.
- D. Provide all instruction to the Owner on maintenance and operation of all systems and equipment provided under this Division.

3.6 WARRANTIES

- A. The warranty period for all systems, equipment, components, work, etc. shall be no less than one (1) year, unless specified otherwise hereinafter and shall include at least one (1) full heating season and one (1) full cooling season. The warranty shall include parts and labor.
- B. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such work done and charge all costs to the Contractor.

- C. The start of the Contractor's warranty period, as defined in the General Conditions, shall commence on the issue of a "Certificate of Substantial Completion", by the Owner or the Owner's Representative for each item of material, equipment or system.
- D. The Subcontractor shall confer with the General Contractor prior to the bid date concerning the project schedule and determine if there is a need to operate any items of equipment or systems for temporary heating and/or cooling or other reasons prior to "Substantial Completion". All required extended warranty costs for equipment, materials, and systems shall be included in the Subcontractor's bid.

END OF SECTION

22 05 29 - HANGERS & SUPPORTS FOR PLUMBING PIPING & EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and applicable requirements of Division 1, “General Requirements”, and Section 22 01 00 “General Plumbing Requirements”, govern this Section.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide pipe hangers, supports, and required appurtenances as specified and indicated

1.3 QUALITY ASSURANCE

- A. MSS Standard Compliance: Provide pipe hangers and supports of materials, design, and manufacture which comply with ANSI/MSS SP-58, SP-59, SP-89, and SP-90.
- B. Acceptable Manufacturers: The model numbers listed in the Specification establish a level of quality and material. Subject to compliance with requirements, provide products and materials by the following:
 - 1. ITT Grinnell Corporation,
 - 2. Fee and Mason,
 - 3. Central Iron Manufacturing Company, and
 - 4. F& S Manufacturing Company
 - 5. Anvil International
 - 6. B-Line

PART 2 – PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS:

- A. General: Provide pipe hangers and supports as specified. Comply with local codes and standards for pipe and equipment support and anchorage. Pipe supports shall be of material that will prevent electrolytic action.
- B. Inserts: Provide Grinnell No. 282 inserts for concrete construction.
- C. Piping in Multiple Parallel Runs: Provide Grinnell No. 45 or No. 50 with Grinnell No. 137 U-bolt pipe clamps or structural channels or angles with U-bolt clamps, supported as trapeze hangers where multiple parallel runs of piping are shown. Select and size members for weights to be carried and span dimensions between supports.
- D. Piping in Single Runs: Provide Fee and Mason Fig. 239 or Grinnell No. 260 clevis hanger.
- E. Hanger Rod: Provide hanger rods of required length. Rod diameters shall be as listed in the following table. Rod diameters may be adjusted after consultation with the Structural Engineer concerning the building framing system, the method of attachment to the structure and the support rod spacing.

<u>Pipe Sizes</u>	<u>Rod Diameter</u>
3/4" - 2"	3/8"
2-1/2" – 3	1/2"
4" – 5	5/8"
6"	3/4"
8" – 12"	7/8"
14" – 18"	1"

- F. Riser Clamps: Provide Fee and Mason Figure 241 riser clamps. Riser clamps for copper tube shall be copper-plated.
- G. Saddles and Shields:
1. Saddles for Horizontal Insulated Piping without Vapor Barrier: At each hanger or support on horizontal runs, provide Grinnell No. 160 or Fee and Mason Figure 171, 1710, 1712, or 172 saddles, as applicable. Shields as described below may be used instead of the saddles. On heating water systems below 140°F (60°C), hangers may be sized for the pipe size and of a material compatible with the pipe. Where dissimilar materials are used, provide dielectric separation. Carry insulation over the hanger and seal where hanger is sized for pipe.
 2. Shields for Horizontal Insulated Water Piping with Vapor Barrier: At each hanger or support for water piping, provide a half section of preformed 6 PCF density fiberglass or rigid calcium silicate, with jacket of adjacent insulation brought across unbroken, supported on semicircular 16 gauge shields. Shields for pipe 4" and smaller shall be 12" long; shields for pipe 5" to 8" shall be 18" long; and shields for larger pipe shall be 24" long.
- H. Piping on Roof: Roof mounted pipe supports are discouraged. If roof supports are necessary, installation methods must be approved by the architect, engineer, general contractor, and the Roofing Contractor.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Independent Support: Support fire sprinkler and standpipe piping independently of other piping in accordance with NFPA-approved methods and local codes and standards.
- B. Provisions for Movement:
1. Movement: Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends, and similar units.
 2. Load Distribution: Install hangers and supports so piping live and dead loading stresses from movement will not be transmitted to any pipe or connected equipment. Pipe supports shall properly transmit the weight of the pipe and its contents to the building structure, or to independent posts, piers, or foundations.
 3. Pipe Slopes: Install hangers and supports to provide the indicated pipe slopes so maximum pipe deflections allowed by ANSI B31 are not exceeded.
- C. Insulated Piping: Comply with the following installation requirements:

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through the insulation; do not exceed pipe stresses allowed by ANSI B31.
 2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold, chilled, or heating water piping, install coated protective shields. For pipe 8" and over, install rigid calcium silicate insulation between saddles and pipe.
- D. Spacing: Install hangers and supports in piping systems to remove stress from equipment flanges and rotating equipment. Space hangers and supports as shown in the following table. Rod spacing may be adjusted after consultation with the Structural Engineer concerning the building framing system, the method of attachment to the structure and the support rod diameters.

<u>Trade Pipe Size</u>	<u>Maximum Spacing</u>
1/2"	5'
3/4"	6'
1" and 1-1/4"	7'
1-1/2"	9'
2"	10'
2-1/2"	11'
3"	12'
4"	14'
5"	16'
6"	17'
8"	19'
10"	22'
12"	23'
14"	25'
16"	27'
18"	28'

- E. Saddles: Where insulation without vapor barrier is indicated, install protection saddles, or use hangers as indicated in Paragraph 2.0/H.1.
- F. Guides: Install pipe guides complying with the manufacturer's published product literature. Where not otherwise indicated, install pipe guides near expansion loops, expansion joints, and ball joints.
- G. Anchors: Install anchors at the proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment. Anchors shall include vibration isolation in accordance with the pipe support system specified. Where the piping system is floating, the anchors shall be termed restraints or braces.
1. Where expansion compensators are indicated, install anchors in accordance with the expansion unit manufacturers written instructions, to limit movement of piping and forces to the maximums recommended by the manufacturer of each unit.
 2. Where not otherwise indicated, install anchors at the ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required accommodating both expansion and contraction of piping.

- H. Leveling: Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.
- I. Hangers: Refer to Section 23 05 48, "Vibration Isolation", for additional information and support requirements. Pipe hangers made of wood, wire, or sheet iron shall not be permitted.
- J. Riser Supports: Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents.
 - 1. Cast iron soil pipe shall be supported at the base and at each story level, but in no case at intervals greater than 10'.
 - 2. Steel pipe shall be supported at the base and at no less than every other story level, but in no case at intervals greater than 25'.
 - 3. Copper tube shall be supported at each story level, but in no case at intervals greater than 10'.
 - 4. Plastic pipe shall be supported at mid point between floors and at ceiling to prevent movement, but in no case at intervals greater than 8'.

END OF SECTION

22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

1.0 GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 22 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the identification of equipment and piping. Comply with other Division 15 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the identification of equipment and piping specified herein and/or as indicated on the drawings.

1.2 DESCRIPTION OF WORK

- A. Work Included: Identification of plumbing equipment shall consist of equipment labeling, pipe marking, and valve tagging as specified hereinafter.
 - 1. In general, all equipment shall be labeled. This shall include all central plant, air handling or air conditioning equipment, and other similar and miscellaneous equipment.
 - 2. Pipe markings shall be applied to all piping.
 - 3. Each valve shall be identified with a stamped tag. Valves and tagging shall be scheduled typewritten on 8 1/2" x 11" paper, tabulating valve number, piping system, system abbreviation, location of valve (Room or area), and service (e.g. – 2nd Floor North Domestic Hot Water). The valve schedule shall be submitted to the Engineer for approval prior to ordering or installing valve tags.
 - 4. Labels, tags, and markers shall comply with ANSI A13.1 and other applicable state and local standards for lettering size, colors, and length of color field.
 - 5. Equipment and device identification specified in other sections shall be provided as a part of those requirements.

1.3 ACCEPTABLE MANUFACTURERS

- A. Labels, markings, and tags shall be manufactured by W.H. Brady, Seton, Allen, or Industrial Safety Supply.

2.0 PRODUCTS

2.1 EQUIPMENT LABELING

- A. Equipment labeling shall be one of the following, unless noted or specified otherwise:
 - 1. Permanently attached engraved brass or plastic laminated signs with 1" high lettering. Signs on exterior equipment shall be brass.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.2 PIPE MARKINGS

- A. On piping less than 6" diameter, install plastic semi-rigid snap-on type, manufacturer's standard pre-printed color-coded pipe markers extending fully around the pipe and insulation or pressure-sensitive vinyl pipe markers similar to the above. Pipe markings can also be applied with the stick type backing in lieu of the semi-rigid snap-on-type.
- B. On piping and insulation 6" and greater diameter, full band as specified above or strip-type markers fastened to the pipe or insulation with laminated or bonded application or by color-coded plastic tape not less than 1 ½" wide, full circle at both ends of the marker. Pipe markings can also be applied with the stick type backing in lieu of the semi-rigid snap-on-type.
- C. Arrows for direction of flow provided integral with the pipe marker or separate at each marker.

2.3 VALVE TAGS

- A. Valve tags shall be polished brass or plastic laminate with solid brass S hook and chain. Tags shall be stamped or engraved with the appropriate abbreviation for the type of service (e.g. – CHW, HW), as well as the designated valve number.
- B. A valve schedule is to be provided to the Owner. For each page of valve schedules, a glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

3.0 EXECUTION

3.1 GENERAL

- A. Identification labeling, marking, and tagging shall be applied after insulation and painting has been completed.
- B. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified, or scheduled on drawings. Prior to ordering any labels, markings, or tags, obtain the approval of the Engineer regarding names, abbreviations, etc.
- C. The Plumbing, HVAC, and Fire Protection Contractors shall coordinate labeling, marking, and tagging to ensure consistent and coordinated identification. In existing buildings, utilize similar names, abbreviations, and other designations that are currently in use to remain consistent with existing identification.
- D. Equipment labeling shall consist of unit designation as shown on the drawings. Exhaust fan labeling shall also indicate service or the room or area of service.
- E. Pipe and ductwork markers shall be placed on piping and ductwork on 25' centers in mechanical rooms and concealed spaces. In locations where piping and ductwork is exposed, place markers on 50' centers. Flow directional arrows should be marked on the piping at taps from the main and riser.

- F. Valve tags shall be placed on each valve except those intended for isolation of individual heat pumps or terminal units (e.g. - VAV boxes, fan coil units, unit heaters, etc.). Valve tag schedules shall be prepared as specified hereinbefore. Copies of one schedule shall be laminated in clear plastic and placed where directed by the Owner. Other sets shall be included in the Operating and Maintenance Manuals.

END OF SECTION

22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 22 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the insulation of Plumbing piping and equipment. Comply with other Division 22 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the insulation system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.1 QUALITY ASSURANCE

- A. Manufacturer: Approved manufacturers are Armstrong, Calsite, Cell-U-Foam Corp, Ceelco, Certainteed Corp, Dow Chemical Company, Forrest Mfg Co, Foster / Chilers, Gemco, Johns Manville, Knauf Fiberglass, Midwest Fastners, Owens Corning Fiberglass, Pittsburg Corning Fiberglass, Rubatex, Trymer, and Venture Tape.
- B. All insulation, jacket and adhesive shall have a fire and smoke hazard ratings as tested under ASTM E 84, NFPA 255, and UL 723 not exceeding:

Flame Spread:	25
Fuel Contributed:	50
Smoke Developed:	50

Exceptions: Type B Insulation and PVC Fitting Covers

1.2 SUBMITTALS

- A. Per Section 22 01 00.
- B. Product Data
 - 1. Type A Insulation
 - 2. Type B Insulation
 - 3. Type C Insulation
 - 4. Type D Insulation
 - 5. Type E Insulation
 - 6. Type F Insulation
 - 7. Type G Insulation
 - 8. Vinyl Lacquer Paint for Type B Insulation
 - 9. Metal Jacket

1.3 DEFINITIONS

- A. The phrase "Storm Drainage Conductor" refers to that portion of the storm drain interior to the building, between the roof drain body and where the pipe goes below grade.

- B. The word “plenum” shall mean a ceiling space or mechanical room used for the transfer of conditioned return and/or outside air.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Type A – Fiberglass (indoor)
 - 1. One Piece glass fiber, rigid molded sectional pipe covering with factory applied aluminum foil and white craft paper flame retardant vapor barrier jacket, conforming to ASTM C547, Class II, Mineral Fiber Preformed Pipe Insulation.
 - 2. Thermal Conductivity (k) equals approximately 0.23 (BTU/HR., SF., Degree F, IN) at 75 °F.
 - 3. Similar to Johns Manville Corp “Micro Lox 650 AP T”, or approved equal.
- B. Type B - Closed Cell (indoor)
 - 1. Closed cell, flexible foamed plastic conforming to ASTM C534, "Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form." Insulation shall be suitable for a temperature range from –40 degrees F to 220 degrees F.
 - 2. Conductivity (k) equals approximately 0.27 (BTUHR., SF., Degree F, IN) at 75 °F.
 - 3. Similar to Armstrong “Armaflex”, or approved equal.
- C. Type C – Polyisocyanurate (outdoor)
 - 1. Prefabricated 2 lb./cu.ft. density polyisocyanurate insulation with waterproof mastic and glass fiber jacket finished with an aluminum jacket with waterproof silicone caulk joints.
 - 2. Conductivity (k) equals approximately 0.14 (BTUHR., SF., degrees F, IN) at 75 °F.
 - 3. Insulation shall be applied per manufacturer’s recommendations. Joint sealants and coatings shall be as approved by the insulation manufacturer for the intended application and service temperature range.
 - 4. Jacketing shall be an all service jacket with 1 mm aluminum foil on pipe insulation and FSK jacket on board stock applied by the manufacturer to ASTM C-1136. Jacket shall have integral flap for sealing joint.
 - 5. Similar to Trymer 9501, or approved equal.
- D. Type Da – Cellular glass
 - 1. Cellular glass shall comply with ASTM C 552.

2.2 EQUIPMENT INSULATION

- A. Type Dh - Fiberglass Board (Hot Equipment)
 - 1. Semi-rigid intermediate service fibrous glass board for operating temperatures greater than 850 degrees F.
 - 2. Conductivity (k) equals approximately 0.23 (BTU/HR., SF., degrees F, IN) at 75 °F. Minimum density of 2.75 lb / cu ft.
 - 3. Similar to Johns Manville Corp “1000 series Spin Glass”, or approved equal.

2.3 METAL JACKET

- A. Smooth aluminum jacket 0.016 inch thick.
- B. Integral polykraft or poly-surlyn moisture barrier.

- C. Banded locking joints with field applied silicone weatherproof sealant.
- D. Similar to Johns Manville Corp, or approved equal.

2.4 INSULATION ACCESSORIES

- A. The following accessories shall be used in the application of the thermal insulations specified under this Section:
 - 1. PVC Fittings Covers: similar to Johns Manville Corp “Zeston”, or approved equal.
 - 2. Pressure Sensitive polyester film tape to secure pipe insulation up to 12” outside diameter: Similar to 3M 30-80, or approved equal.
 - 3. Vapor Seal Mastic: Similar to Childers CP-35, or approved equal.
 - 4. Lagging Adhesive: Similar to Childers CP-52, or approved equal.
 - 5. Wire: 16 gauge soft stainless steel.
 - 6. Insulation Bonding Adhesive (To Metal): Similar to Childers CP-82, or approved equal.
 - 7. Insulating and Finishing Cement: Similar to Insulco Smooth Kote, or approved equal.
 - 8. Mechanical Fasteners - Welded or adhered pins with speed clip washers: Similar to Gemco Midwest Fasteners, or approved equal.
 - 9. Bands for Equipment:
 - a. Outside diameter of insulation is less than 24 inch: 1/2 inch x 0.020-inch (25 ga.) stainless steel.
 - b. Where diameter is 36 inches or larger: 3/4 inch x 0.020 inch.
 - 10. Bands for Piping: 1/2 inch x 0.020-inch stainless steel.
 - 11. Wire Mesh: 1 inch by 20-gage stainless steel hexagonal wire netting.

PART 3 - EXECUTION

3.1 INSULATION APPLICABILITY

- A. Condensate Drains (except in plenums and fire partitions/floors) – Type B insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1/2	all

- B. Condensate Drains (inside plenums and fire partitions/floors) – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1/2	up to 1
3/4	1-1/4 and up

- C. Horizontal storm leaders, roof drain bodies, and underside of drains receiving condensate from cooling coils – Type F insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
2	all

- D. Horizontal waste piping from electric water coolers – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1/2	all

E. Domestic Cold Water – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
3/4	up to 1-1/4"
1	1-1/2 and up

F. Domestic Hot Water and Tempered Water – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1	up to 1-1/4"
1-1/5	1-1/2 and up

G. Hot equipment – Type Dh insulation required, minimum 2". Consult with equipment manufacturer as thickness may vary depending on service application and equipment manufacturer installation recommendations.

Notes:

- a. The above thicknesses are the minimum required. All local codes and local energy codes shall be complied with.
- b. All piping exposed to outdoors shall be insulated. All piping subject to freezing shall be provided with heat tracing. Coordinate insulation with heat trace cable and controls.
- c. Insulation types and thickness are a minimum standard. Each application shall be carefully considered and insulation product type and thickness shall be appropriate for each specific application. Submit all insulation products with verification of their service intent.

3.2 PIPING INSULATION GENERAL REQUIREMENTS

A. Preparation

1. Do not apply insulation until piping has been leak tested.
2. All surfaces to be insulated shall be dry and free of loose scale, rust, dirt, oil or water.

B. Application:

1. Insulation shall be installed in a smooth, clean workmanlike manner. Joints shall be tight and finished smooth without fish-mouths.
2. Insulation shall fit tightly against the surface to which it is applied to prevent air circulation between the insulation and the pipe or equipment to which it is applied.
3. Insulation applied to cold piping or equipment shall be completely vapor sealed, free of pinholes or other openings.
4. Do not use wet insulation materials.
5. All longitudinal joints on vertical pipe runs shall be staggered.
6. Apply insulation so as to permit expansion or contraction of pipelines without causing damage to insulation or surface finish.
7. Do not apply mastic or adhesive until all previous applications of mastic and adhesives have thoroughly dried.
8. No bands or staples shall be provided on covering.
9. The adhesive used in connection with all covering work shall contain an approved vermin and rodent proof ingredient.
10. Provide 24-gauge sheet-metal saddle between the pipe hanger/support and the exterior of the insulation. Saddle length shall be the same as insulation inserts.

C. Application at Fittings:

1. Insulation of flanges and flanged fittings shall overlap adjacent pipe covering at least 1 inch. Valves shall be insulated up to the gland only.
2. Pipeline strainers shall be insulated in such a manner as to permit removal of strainer basket without disturbing insulation of the strainer body.
3. Insulation adjacent to un-insulated flanges shall be tapered back and neatly finished so as to allow access to and removal of bolts without injury to covering.

3.3 TYPE A INSTALLATION

- A. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with a self-sealing adhesive. Seal end joints with 4-inch wide straps of matching vapor barrier tape. Seal off ends of insulation with vapor seal mastic at valves, fittings and flanges. No further finish required. Mastic shall extend onto the bare pipe and over the insulation O.D.
- B. PVC fitting jackets shall be used when they are available for the particular application. When molded or routed coverings are not available, the coverings shall be fabricated in the field similar to equipment insulation. Molded or routed fitting covers are highly recommended. Order PVC pre-curved.
- C. Cold Piping:
 1. Cover valves, fittings and flanges with insulation having the same thickness as adjacent pipe covering, securing in place reforming tape up to 12" O.D. and ½" wide SST bands on larger O.D. Apply a PVC jacket and seal joints with PVC cement (solvent welding).
- D. Hot Piping:
 1. Covers shall overlap the pipe insulation by the thickness of the insulation or 2" min. Cover valves, fittings and flanges with insulation similar to the adjacent pipe covering, securing in place with reforming tape up to 12" O.D. and ½" wide SST bands on larger O.D. Apply a PVC jacket and tape end joints to adjacent pipe insulation.
 2. Do not use PVC fitting jackets where the surface of the insulation is above 150 degrees F.
- E. Exterior Piping:
 1. Exterior above grade water piping shall be finished with a weatherproof jacket and an aluminum jacket. Lap and seal joints as per manufacturer's instructions. Place laps to shed water.

3.4 TYPE B INSTALLATION

- A. Type B insulation shall be slipped on the pipe prior to connection, and the butt joints shall be sealed. Where the slip on technique is not possible, the insulation shall be carefully slit and applied to the pipe.
- B. All joints shall be completely butt sealed with the manufacturer's recommended adhesive.
- C. Do not apply Type B insulation in multiple layers.
- D. Type B insulation shall not be used in plenums nor firewall penetrations.
- E. This Contractor shall paint Type B insulation exterior to the building with two coats of a vinyl acrylic paint recommended by the insulation manufacturer for protection

against ultraviolet degradation and shall be flexible with no cracking. It is recommended in high humid areas to coat the insulation with a vapor barrier mastic to .037 min. DFT.

3.5 TYPE C INSTALLATION

- A. Exterior
 - 1. Butter joints of insulation with non-setting adhesive. Secure with factory applied Self-Seal laps. Installation shall be as per manufacturer's guidelines.
 - 2. Finish shall be factory applied All Service Jackets. All fittings shall be finished with vapor seal mastic reinforced with white glass mesh. Minimum 0.037 thick DFT of mastic.
 - 3. Piping exposed in machine rooms shall be finished with vapor seal mastic and open weave membrane 10 x 10.
 - 4. Piping exposed to weather shall be finished with all service jacket and additional finish of 0.16 thick aluminum jacket. Aluminum jacket shall be secured with stainless bands located on maximum centers of 12 inches and at the overlap. No screws or pop rivets shall be used.
 - 5. Fittings and valves shall be finished with vapor seal mastic, reinforced with minimum 0.037" DFT of mastic, glass mesh and aluminum preformed fitting covers.

3.6 TYPE D AND E INSTALLATION

- A. Equipment Insulation Application:
 - 1. Apply insulation to fit as closely as possible to equipment.
 - 2. Stagger joints where possible.
 - 3. Bevel insulation around nameplates, ASME stamp and access plates.
 - 4. Insulation on equipment that must be opened periodically shall be constructed so insulation can be removed and replaced without damage.
 - 5. Do not install Type E insulation on aluminum surfaces or with aluminum jacket.
- B. Hot Equipment:
 - 1. Install 3/4-inch expanded metal over equipment with standing ribs or seams prior to applying insulation to eliminate ribs or seams penetrating through the insulation.
 - 2. Secure the insulation with steel bands spaced on 12-inch centers.
 - 3. Where required, use welded studs, clips or angles as anchors for wire or bands on flat surfaces.
 - 4. Seal joints with insulating cement.
 - 5. Over the insulation stretch 1-inch hexagonal mesh wire and lace the edges together.
 - 6. Apply a 1/4-inch thick coat of finishing cement and trowel smooth.
 - 7. Smooth insulation with lagging adhesive, cover with glass cloth and a final coat of lagging adhesive.
 - 8. On small equipment where it is not practical, omit the wire mesh and finishing cement on Type D insulation.
- C. Roof Drain Bodies
 - 1. Insulate similar to cold equipment.
 - 2. Insulated boxes around roof drain bodies are not acceptable.

3.7 METAL JACKET INSTALLATION

- A. Cover all piping insulation exposed to the exterior with metal jacket as specified herein.

3.8 HANGERS

- A. Continue insulation through pipe hangers. Provide either rigid insulation inserts or sheet metal inserts at all outside pipe hangers. Provide rigid insulation inserts for piping operating below 60 °F. and sheet metal inserts for piping above 60 °F.
- B. Provide rigid insulation (on non-insulated piping) or sheet metal inserts (on insulated piping) between the pipe and pipe hanger - shall be of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation insert shall not be less than the following lengths:

1/2" to 2 1/2" pipe size	10 Inches Long
3" to 6" pipe size	12 Inches Long
8" to 10" pipe size	16 Inches Long
12" and over	22 Inches Long

- C. Inserts for cold piping shall have a vapor barrier facing of the same material as the adjacent pipe insulation. Seal inserts into insulation with vapor seal mastic.
- D. Sheet metal inserts shall be of steel sheet. Gauge shall conform to manufacturer's recommendation for pipe size. Sheet metal inserts shall have insulation filler of the same material as the adjacent pipe insulation.

3.9 PIPE SLEEVES

- A. Pipe insulation and vapor barrier shall be continuous through sleeves in walls and floors.
- B. Type B insulation shall not be used in sleeves through firewalls or fire rated (2-hour) floor systems. Use Type A or Type C through the sleeve instead and vapor seal the joint between the two insulations.
- C. Provide 26 gauge galvanized steel or 0.020 inch aluminum jacket over insulation on pipe passing through sleeves where sealant is required.
- D. Where penetrating interior walls, extend the metal jacket 2 inches out either side of the wall and secure each end with a metal band compressing the insulation slightly.
- E. Where penetrating floors, extend the metal jacket 2 inches below the floor and 5 inches above the floor. Secure with metal bands.

END OF SECTION

22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 22 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the plumbing piping systems. Comply with other Division 22 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the plumbing piping systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide complete operating plumbing piping systems including pipe, tube, fittings, and appurtenances as indicated and in compliance with these Specifications.
- B. Applications: Applications of piping systems include, but are not limited to, the systems as listed below:

<u>System</u>	<u>Working Pressure</u>	<u>Operating Temperatures</u>
Domestic Cold Water		
High	350 psig	55 to 80°F
Medium	300 psig	55 to 80°F
Low	150 psig	55 to 80°F
Domestic Hot Water		
High	350 psig	90 to 120°F
Medium	300 psig	90 to 120°F
Low	150 psig	90 to 120°F
Sanitary Drainage	--	--
Storm Drainage	--	--
Natural Gas	--	--

1.3 QUALITY ASSURANCE

- A. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before

welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. General: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.
1. Steel Pipe: ASTM A53, ASTM A106, or ASTM A120, black or hot-dipped galvanized as specified.
 2. Copper Tube: ASTM B88, Types "K", Type "L", or Type "M" copper water tube as defined by the Copper and Brass Research Association.
 3. Ductile Iron Pipe: ANSI A21.51, Class 150 with bell and spigot ends for push-on joints.
 4. Cast Iron Soil Pipe: ASTM A74, standard weight, hub and spigot-type.
 5. Hubless Cast Iron Pipe: CISPI 301-78, standard weight with spigot bead ends for coupling assembly.
 6. Polyvinyl Chloride (PVC) Pipe: Sewer main SDR 41, ASTM D3034 with bell ends and pre-inserted gasket joints.
 7. Pre-insulated Steel Pipe: ASTM A53, ASTM A106, ASTM A120, and ANSI B31.1.
 8. Polyvinyl Chloride (PVC) Water Pipe: Class 150, thickwall, Schedule 80, AWWA C90 mechanical joint.
 9. Copper Drainage Pipe: DWV copper piping.
 10. Polyvinyl Chloride (PVC) Drainage Pipe: Schedule 40 PVC.
 11. Chlorinated Polyvinyl Chloride (CPVC) Drainage Pipe: Schedule 40 CPVC. Type IV Grade I with cell classification of 23447 as defined in ASTM D1784. Rated for temperatures up to and including 200°F.

2.2 PIPE / TUBE FITTINGS

- A. General: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.
1. Cast Iron Flanged Fittings: ANSI B16.1, Class 125 or Class 250, black or galvanized as specified, including bolting and gasketing.

2. Cast Iron Threaded Fittings: ANSI B16.4 or ASTM A126, Class 125 or Class 250, black or galvanized as specified.
3. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or Class 300, black or galvanized as specified.
4. Malleable Iron Threaded Unions: ANSI B16.39, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.
5. Threaded Pipe Plugs: ANSI B16.14.
6. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections.
7. Forged Steel Socket-welding and Threaded Fittings: ANSI B16.11, rated to match schedule of connected pipe.
8. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.
9. Cast Iron Drainage Fittings: ANSI B16.22 galvanized with pitched threaded ends.
10. Pipe Nipples: Fabricated from same pipe as used for connected pipe, except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1/2". Do not thread nipples full length (no all-thread nipples).
11. Wrought Copper/Bronze Solder-Joint Fittings: ANSI B16.22 suitable for working pressure up to 250 psig.
12. Hub-less Cast Iron Pipe Fittings: CISPI 301-78 and comply with governing regulations.
13. Cast Iron Soil Pipe Fittings: ASTM A74.
14. Compression Gaskets: CISPI HSN-75.
15. Lead/Oakum Joint Materials: Comply with governing regulations for service use indicated.
16. Grooved End Fittings: ASTM A47 or ASTM A536 joined with Victaulic Style 77 couplings and Grade "E" gaskets.
17. Flanged Fittings: Comply with ANSI B16.15 for bolt-hole dimensioning, materials, and flange-thickness.
18. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.
19. Flange Bolt Thread Lubricant: Lubricant shall be an anti-seize compound designed for temperatures up to 1000°F and shall be Crane Anti-Seize Thread Compound or approved equal.

20. Copper Drainage Fitting: DWV copper drainage fittings.

B. Miscellaneous Piping Materials/Products:

1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.
2. Brazing Materials: American Welding Society, AWS A5.B, Classification BCup-5.
3. Gaskets for Flanged Joints: 1/8" thick gaskets. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.
4. Insulating (Dielectric) Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation or equal.
5. Gaskets for Cast Iron Soil Pipe: ASTM C 564, neoprene, compression-type.
6. Push-on-Joints: ANSI A21.11, rubber compression-type, "Tyton Joint" as manufactured by US Pipe or equal.
7. Hub-less Cast Iron Joints: CISPI 310, stainless steel corrugated shield and clamp assembly over one piece neoprene sealing sleeve.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. General:

1. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.
2. Systems: Install piping parallel or perpendicular to lines of building, true to line and grade, and with sufficient hangers to prevent sags between hangers. Provide fittings at changes in direction. Piping in finished areas shall be concealed, except in mechanical rooms. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.
3. Expansion and Contraction: Install loops, offsets, sizing joints, and expansion joints, as necessary, to avoid strain resulting from expansion and contraction of piping systems on fixtures and equipment. Provide mechanical grooved connections required by the application to reduce vibration at equipment connections. Provide expansion joints in piping systems by mechanical grooved connections where required.

- B. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up.
- C. Copper Pipe: Cut copper pipe square and ream to remove burrs. Clean fitting socket and pipe ends with sand cloth or wire brush.
- D. Final Connections to Equipment Furnished by Owner or Under Other Divisions of These Specifications: Where equipment is to be furnished under other Divisions of these Specifications or by the Owner, such equipment will be delivered to the site, uncrated, assembled, and set in-place under those other Divisions of these Specifications or under the separate contracts. Any required automatic control valves shall also be provided under those other Divisions of these Specifications or other separate contracts. Make all final connections of hot water, condenser water, gas, domestic water, waste, and vent as required. Provide valves, unions, strainers, check valves, and traps as required for proper operation of systems and equipment. Equipment not shown on the Architectural Drawings or noted by the Architect and/or Engineer shall not be included in the scope of this requirement.
- E. Excavation, Installation, and Backfill for Underground Pipe:
 - 1. Layout: Pipes shall be laid and pipe joints made in presence of the General Contractor and field measurements, layouts, batter board alignment, grade establishments, and similar locations shall be performed by a Professional Engineer in the employ of the Contractor. The Contractor's engineer shall be on the job during all underground work. A "Bench-Mark" reference shall be provided by the General Contractor.
 - 2. Pipe Grading: Lay and maintain all pipes at required lines and grades during the course of the Work.
 - 3. Trench: Excavate the trench to the depth required. Properly brace and de-water the trench and keep it free of water during installation, testing pipe, and backfilling. No water shall be discharged onto the street or freeway without approval by the Owner.
 - 4. Excavation: The trench shall be at least 18" wider than the maximum diameter of the pipe or largest bell and the pipe shall be laid in the center of the trench. The trench shall be excavated to a depth sufficient to provide for pipe cushions or supports as specified. Trench width may be increased as required and piling left in place until sufficient compacted backfill is in place. Properly sheet and brace all open trenches to render them secure and remove all such sheeting and bracing before completing the backfill. Comply with all applicable national, state, and local codes and regulations. The quantity of excavation required to install sheeting and the installation and removal of sheetings and bracings will not be regarded as Extra Work. All costs incurred for this excavation and the installation of sheeting shall be included in the Contract Price.
 - 5. Grading: Upon completion of excavation and prior to the laying of the pipe, the trench bottom shall be brought up to the required elevation with a pipe cushion, except where the cushion has been eliminated by the General Contractor. Pipe cushions shall be select material deposited in the trench and shall be compacted, leveled off, and shaped to obtain a smooth compacted bed along the laying length of the pipe. Pipe cushion material shall be as follows:

- a. Domestic Water Pipes: Material for pipe cushion shall comply with local codes and conform with the geo-technical report. In absence of local code requirements and/or geo-technical report, the cushion shall be bank sand or select backfill material approved by the General Contractor. Any material used shall pass a one-inch screen.
 - b. Sanitary and Storm Sewers: Material for pipe cushion shall comply with local codes and conform with the geo-technical report. In absence of local code requirements and/or geo-technical report, the cushion shall be bank sand or select backfill material approved by the General Contractor. Any material used shall pass a one-inch screen.
6. Anchors: Cast iron pipes shall have concrete anchors at each change in direction and/or as directed. Any change in direction exceeding 15 degrees shall be anchored. Concrete anchors shall rest against solid (virgin) ground with the required area of bearing on pipe and ground to provide suitable anchoring.
 7. Backfill: Backfill trenches only after piping has been inspected, tested, and approved by the General Contractor. Backfill shall be provided as recommended in the geo-technical report included in these Contract Documents, or in the absence of a geo-technical report, as required by site conditions. Refer to Division 2 or elsewhere in the Contract Documents for additional trenching and backfill requirements.
 8. Existing Surfaces: Restore existing streets, driveways, and sidewalks damaged during the excavation work to acceptable condition, subject to approval by the Owner.
 9. Safety: Provide street and sidewalk excavations with approved barricades, warning lights, and cover plates as required by the local authorities.

3.2 PLUMBING SERVICES

- A. Scope:
 1. This Contractor shall provide the building sanitary sewer to 5 feet outside the building and shall extend the domestic water service from the main shutoff valve stubbed above floor in the building.
 2. Provide storm drainage system as required to 5 feet outside the building.
 3. Verify locations and conditions.
- B. General: Install the various piping systems as described hereinafter, and as required by the local plumbing inspection department.
 1. Slope domestic hot and cold water piping to drain and provide with hose valves (drain valves) at low points.
 2. Install soil, waste, and vent piping with horizontal lines pitched in accordance with local codes, but in no case less than 1/4" per foot for pipe 3" and smaller, and 1/8" per foot for pipe 4" and larger. Install soil, waste, and vent piping with hubs of each length of piping in the upstream position.
 3. Make-up lead and oakum joints with molten lead run into hubs in one continuous pour, to a minimum depth of one inch.
 4. Make-up "Ty-Seal" or "Dual-Tite" gasketed joints using lubrication and joining tools as instructed by the manufacturers. Base of stacks, horizontal runs under pressure, and gasketed pipe 5" and larger shall be made up using "Lubrifest" joining material.

5. Torque "No-Hub" joints in accordance with manufacturer's instructions. Do not install "No-Hub" joints below ground.
 6. Provide chrome-plated piping at each fixture installed in a finished space. Install with proper strap wrenches to avoid marking or defacing.
 7. Provide proper restraints on riser and stack offsets.
- C. Plumbing Connections to Fixtures and Equipment:
1. General: Provide necessary pipe and fittings. Make final connections to provide cold water make-up and natural gas supply to mechanical equipment. Locate cold water make-up and gas supply where shown and connect with suitable stop valves.
 2. Cold Water Make-up: Provide cold water make-up to closed loop condenser water circulating systems, cooling tower system, and hot water heating systems.
 3. Gas Supply: Provide gas supply separately metered to an approved location for future routing to kitchen locations.
- D. The domestic water service shall be Class 150 AWWA cement lined C.I. with Class 250 fittings, mechanical joints or push-on rubber ring gaskets, ASTM A377-66 or PVC AWWA C900 with solvent welded fittings. Provide tie rods and thrust blocks as required.

3.3 DOMESTIC HOT AND COLD WATER PIPING SYSTEMS

- A. Interior Hot and Cold Water Piping:
1. Type "L" hard drawn copper tubing with wrought copper solder end fittings.
 2. Piping Run-outs to Fixtures: Provide piping run-outs to fixtures sized to comply with governing regulations. Each fixture shall be provided with a shut-off valve for each supply line. Provide all shutoff valves necessary to isolate mains to each restroom. Exposed lines shall be chromium-plated.
- B. Air Chambers: Provide the necessary air chambers, shock absorbers, or water hammer arrestors, specifically sized for the application to prevent water hammer.
1. All water hammer arrestors shall be PDI certified, size A, B, C, D, E, F, as indicated and/or as appropriate for the fixtures served. Josam, Zurn, or Jay R. Smith.
 2. Water hammer arrestors shall be installed at the top of each riser, and on each fixture branch, with quick closing valves, in accordance with Plumbing and Drainage Institute Standard WH201.

3.4 UNDERGROUND DOMESTIC WATER SERVICE & FIRE PROTECT. PIPING

- A. Piping Two-and-a-half Inches and Smaller: Type "K", copper tubing with wrought copper brazed end fittings.
- B. Piping Three Inches and Larger: Ductile iron bell and spigot, push-on joint, pressure water pipe. Joints shall be of the push-on-type employing a molded rubber gasket retained in a ring recessed into the inside of the bell. Pipe and joints shall be manufactured by Tyler Pipe and Foundry Company or equal. Coat pipe and fittings inside and outside with the manufacturer's standard coal tar enamel suitable for

domestic water service. PVC AWWA C900 piping with solvent welded fittings can be used where acceptable by the local authorities.

3.5 STORM AND SANITARY DRAINAGE PIPING SYSTEMS

- A. Soil, Waste, and Vent Piping Underground: Service weight cast iron hub and spigot. Provide and install code-approved manholes as required.
 - 1. Grease waste piping and/or waste piping in commercial kitchen applications with water temperatures greater than 140°F shall be service weight cast iron from floor drains, floor sinks, or hub drains to connection to grease trap or connection to civil sanitary piping.
- B. Storm Drainage Piping Underground: Same as soil, waste, and vent piping underground.
- C. Soil, Waste, and Vent Piping Above Ground: Service weight cast iron soil pipe and fittings with heavy duty 4 band mechanical clamps
- D. Storm Piping Above Ground: Service weight cast iron soil pipe and fittings with heavy duty 4 band mechanical clamps
- E. Pump Discharge Piping: Discharge from pumps to the horizontal gravity main shall be type "L" copper with wrought copper solder end fittings
- F. Cleanouts:
 - 1. General: Care shall be used when locating cleanouts. Wherever possible, do not place cleanouts in "finished" areas. All locations shall be approved by the Architect.
 - 2. Finished Floor: Jay R. Smith No. 4434, cast iron adjustable assembly with nickel bronze cover and tapered thread bronze plug. Provide clamping collar when installed in floors having waterproof membrane.
 - 3. Unfinished Areas: Jay R. Smith No. 4434 cleanout with cadmium-plated, cast iron plug.
 - 4. Walls: Jay R. Smith No. 4434, cast iron with nickel bronze, square, smooth, access cover, vandal-proof screws.
 - 5. Outside: Jay R. Smith No. 4434, non-slip, vandal-proof cover.
 - 6. Locations:
 - a. At base of every drainage stack
 - b. Maximum distance between cleanouts is 90 feet.
 - c. At turns greater than 45 degrees.
 - d. Other locations required by local code.

3.6 NATURAL GAS PIPING SYSTEM

- A. Code Compliance Products: Comply with local utility company codes and AGA regulations which require the products used for gas piping work to be selected from lists in certain published standards or coded as indicated.
- B. Gas Piping: Gas piping intended for operation at pressures of 5 psig or greater shall be ASTM A53, Schedule 40, black steel joined by Schedule 40, black welding fittings. Gas piping intended for operation at pressures less than 5 psig shall be ASTM A53,

Schedule 40, black steel joined by Schedule 40, black welded fittings or Class 150 pounds, banded, black malleable iron, threaded fittings.

- C. Concealed Piping and Protection: Gas piping run concealed in walls, chases, or above ceilings shall be installed as required by local codes and the serving utility company.
- D. Underground Piping: High density polyethylene (HDPE) with electro/heat fusion joints. Pipe shall be installed per 49CFR Part 192, by a certified installer.

3.7 CLEANING, FLUSHING, TESTING, AND INSPECTING

- A. Cleaning: Clean exterior surfaces of installed piping systems and prepare surface for application of any required coatings.
- B. Flushing: Flush piping systems with clean water prior to performing any required tests.
- C. Piping Tests:
 - 1. General: Blank off equipment during tests. Perform tests before piping is enclosed in walls, floors, partitions or in any other way concealed from view. Tests may be performed in sections. Tests shall be witnessed by the General Contractor and local inspectors and the test results presented to the Engineer for acceptance and approval prior to concealing piping from view. Provide all necessary equipment for testing, including pumps and gauges. Note: All test results are to be submitted to the Engineer as specified in Section 22 01 00.
 - 2. Domestic Water Systems: Test hot and cold water systems hydrostatically to a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 4 hours. Repair all leaks, replacing materials as necessary, and repeat tests until systems are proven tight.
 - 3. Soil, Waste, and Vent Piping System: Test soil, waste, and vent piping by plugging all openings and filling system to height required by City Plumbing Inspector, but not less than 10'. Inspect all joints for leaks, repair all leaks found, and retest until piping is demonstrated to be free from leaks. In addition to water test, apply peppermint or smoke tests, if required by local code. All underground main piping shall be inspected with a camera and the taped test results submitted to the Owner.
 - 4. Storm Drainage Piping System: Test storm drainage piping same as specified for Soil, Waste, and Vent Piping System.
 - 5. Natural Gas Piping System: Test natural gas piping with compressed air or nitrogen at 5 times service pressure but not less than 100 psig for 24 hours and in accordance with the requirements of the local codes and the serving utility company. Repair all leaks, replacing materials as necessary, and repeat test until systems are proven tight.
 - 6. Disinfecting of Water Systems: Disinfect as required by code. Where code does not dictate tests to be conducted, at a minimum disinfect the hot and cold water systems as follows: Fill systems with water solution containing 50 ppm available chlorine; allow to stand for 4 hours, opening and closing all valves several times during this period; thoroughly flush; refill and place system in service; ensure a chlorine content of 2.5 ppm.
 - 7. Cleaning and Adjusting: Thoroughly clean and disinfect all plumbing fixtures, including all exposed trim. Adjust all flush valves for proper flushing, but without excess use of water.
- D. Inspecting: Visually inspect each run of each system for completion of joints, adequate hangers, supports, and inclusion of accessories.

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END OF SECTION

22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 22 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the water source heat pump systems. Comply with other Division 22 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the water source heat pump systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable subject to compliance with the requirements of these Specifications.
 - 1. Fixtures
 - a. Zurn Industries, Inc.
 - b. American Standard
 - c. Kohler Company
 - d. Crane Company
 - e. Toto
 - 2. Faucets
 - a. Chicago Faucet Company
 - b. Speakman Company
 - c. T & S Brass and Bronze Works, Inc.
 - d. Delta
 - e. Zurn Industries, Inc.
 - 3. Flush Valves
 - a. Sloan Valve Company
 - b. Delany Flush Valves
 - c. Zurn Industries, Inc.
 - 4. Seats
 - a. Church Products, Forbes-Wright Ind., Inc.
 - b. Olsonite Corporation
 - c. Beneke Corporation
 - d. Bemis
 - 5. Carriers
 - a. Zurn Industries, Inc.
 - b. J. R. Smith Mfg. Co.
 - c. Wade Div./Tyler Pipe
 - 6. Drinking Fountains
 - a. Halsey Taylor - Div. Household Int. Co.
 - b. Elkay Mfg. Company

- c. Ebco/Oasis
- 7. Stainless Steel Sinks
 - a. Elkay Mfg. Company
 - b. Just Mfg. Company

PART 2 - PRODUCTS

See drawings for Fixture Schedule

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Heights: Set fixtures at heights as shown on the Architect's Drawings.
- B. Caulking: This Contractor shall caulk the joint between the finished wall surface and all plumbing fixtures. Verify colors with the Architect. Caulking material shall comply with the appropriate section of these Specifications.
- ~~C. **Emergency Shower: Install an emergency shower and eye wash adjacent to the chemical treatment feeder system, and in other locations as required by code or as indicated on the drawings. Pipe domestic cold water to shower.**~~
- D. Each fixture shall be provided with a shut-off valve for each supply line. All exposed lines shall be chromium-plated.

END OF SECTION

23 01 00 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Division 23 includes Division 23 01 00 of the Specifications and Mechanical Drawings (HVAC). Elements of the Scope of Work include, but are not limited to, labor, materials, equipment, supplies, storage, transportation and all required permits, fees and licenses. Division 23 does not stand alone, but is part of the complete project and its Documents. Requirements of the General Conditions and Division 1 apply to all work in the Division.
- B. Provide the necessary interface with other Divisions to provide a complete project. Carefully check the Documents of this Division with those Documents of other Divisions. Determine the requirements of any interfacing materials or equipment being furnished and/or installed by those Sections and Divisions, and provide proper installation and required interface.
- C. No deviation from the Contract Documents shall be made without the written consent of the Architect and Engineer.
- D. All Specifications and Drawings are to be considered together as the Contract Documents. Any work shown in one and not the other, or is implied by either, shall be provided to make a complete project. Should conflicts exist between the Specifications and Drawings or there is an item shown or noted for which is not clearly defined, immediately submit a request for clarification. Under no circumstance will conflicts between the Specifications and Drawings be grounds for additional cost to the Contract after the Contract is established.
- E. The Drawings are schematic and are not intended to show the exact location of duct, piping, equipment, etc.
- F. Dimensions and information regarding accurate locations of equipment, and structural limitations and finish shall be coordinated and verified with other Divisions of Work. Be prepared to furnish dimensions and information regarding the Work of this Division to other trades.
- G. The right is reserved to relocate any device (receptacle, switch, fire alarm, audio/visual, junction box, outlet, etc.) a maximum of 10'-0" before it is permanently installed without incurring additional cost to the Contract.

1.2 REFERENCE STANDARDS

- A. All work shall comply with the most recently revised versions of all local, state and federal codes, ordinances of the authority having jurisdiction, laws, rules and regulations. Any modifications required by any of the above shall be made without any additional cost to the Owner. Where requirements between

governing Codes and Regulations vary, the more restrictive provision shall apply.

- B. Nothing contained in the Contract Documents shall be construed as authority or permission to disregard legal requirements and regulations. The Contractor shall thoroughly review the Documents and bring any such conflicts to the attention of the Architect and Engineer prior to Installation.
- C. All materials, installation, and workmanship shall comply standards and/or codes of the following:
 - 1. International Building Code – 2015 edition
 - 2. International Mechanical Code - 2015 edition
 - 3. International Plumbing Code - 2015 edition
 - 4. International Fuel Gas Code - 2015 edition
 - 5. International Fire Prevention Code - 2015 edition
 - 6. ASHRAE Standard 90.1 – Energy Standard – 2010 Edition
 - 7. National Electrical Code
 - 8. National Fire Protection Association
 - 9. ANSI - American National Standards Institute
 - 10. ASTM - American Society of Testing and Materials
 - 11. NEMA - National Electrical Manufacturer's Association
 - 12. OSHA - Occupational Safety and Health Act
 - 13. UL - Underwriter's Laboratories
 - 14. ASHRAE - American Society of Heating and Air Conditioning Engineers
 - 15. SMACNA - Sheet Metal and Air Conditioning Contractors' Nat'l Assoc.
- D. All materials shall be new and shall bear the label of UL.

1.3 EXISTING CONDITIONS

- A. Where work is to be performed in an existing facility, the contractor shall visit the site prior to bid and be familiar with all existing conditions. Special attention shall be given to work to be performed above an existing ceiling.
- B. Where existing slabs are to be cut or core drilled, the contractor shall x-ray the existing slabs to avoid cutting or disrupting existing conduits, cables, plumbing or structural members.
- C. HVAC systems, plumbing systems, and electrical service to the building shall not be interrupted without written consent of the building owner.
- D. No allowance will be made for lack of knowledge of existing conditions.
- E. At the completion of the project, all work under this Division shall be completely integrated with the existing systems and left in perfect operating condition.
- F. Where work under this Division disrupts the continuity of any existing to remain electrical circuit or feeder, the Contractor shall repair/replace as necessary to return to a perfectly functional and safe operating condition.

- G. Prior to any demolition or construction the Contractor shall have the existing conditions inspected by an EPA, OSHA certified asbestos abatement agency to identify the presence of asbestos. Should any asbestos be found it shall be brought to the immediate attention of the Architect and Owner and specifically identified in writing.

1.4 DEFINITIONS

- A. Provide: to furnish, install and connect.
- B. Furnish: to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application.
- C. Install: to join, unite, fasten, link, attach, set-up or connect together, complete, tested, and ready for normal satisfactory operation.
- D. Engineer: the Engineer of record.
- E. Contract Documents: the complete set of Specifications and Drawings of all Divisions.
- F. Work: labor, materials, equipment, accessories, controls and other items required for a complete installation.
- G. Concealed: embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.
- H. Exposed: not installed underground or concealed.
- I. Equal: equal in quality, workmanship, materials, weight, size, design and efficiency of the specified product, conforming with manufacturers.
- J. Supply: to purchase, procure, acquire and deliver complete with related accessories.
- K. Authority Having Jurisdiction (AHJ): applicable local, state and federal authorities having jurisdiction over any part of the Scope within this Division and other Divisions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer's names and catalog numbers specified in the Contract Documents are intended to describe the material and set the standard of quality. All bids shall be based on material specified. Request for approval of material not specified shall be considered if the request is in written form and submitted to the

Architect no later than fourteen (14) days prior to the bid date. All requests shall conform to the provisions of the general and supplementary conditions.

- B. When specific names are not stated, only the best available quality of material or equipment shall be submitted for review and used in the installation.

2.2 BASIS OF DESIGN

- A. Where a product is designated as "BASIS OF DESIGN", the Contractor is notified that mechanical, electrical, structural, architectural, space conditions and/or other features of the overall project design have been based on the requirements of the "BASIS OF DESIGN" product.
- B. Where a product is substituted for a "BASIS OF DESIGN" product, the Contractor is notified that changes in project design may be mandatory in order to permit use and installation of the substitute product. Shop drawing submittal for a substitute product shall include a complete schedule of changes in project design, if any, which must be made in order to permit use and installation of the substitute product. The Contractor shall bear all expenses related to the use of a substitute product.

2.3 SHOP DRAWINGS AND PRODUCT DATA

- A. The Contractor shall obtain complete shop drawings, product data and samples from the manufacturers, suppliers, vendors, and all Division 23 Subcontractors, for all materials and equipment as specified herein in various Sections of the Specifications, and shall submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the shop drawings, product data and samples to the Architect and Engineer, the Contractor shall thoroughly review the shop drawings, product data and samples and certify they are in compliance with the Contract Drawings. Further, the Contractor shall check all materials and equipment upon their arrival on the Project site and verify their condition and compliance with the Contract Documents. Any Work which proceeds prior to receiving reviewed shop drawings shall be modified as required to comply with the Contract Documents and the shop drawings. A minimum period of ten (10) working days, exclusive of transmittal time, will be required in the Engineer's office each time a shop drawing, product data and/or sample is submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his Work. The initial shop drawing review for equipment and materials may be expedited through the mutual consent of the Contractor, Architect, Engineer, and Owner providing the Contractor agrees to submit complete, certified, documented, and coordinated shop drawings for review in accordance with the requirements of the Contract Documents.
- B. The review of shop drawings, product data, and samples by the Architect and Engineer shall not relieve the Contractor of the responsibility for dimensions or errors that may be contained therein, or for deviations from requirements in the Contract Documents. It shall be clearly understood that the noting of some errors by the Engineer but overlooking others does not grant the Contractor permission to proceed in error.

- C. All shop drawings and product data/submittals shall be submitted in compliance with the requirements of the general and supplementary conditions. No more than four (4) copies of submittal data will be reviewed. Any additional copies will be returned unmarked. The responsibility of copying review comments on any additional copies will rest solely with the Contractor.
- D. All product data/submittals shall bear the name of the manufacturer to be used.
- E. All shop drawings and submittals shall include a stamped indication signifying that the submittal has been reviewed for compliance with the Contract Documents by the Contractor. This stamped indication also represents the fact that the Contractor has checked this submittal for its interaction with all other Divisions and certifies by his signature or initials that all coordination has taken place. The stamp shall include the date, name of the Contracting Firm, the signature of the Contractor, certification of compliance and approval. This stamp shall be on the submittal before the Engineer will review it.
- F. The Engineer will review an individual submittal not more than twice. If the submittal is rejected again on the second review, the Contractor will bare all responsibility for paying for the Engineer's time for additional reviews. Such payments to the Engineer shall be withheld from the next monthly pay application.
- G. Shop drawings and/or product data shall be submitted for the following for review:
 - 1. HVAC duct system layouts, including supply air, return air, exhaust air, and outside air. HVAC piping system layouts. These drawings must include associated equipment, drawn to scale based on submittals for that equipment, must be dimensioned, and must include duct, piping and equipment elevation tags (distance above finished floor to bottom).

The Contractor is encouraged to develop their own shop drawings, without having have had the Engineer's CAD files (as previously stated, the Engineer's drawings are schematic/diagrammatic in nature). Should the Contractor insist on using the Engineer's CAD files in the procurement of shop drawings, the Contractor must pay the Engineer \$ 150.00 per sheet for the CAD files.

The Contractor shall give the Engineer a written release, acceptable to the Engineer, signed by a corporate officer of the Contractor. This release shall also include a copyright statement indicating that these drawings or electronic data contained will not be used on any other project. The release and payment for the files must be received PRIOR to delivery of the CAD files.
 - 2. Equipment, including but not limited to: chillers, cooling towers, boilers, pumps, heat exchangers, rooftop units, split systems, fans, heaters, water-cooled self-contained units, water-source heat pumps, coils, air distribution devices (diffusers, etc.), air terminal units (PIU's, etc.), ductwork accessories, louvers, hoods, heat tracing, insulation, piping specialties, etc.

2.4 AS-BUILT DRAWINGS

- A. The Contractor shall maintain on a daily basis at the Project site a complete set of "Record Drawings". The "Record Drawings" shall consist of a set of black-line or blue-line prints or AutoCAD files of the Contractor Coordination Drawings for this Division. The prints shall be marked or the AutoCAD file electronically updated to show the precise location of all work and equipment, and all changes and deviations in the work from that shown on the Contract Documents. This requirement shall not be construed as authorization for the Contractor to make changes in the layout or work without definite instructions from the Architect or Engineer. The continuously updated coordination drawings (shop drawings previously described) shall be used to produce the final "Record Drawings" which shall be delivered to the Owner in AutoCAD electronic format (CD) upon Project completion.
- B. Record dimensions shall clearly and accurately delineate the work as installed; locations shall be suitably identified by at least two dimensions to permanent structures.
- C. The Contractor and Subcontractor shall mark all "Record Drawings" on the drawings with a rubber stamp impression or an AutoCAD image that states such.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The equipment selections used in the preparation of the Contract Documents will fit into the physical spaces provided and indicated, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearance in accordance with the Code requirements and the requirements of the local Authorities having jurisdiction, and the equipment manufacturer's recommendations.
- B. In the preparation of Drawings, a reasonable effort to accommodate acceptable equipment manufacturer's space requirements has been made. However, since space requirements and equipment arrangement vary according to each manufacturer, the responsibility for initial access, maintenance access, code required access, and proper fit rests with the Contractor.
- C. Physical dimensions and arrangements of equipment to be installed shall be subject to the Architect's and Engineer's review.
- D. The General Contractor and all Subcontractors shall coordinate the installation of ductwork, conduit, busway, piping, cable trays, etc., installation with lighting fixtures, special ceiling construction, air distribution equipment, and the structure. Provide additional rises, drops and offsets as required. If after installed, new ductwork, conduit, busway, piping or cable is found to be in conflict with the architecture, structure, or other trade Work which is either existing or shown on

- the Contract Documents, the ductwork, conduit, busway, piping or cable shall be relocated without additional cost to the Owner.
- E. No ductwork, piping, equipment, etc., shall be installed in the eight (8) inch high zone directly above the ceiling in tenant areas to allow for tenant build-out and flexibility unless otherwise specifically shown on the Drawings or prior written authorization is received from the Engineer.
 - F. Accessibility and Clearance:
 - G.
 - 1. Mechanical equipment, ductwork, piping, etc. shall be installed in accessible locations, avoiding obstructions, preserving headroom, and keeping openings and passageways clear.
 - 2. Minor adjustments in the locations of equipment shall be made where necessary, providing such adjustments do not adversely affect functioning of the equipment.
 - H. Scaffolds and staging for installation of mechanical work shall be provided under the work of this Division.

3.2 STRUCTURAL FITTINGS

- A. Furnish and install the necessary sleeves, inserts, hangers, anchor bolts, and related structural items. Install at the proper time.
- B. Openings may have been indicated on the Architectural and Structural drawings. Should any additional openings or holes be required, the same shall be provided at no additional cost to the Owner.
- C. Location: At a time in advance of the work, verify openings shown on the Architectural and Structural drawings, and coordinate any additional openings.
- D. If the work of this Section requires modification of the Architectural or Structural drawings, furnish new instructions as to requirements for these openings. Submit for review and coordination to Architect.
- E. Sleeves shall be supplied for mechanical piping passing through walls or slabs and shall be placed before concrete is poured.
- F. Equipment supports for mechanical work shall be fastened to the structure by inserts, anchor bolts, bolting to drilled and tapped structural members, or be welded to the structure.
 - 1. Welding shall be done by the electric arc method with fully competent welders. Supporting members shall be shop coated with a suitable primer.
 - 2. Surfaces damaged by installation of supports shall be touched up with primer to match shop coat. Any drilling of structural members shall be
- G. Flashing:

1. Wherever ductwork and/or piping pass through the roof or outer walls, base flashing and counter-flashing shall be provided.
 2. Such flashing shall be properly installed by skilled workmen, and shall include grouting, mastic or tar application, or other means to insure a permanent, waterproof, neat and workmanlike installation.
 3. Insofar as possible, flashing shall comply with and be similar to requirements for flashing in General Construction Work.
- H. Anchor bolts and inserts shall be galvanized and of adequate size and strength for installation of electrical work and shall be placed in forms before concrete is poured.
1. Placement of bolts in bases shall be done under other Division. Furnish detail drawings, templates, and anchor bolts for bases to the General Contractor in time to avoid delaying work schedules.
 2. Expansion shields shall only be used with specific approval of the Architect. Wooden or soft metal plugs shall not be used.
- I. Cutting and patching:
1. All additional cutting, patching and reinforcement of construction of building, subject to review by the Architect, shall be performed under this Section.
 2. Refer to appropriate Division for requirements.

3.3 WEATHERPROOF EQUIPMENT

- A. Mechanical devices or equipment located in damp, semi-exposed areas shall be weather-resistant. Enclosures shall comply with NEMA Type 3R requirements.
- B. Air distribution devices located in damp areas outside shall be weather-resistant (aluminum, etc.).

3.4 CLEANING

- A. Brush and clean work prior to concealing, painting and acceptance. Perform in stages if directed.
- B. Painted exposed work soiled or damaged: Clean and repair to match adjoining work before final acceptance.
- C. Remove dust and debris from inside and outside of material and equipment.

3.5 TESTS AND DEMONSTRATIONS

- A. All systems shall be tested in the presence of the Owner or an Owner designated representative upon completion of the Work and demonstrates that the installation is in accordance with the Contract Documents.

- B. All motors shall be checked and adjusted for correct direction of rotation.
- C. Any work found not to be in compliance with the Contract documents shall be repaired or replaced without incurring additional cost to the Contract price.
- D. Provide all instruction to the Owner on maintenance and operation of all systems and equipment provided under this Division.

3.6 WARRANTIES

- A. The warranty period for all systems, equipment, components, work, etc. shall be no less than one (1) year, unless specified otherwise hereinafter and shall include at least one (1) full heating season and one (1) full cooling season. The warranty shall include parts and labor.
- B. The Contractor shall, without cost to the Owner, remedy any defects within a reasonable time to be specified in notice from the Architect. In default thereof, the Owner may have such work done and charge all costs to the Contractor.
- C. The start of the Contractor's warranty period, as defined in the General Conditions, shall commence on the issue of a "Certificate of Substantial Completion", by the Owner or the Owner's Representative for each item of material, equipment or system.
- D. The Subcontractor shall confer with the General Contractor prior to the bid date concerning the project schedule and determine if there is a need to operate any items of equipment or systems for temporary heating and/or cooling or other reasons prior to "Substantial Completion". All required extended warranty costs for equipment, materials, and systems shall be included in the Subcontractor's bid.

END OF SECTION

23 05 29 - HANGERS & SUPPORTS FOR HVAC PIPING & EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. The Conditions of the Contract and applicable requirements of Division 1, “General Requirements”, and Section 23 01 00 “General Mechanical Requirements”, govern this Section.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide pipe hangers, supports, and required appurtenances as specified and indicated

1.3 QUALITY ASSURANCE

- A. MSS Standard Compliance: Provide pipe hangers and supports of materials, design, and manufacture which comply with ANSI/MSS SP-58, SP-59, SP-89, and SP-90.
- B. Acceptable Manufacturers: The model numbers listed in the Specification establish a level of quality and material. Subject to compliance with requirements, provide products and materials by the following:
 - 1. ITT Grinnell Corporation,
 - 2. Fee and Mason,
 - 3. Central Iron Manufacturing Company, and
 - 4. F& S Manufacturing Company
 - 5. Anvil International
 - 6. B-Line

PART 2 – PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS:

- A. General: Provide pipe hangers and supports as specified. Comply with local codes and standards for pipe and equipment support and anchorage. Pipe supports shall be of material that will prevent electrolytic action.
- B. Inserts: Provide Grinnell No. 282 inserts for concrete construction.
- C. Piping in Multiple Parallel Runs: Provide Grinnell No. 45 or No. 50 with Grinnell No. 137 U-bolt pipe clamps or structural channels or angles with U-bolt clamps, supported as trapeze hangers where multiple parallel runs of piping are shown. Select and size members for weights to be carried and span dimensions between supports.

- D. Piping in Single Runs: Provide Fee and Mason Fig. 239 or Grinnell No. 260 clevis hanger.
- E. Hanger Rod: Provide hanger rods of required length. Rod diameters shall be as listed in the following table. Rod diameters may be adjusted after consultation with the Structural Engineer concerning the building framing system, the method of attachment to the structure and the support rod spacing.

<u>Pipe Sizes</u>	<u>Rod Diameter</u>
3/4" - 2"	3/8"
2-1/2" - 3	1/2"
4" - 5	5/8"
6"	3/4"
8" - 12"	7/8"
14" - 18"	1"

- F. Riser Clamps: Provide Fee and Mason Figure 241 riser clamps. Riser clamps for copper tube shall be copper-plated.
- G. Saddles and Shields:
 1. Saddles for Horizontal Insulated Piping Without Vapor Barrier: At each hanger or support on horizontal runs, provide Grinnell No. 160 or Fee and Mason Figure 171, 1710, 1712, or 172 saddles, as applicable. Shields as described below may be used instead of the saddles. On heating water systems below 140°F (60°C), hangers may be sized for the pipe size and of a material compatible with the pipe. Where dissimilar materials are used, provide dielectric separation. Carry insulation over the hanger and seal where hanger is sized for pipe.
 2. Shields for Horizontal Insulated Water Piping with Vapor Barrier: At each hanger or support for water piping, provide a half section of preformed 6 PCF density fiberglass or rigid calcium silicate, with jacket of adjacent insulation brought across unbroken, supported on semicircular 16 gauge shields. Shields for pipe 4" and smaller shall be 12" long; shields for pipe 5" to 8" shall be 18" long; and shields for larger pipe shall be 24" long.
- H. Piping on Roof: Roof mounted pipe supports are discouraged. If roof supports are necessary, installation methods must be approved by the architect, engineer, general contractor and the Roofing Contractor.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Independent Support: Support fire sprinkler and standpipe piping independently of other piping in accordance with NFPA-approved methods and local codes and standards.

B. Provisions for Movement:

1. Movement: Install hangers and supports to allow controlled movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate the action of expansion joints, expansion loops, expansion bends, and similar units.
2. Load Distribution: Install hangers and supports so piping live and dead loading stresses from movement will not be transmitted to any pipe or connected equipment. Pipe supports shall properly transmit the weight of the pipe and its contents to the building structure, or to independent posts, piers, or foundations.
3. Pipe Slopes: Install hangers and supports to provide the indicated pipe slopes so maximum pipe deflections allowed by ANSI B31 are not exceeded.

C. Insulated Piping: Comply with the following installation requirements:

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through the insulation; do not exceed pipe stresses allowed by ANSI B31.
2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold, chilled, or heating water piping, install coated protective shields. For pipe 8" and over, install rigid calcium silicate insulation between saddles and pipe.

D. Spacing: Install hangers and supports in piping systems to remove stress from equipment flanges and rotating equipment. Space hangers and supports as shown in the following table. Rod spacing may be adjusted after consultation with the Structural Engineer concerning the building framing system, the method of attachment to the structure and the support rod diameters.

<u>Trade Pipe Size</u>	<u>Maximum Spacing</u>
1/2"	5'
3/4"	6'
1" and 1-1/4"	7'
1-1/2"	9'
2"	10'
2-1/2"	11'
3"	12'
4"	14'
5"	16'
6"	17'
8"	19'
10"	22'
12"	23'
14"	25'
16"	27'
18"	28'

- E. Saddles: Where insulation without vapor barrier is indicated, install protection saddles, or use hangers as indicated in Paragraph 2.0/H.1.
- F. Guides: Install pipe guides complying with the manufacturer's published product literature. Where not otherwise indicated, install pipe guides near expansion loops, expansion joints, and ball joints.
- G. Anchors: Install anchors at the proper locations to prevent stresses from exceeding those permitted by ANSI B31 and to prevent the transfer of loading and stresses to connected equipment. Anchors shall include vibration isolation in accordance with the pipe support system specified. Where the piping system is floating, the anchors shall be termed restraints or braces.
 - 1. Where expansion compensators are indicated, install anchors in accordance with the expansion unit manufacturers written instructions, to limit movement of piping and forces to the maximums recommended by the manufacturer of each unit.
 - 2. Where not otherwise indicated, install anchors at the ends of principal pipe runs and at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required accommodating both expansion and contraction of piping.
- H. Leveling: Adjust hangers and supports and place grout as required under supports to bring piping to proper levels and elevations.
- I. Hangers: Refer to Section 23 05 48, "Vibration Isolation", for additional information and support requirements. Pipe hangers made of wood, wire, or sheet iron shall not be permitted.
- J. Riser Supports: Vertical piping shall be secured at sufficiently close intervals to keep the pipe in alignment and carry the weight of the pipe and contents.
 - 1. Cast iron soil pipe shall be supported at the base and at each story level, but in no case at intervals greater than 10'.
 - 2. Steel pipe shall be supported at the base and at no less than every other story level, but in no case at intervals greater than 25'.
 - 3. Copper tube shall be supported at each story level, but in no case at intervals greater than 10'.
 - 4. Plastic pipe shall be supported at mid point between floors and at ceiling to prevent movement, but in no case at intervals greater than 8'.

END OF SECTION

23 05 48 - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the vibration isolation systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the vibration isolation systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide vibration isolation work as specified and indicated, including the following:
 - 1. Support isolation for motor-driven mechanical equipment
 - 2. Inertia base frames in conjunction with equipment isolation
 - 3. Support isolation of air-handling housings
 - 4. Isolation including support isolation for piping risers
 - 5. Support isolation of piping
 - 6. Flexible ductwork connections

1.3 QUALITY ASSURANCE

- A. General: Except as otherwise indicated, obtain support isolation units from a single manufacturer.
- B. Supervision: Manufacturer shall provide technical supervision of the installation of support isolation units produced by him and of associated inertia bases.
- C. Manufacturers: Provide vibration isolation support units manufactured by one of the following or an approved equal: Amber-Booth, Vibrations Mounting and Controls, Inc., Korfund Dynamics Corporation, Consolidated Kinetics Corporation.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Chilled and Heating Hot Water Pumps: Provide concrete inertia bases with structural steel pouring forms sized and reinforced as required for the intended service. Size bases to support the piping elbow supports and furnish with Type RSW recessed spring isolators properly sized for one-inch static deflection. Mount springs on concrete bases 3-1/2" high. Inertia base is not required for pumps installed on slabs on grade.

- B. Suspended Fans: Isolate with not less than four combination spring and rubber-in-shear vibration isolators.
- C. Suspended Fan & Coil Unit: Isolate with not less than four combination spring and rubber "in-shear" vibration isolators.
- D. Flexible Pipe Connections at Rotating Equipment: Isolate supply and return piping to each pump with braided metal hose connectors between pump and valve.
- E. Flexible Ductwork Connections to Equipment: Install flexible connections between sheet metal ductwork and equipment or fan collar. Locate as close to fan as possible. Isolate the duct system from the equipment by at least 1".

PART 3 - EXECUTION

3.1 ISOLATOR PERFORMANCE

- A. General: Comply with the minimum static deflections recommended by the American Society of Heating, Refrigerating and Air Conditioning Engineers, including the definitions of critical and non-critical locations, for the selection and application of vibration isolation materials and units as indicated.
- B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's instructions for selection and application of vibration isolation materials and units.

3.2 RELATED WORK EXAMINATION

- A. Examination and Reporting: Installer of vibration isolation work shall observe the installation of other work related to and connected to vibration isolation work. After completion of other related work (but before equipment start-up), installer shall furnish a written report to the Contractor, with a copy to the Engineer, listing observed inadequacies for proper operation and performance of vibration isolation work.
- B. Correction and Start-up: Do not start-up equipment until inadequacies have been corrected in a manner acceptable to the vibration isolation Installer.

3.3 EQUAL LOADING

- A. General: Equipment installed on vibration isolating mountings shall be level after load is applied. Further vibration isolating mountings shall be selected and installed to compensate for unequal loading. Spring isolators with coils touching during equipment start-up or operation will not be acceptable.

END OF SECTION

23 05 53 - HVAC EQUIPMENT AND PIPING IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the identification of equipment and piping. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the identification of equipment and piping specified herein and/or as indicated on the drawings.

1.2 DESCRIPTION OF WORK

- A. Work Included: Identification of mechanical equipment shall consist of equipment labeling, pipe marking, and valve tagging as specified hereinafter.
 - 1. In general, all equipment shall be labeled. This shall include all central plant, air handling or air conditioning equipment, and other similar and miscellaneous equipment.
 - 2. Pipe markings shall be applied to all piping.
 - 3. Each valve shall be identified with a stamped tag. Valves and tagging shall be scheduled typewritten on 8 ½" x 11" paper, tabulating valve number, piping system, system abbreviation, location of valve (Room or area), and service (e.g. – 2nd Floor North Domestic Hot Water). The valve schedule shall be submitted to the Engineer for approval prior to ordering or installing valve tags. See Section 23 01 00, "General Mechanical Requirements" for information and requirements regarding Operation and Maintenance Manuals.
Labels, tags, and markers shall comply with ANSI A13.1 and other applicable state and local standards for lettering size, colors, and length of color field.
 - 4. Equipment and device identification specified in other sections shall be provided as a part of those requirements.

1.3 ACCEPTABLE MANUFACTURERS

- A. Labels, markings, and tags shall be manufactured by W.H. Brady, Seton, Allen, or Industrial Safety Supply.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELING

- A. Equipment labeling shall be one of the following, unless noted or specified otherwise:
 - 1. Permanently attached engraved brass or plastic laminated signs with 1" high lettering. Signs on exterior equipment shall be brass.
 - 2. Stencil painted identification, 2" high letters, with standard fiberboard stencils and standard black (or other appropriate color) exterior stencil enamel.

2.2 PIPE MARKINGS

- A. On piping less than 6" diameter, install plastic semi-rigid snap-on type, manufacturer's standard pre-printed color-coded pipe markers extending fully around the pipe and insulation or pressure-sensitive vinyl pipe markers similar to the above. Pipe markings can also be applied with the stick type backing in lieu of the semi-rigid snap-on-type.
- B. On piping and insulation 6" and greater diameter, full band as specified above or strip-type markers fastened to the pipe or insulation with laminated or bonded application or by color-coded plastic tape not less than 1 ½" wide, full circle at both ends of the marker. Pipe markings can also be applied with the stick type backing in lieu of the semi-rigid snap-on-type.
- C. Arrows for direction of flow provided integral with the pipe marker or separate at each marker.

2.3 VALVE TAGS

- A. Valve tags shall be polished brass or plastic laminate with solid brass S hook and chain. Tags shall be stamped or engraved with the appropriate abbreviation for the type of service (e.g. – CHW, HW), as well as the designated valve number.
- B. A valve schedule is to be provided to the Owner. For each page of valve schedules, a glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

PART 3 - EXECUTION

3.1 GENERAL

- A. Identification labeling, marking, and tagging shall be applied after insulation and painting has been completed.
- B. Coordinate names, abbreviations, and other designations used in mechanical identification work with corresponding designations shown, specified, or

- scheduled on drawings. Prior to ordering any labels, markings, or tags, obtain the approval of the Engineer regarding names, abbreviations, etc.
- C. The Plumbing, HVAC, and Fire Protection Contractors shall coordinate labeling, marking, and tagging to ensure consistent and coordinated identification. In existing buildings, utilize similar names, abbreviations, and other designations that are currently in use to remain consistent with existing identification.
 - D. Equipment labeling shall consist of unit designation as shown on the drawings. Exhaust fan labeling shall also indicate service or the room or area of service.
 - E. Pipe and ductwork markers shall be placed on piping and ductwork on 25' centers in mechanical rooms and concealed spaces. In locations where piping and ductwork is exposed, place markers on 50' centers. Flow directional arrows should be marked on the piping at taps from the main and riser.
 - F. Valve tags shall be placed on each valve except those intended for isolation of individual heat pumps or terminal units (e.g. - VAV boxes, fan coil units, unit heaters, etc.). Valve tag schedules shall be prepared as specified hereinbefore. Copies of one schedule shall be laminated in clear plastic and placed where directed by the Owner. Other sets shall be included in the Operating and Maintenance Manuals.

END OF SECTION

23 05 93 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the testing, adjusting, and balancing of HVAC systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Provide testing, adjusting, and balancing specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included:
 - 1. All air and water systems shall be tested, adjusted, and balanced to optimize operating and comfort conditions. Record test data as outlined hereinafter and submit for review and approval. Systems shall be fully tested and balanced prior to Building commissioning and acceptance.
 - 2. Conduct tests as specified herein, and as required by authorities having jurisdiction, including Local Inspection Department or Construction Manger.
 - 3. Repair or replace defects discovered or resulting from the required tests to a like new condition.
 - 4. All tenant finish air balancing will be by the tenant finish contractor. All air and water moving equipment installed under the shell building contracts will be balanced by the shell contractor.

1.3 QUALITY ASSURANCE

- A. Personnel: Submit evidence to show that the personnel who will actually balance the systems are qualified. Evidence showing that the personnel have passed the tests required by the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB) will be sufficient.

PART 2 - PRODUCTS

Not applicable.

PART 3 - EXECUTION

3.1 TEST DATA

- A. General: Record test data after balancing has been completed and deliver recorded data to the Engineer for review and evaluation. Should deficiencies or discrepancies be found, repeat balancing procedures to achieve correct test data results. Certify the test and balancing data as being true and correct over the Contractor's signature. Execute the Certification by an authorized officer if the contracting firm is a corporation, by a partner if the firm is a partnership, by the firm's owner if the firm is a sole proprietorship, or by the authorized representative if the firm is a joint venture. Include a copy of the approved test and balancing data in the Owner's Manual.
- B. Test Forms: Record and submit test and balancing data on forms similar to those of the AABC or NEBB.

3.2 CALIBRATION TEST

- A. Submit evidence to show that the balancing devices are properly calibrated before proceeding with system balancing.

3.3 PRELIMINARY AIR TESTING

- A. General: Preliminary air tests shall be performed before duct work or equipment is enclosed in walls, floors, ceilings, chases, or in any other way concealed from view. Tests may be conducted on individual systems. Submit notification when systems are ready for preliminary air tests. Condenser water shall not be required for preliminary air tests. Make necessary arrangements to energize fan motors for the tests. Where possible, conduct the tests before the application of exterior duct insulation and installation of grilles or diffusers. Remove section of duct to allow design airflow at design static pressure where necessary.
- B. Tests: Demonstrate that there is no excessive leakage of the duct work by visual inspection, that fans are operating at essentially the correct speed, that motors will not overload, and that equipment delivers design cfm. Correct any deficiencies found. Repeat preliminary air tests until tests have proven satisfactory.
- C. Inspection: Inspection and acceptance of the Work shall, in addition to the foregoing requirements, be subject to the following conditions:
 - 1. Instruments: Test instruments, devices, and similar items, their accuracy and the methods by which instruments are employed, shall be approved by AABC or NEBB for use at the job site.

3.4 FINAL AIR BALANCE

- A. General: When tests have been completed and systems are complete and ready for operation, perform the following steps of final air balance and record the results.
- B. Motors: Verify correct rotation of rotating equipment. Verify that properly sized thermal heater elements are installed in starters. Verify that properly sized dual-element fuses, where specified, are installed in disconnect switches.
- C. Filters: Check air filters or filter media. Balance system only with clean filters or filter media.
- D. Airflow at Each Unit: Read and record return and/or outside air, supply air cfm, and temperature at each fan and blower.
- E. Water flow at Each Unit: Set thermostat for full cooling and for full heating loads. Measure and record supply and return water flow at each cooling/heating coil.
- F. Coil Temperatures: Set thermostat for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures at each cooling and heating coil.
- G. Outlet Airflow: Adjust each air exhaust inlet and supply diffuser, register, and grille to within 10% of design air cfm. Dampers in diffusers (if specified) may be used for only 10% adjustment from full open airflow. Include terminal points of air supply and points of exhaust.

END OF SECTION

23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the insulation of HVAC and Plumbing piping, duct, and equipment. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the insulation system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 QUALITY ASSURANCE

- A. Manufacturer: Approved manufacturers are Armstrong, Calsite, Cell-U-Foam Corp, Ceelco, Certainteed Corp, Dow Chemical Company, Forrest Mfg Co, Foster / Chilers, Gemco, Johns Manville, Knauf Fiberglass, Midwest Fastners, Owens Corning Fiberglass, Pittsburg Corning Fiberglass, Rubatex, Trymer, and Venture Tape.
- B. All insulation, jacket and adhesive shall have a fire and smoke hazard ratings as tested under ASTM E 84, NFPA 255, and UL 723 not exceeding:

Flame Spread:	25
Fuel Contributed:	50
Smoke Developed:	50

Exceptions: Type B Insulation and PVC Fitting Covers

1.3 SUBMITTALS

- A. Per Section 23 01 00.
- B. Product Data
 - 1. Type A Insulation
 - 2. Type B Insulation
 - 3. Type C Insulation
 - 4. Type D Insulation
 - 5. Type E Insulation
 - 6. Type F Insulation
 - 7. Type G Insulation
 - 8. Vinyl Lacquer Paint for Type B Insulation
 - 9. Metal Jacket

1.4 DEFINITIONS

- A. The word “plenum” shall mean a ceiling space or mechanical room used for the transfer of conditioned return and/or outside air.

PART 2 - PRODUCTS

2.1 PIPING INSULATION

- A. Type A – Fiberglass (indoor)
1. One Piece glass fiber, rigid molded sectional pipe covering with factory applied aluminum foil and white craft paper flame retardant vapor barrier jacket, conforming to ASTM C547, Class II, Mineral Fiber Preformed Pipe Insulation.
 2. Thermal Conductivity (k) equals approximately 0.23 (BTU/HR., SF., Degree F, IN) at 75 °F.
 3. Similar to Johns Manville Corp “Micro Lox 650 AP T”, or approved equal.
- B. Type B - Closed Cell (indoor)
1. Closed cell, flexible foamed plastic conforming to ASTM C534, "Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form." Insulation shall be suitable for a temperature range from –40 degrees F to 220 degrees F.
 2. Conductivity (k) equals approximately 0.27 (BTUHR., SF., Degree F, IN) at 75 °F.
 3. Similar to Armstrong “Armaflex”, or approved equal.
- C. Type C – Polyisocyanurate (outdoor)
1. Prefabricated 2 lb./cu.ft. density polyisocyanurate insulation with waterproof mastic and glass fiber jacket finished with an aluminum jacket with waterproof silicone caulk joints.
 2. Conductivity (k) equals approximately 0.14 (BTUHR., SF., degrees F, IN) at 75 °F.
 3. Insulation shall be applied per manufacturer’s recommendations. Joint sealants and coatings shall be as approved by the insulation manufacturer for the intended application and service temperature range.
 4. Jacketing shall be an all service jacket with 1 mm aluminum foil on pipe insulation and FSK jacket on board stock applied by the manufacturer to ASTM C-1136. Jacket shall have integral flap for sealing joint.
 5. Similar to Trymer 9501, or approved equal.
- B. Type Da – Cellular glass

1. Cellular glass shall comply with ASTM C 552.

2.2 EQUIPMENT INSULATION

A. Type Dh - Fiberglass Board (Hot Equipment)

1. Semi-rigid intermediate service fibrous glass board for operating temperatures greater than 850 degrees F.
2. Conductivity (k) equals approximately 0.23 (BTU/HR., SF., degrees F, IN) at 75 °F. Minimum density of 4.25 lb / cu ft.
3. Similar to Johns Manville Corp "Spin Glass", or approved equal.

B. Type Dc - Foamed Plastic (Cold Equipment)

1. Foamed plastic sheet suitable for operating temperatures between -40 degrees F and 22- degrees F.
2. Conductivity (k) equals approximately 0.27 (BTU/HR., SF., Degree F, IN) at 75 °F.
3. Similar to Armstrong "Armaflex", or approved equal.

C. Type E

1. Calcium silicate block conforming to ASTM C 553, Type I (1200 degrees F. max), asbestos free.
2. Conductivity (k) equals approximately 0.42 (BTU IN/HR., SF., degree F) per inch thickness at 200 °F.
3. Similar to Calsilite, or approved equal.

2.3 DUCTWORK INSULATION

A. Type F – Duct Wrap

1. Duct insulation shall be 2" thick, minimum 3/4 lb. density fiberglass with an FSKL aluminum foil jacket, reinforced with fiberglass scrim.
2. Conductivity (k) equals approximately 0.24 (BTUHR., SF., degrees F, IN) at 75 °F.
3. Integral UL rated vapor barrier of:
 - a. Aluminum foil reinforced with fiberglass scrim laminated to 30-lb. kraft paper.
 - b. Class I white vinyl 0.004 inch thick, where specified.
4. Similar to Johns Manville Corp "Microlite", or approved equal.

B. Type G - Duct Liner

1. ASTM C1071, Type II, Grade 2, R-6, 1" thickness, 1.5 lb. Density for low pressure ductwork and 3.0 lb density for medium pressure ductwork, bonded mat of glass fiber coated with black fire resistant and microbial resistant coating, complying with TIMS AHC 101. Moisture adsorption shall not be greater than 0.5% moisture by volume when exposed to moisture-laden air at 120°F and 96%

- RH, per ASTM C553. Insulation shall be Schuller "Permacote Linacoustic" R-300, "Aeroflex Ductliner" as manufactured by Owens Corning Fiberglass Corp. or "Ultralite with Certa Edge" by Certainteed Corp. or equal by Knauf Fiberglass.
2. Duct liner adhesive shall comply with ASTM C916 "Specifications for Adhesives for Duct Thermal Insulation".
 3. Liner Fasteners: Mechanical or weld secured fasteners for duct liner where finish of duct is not exposed. For exposed ductwork, except in mechanical rooms, provide adhesively secured fasteners. Position fasteners are recommended by SMACNA.
 4. Minimum Sound Absorption coefficients shall be:

	125	250	500	1000	2000	4000
Coefficient	0.34	0.42	0.47	0.64	0.80	0.79
Attenuation*	3	5	12	24	21	17

* Attenuation in dB per 10 lineal feet, per ASTM E477

2.4 METAL JACKET

- A. Smooth aluminum jacket 0.016 inch thick.
- B. Integral polykraft or poly-surlyn moisture barrier.
- C. Banded locking joints with field applied silicone weatherproof sealant.
- D. Similar to Johns Manville Corp, or approved equal.

2.5 INSULATION ACCESSORIES

- A. The following accessories shall be used in the application of the thermal insulations specified under this Section:
 1. PVC Fittings Covers: similar to Johns Manville Corp "Zeston", or approved equal.
 2. Pressure Sensitive polyester film tape to secure pipe insulation up to 12" outside diameter: Similar to 3M 30-80, or approved equal.
 3. Vapor Seal Mastic: Similar to Childers CP-35, or approved equal.
 4. Lagging Adhesive: Similar to Childers CP-52, or approved equal.
 5. Wire: 16 gauge soft stainless steel.
 6. Insulation Bonding Adhesive (To Metal): Similar to Childers CP-82, or approved equal.
 7. Insulating and Finishing Cement: Similar to Insulco Smooth Kote, or approved equal.
 8. Mechanical Fasteners - Welded or adhered pins with speed clip washers: Similar to Gemco Midwest Fasteners, or approved equal.
 9. Bands for Equipment:
 - a. Outside diameter of insulation is less than 24 inch: 1/2 inch x 0.020-inch (25 ga.) stainless steel.
 - b. Where diameter is 36 inches or larger: 3/4 inch x 0.020 inch.
 10. Bands for Piping: 1/2 inch x 0.020-inch stainless steel.
 11. Wire Mesh: 1 inch by 20-gage stainless steel hexagonal wire netting.

PART 3 - EXECUTION

3.1 INSULATION APPLICABILITY

A. Interior Chilled Water - Type Da insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1-1/2	up to 1-1/4
2	1-1/2 and up

B. Interior Hot Water– Type A insulation required::

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1-1/2	up to 2-1/2
2	3 and up

C. Condensate Drains (except in plenums and fire partitions/floors) – Type B insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1/2	all

D. Condensate Drains (inside plenums and fire partitions/floors) – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1/2	up to 1
3/4	1-1/4 and up

E. Refrigerant Suction Lines & Valves (except in plenums and fire partitions/floors) – Type B

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1	all

F. Refrigerant Suction Lines & Valves (in plenums and fire partitions/floors), and hot gas bypass piping – Type A insulation required:

<u>Insulation Thickness (in)</u>	<u>Pipe Sizes (in)</u>
1	all

G. Medium Pressure Supply Ducts – Type F insulation required (see Note G below):

<u>Insulation Thickness (in)</u>	<u>Duct Sizes (in)</u>
2	all

H. Low Pressure Supply Ducts – Type F insulation required (see Note G below):

<u>Insulation Thickness (in)</u>	<u>Duct Sizes (in)</u>
2	all

I. Outside air ductwork: No insulation required (except when air is pre-cooled below dew point of air surrounding duct).

- J. Domestic Water Heaters shall be factory insulated.
- K. Cold equipment – Type Dc insulation required, minimum 1/2". Consult with equipment manufacturer as thickness may vary depending on service application and equipment manufacturer installation recommendations.
- L. Hot equipment – Type Dh insulation required, minimum 2". Consult with equipment manufacturer as thickness may vary depending on service application and equipment manufacturer installation recommendations.

Notes:

- a. Insulate necks, bells, and plenums of supply diffusers with Type F insulation. Factory applied insulation to diffusers and plenums is acceptable.
- b. Exhaust ductwork is not insulated, unless otherwise noted.
- c. Exposed supply and return ductwork will be double wall, internally lined.
- d. All duct connected to equipment without compressors must be internally lined with Type G duct liner for a distance not less than 5 feet from the equipment connection.
- e. All duct connected to equipment that contains compressors must be internally lined with Type G duct liner for a distance not less than 10 feet from the equipment connection.
- f. The above thicknesses are the minimum required. All local codes and local energy codes shall be complied with.
- g. All piping exposed to outdoors shall be insulated. All piping subject to freezing shall be provided with heat tracing. Coordinate insulation with heat trace cable and controls.
- h. Insulation types and thickness are a minimum standard. Each application shall be carefully considered and insulation product type and thickness shall be appropriate for each specific application. Submit all insulation products with verification of their service intent.

3.2 PIPING INSULATION GENERAL REQUIREMENTS

A. Preparation

- 1. Do not apply insulation until piping has been leak tested.
- 2. All surfaces to be insulated shall be dry and free of loose scale, rust, dirt, oil or water.

B. Application:

- 1. Insulation shall be installed in a smooth, clean workmanlike manner. Joints shall be tight and finished smooth without fish-mouths.
- 2. Insulation shall fit tightly against the surface to which it is applied to prevent air circulation between the insulation and the pipe or equipment to which it is applied.
- 3. Insulation applied to cold piping or equipment shall be completely vapor sealed, free of pinholes or other openings.
- 4. Do not use wet insulation materials.
- 5. All longitudinal joints on vertical pipe runs shall be staggered.
- 6. Apply insulation so as to permit expansion or contraction of pipelines without causing damage to insulation or surface finish.

7. Do not apply mastic or adhesive until all previous applications of mastic and adhesives have thoroughly dried.
8. No bands or staples shall be provided on covering.
9. The adhesive used in connection with all covering work shall contain an approved vermin and rodent proof ingredient.
10. Provide 24-gauge sheet-metal saddle between the pipe hanger/support and the exterior of the insulation. Saddle length shall be the same as insulation inserts.

C. Application at Fittings:

1. Insulation of flanges and flanged fittings shall overlap adjacent pipe covering at least 1 inch. Valves shall be insulated up to the gland only.
2. Pipeline strainers shall be insulated in such a manner as to permit removal of strainer basket without disturbing insulation of the strainer body.
3. Insulation adjacent to un-insulated flanges shall be tapered back and neatly finished so as to allow access to and removal of bolts without injury to covering.

3.3 TYPE A INSTALLATION

- A. Tightly butt together sections of insulation on pipe runs sealing longitudinal seams of jacket with a self-sealing adhesive. Seal end joints with 4-inch wide straps of matching vapor barrier tape. Seal off ends of insulation with vapor seal mastic at valves, fittings and flanges. No further finish required. Mastic shall extend onto the bare pipe and over the insulation O.D.
- B. PVC fitting jackets shall be used when they are available for the particular application. When molded or routed coverings are not available, the coverings shall be fabricated in the field similar to equipment insulation. Molded or routed fitting covers are highly recommended. Order PVC pre-curved.
- C. Cold Piping:
 1. Cover valves, fittings and flanges with insulation having the same thickness as adjacent pipe covering, securing in place reforming tape up to 12" O.D. and ½" wide SST bands on larger O.D. Apply a PVC jacket and seal joints with PVC cement (solvent welding).
- D. Hot Piping:
 1. Covers shall overlap the pipe insulation by the thickness of the insulation or 2" min. Cover valves, fittings and flanges with insulation similar to the adjacent pipe covering, securing in place with reforming tape up to 12" O.D. and ½" wide SST bands on larger O.D. Apply a PVC jacket and tape end joints to adjacent pipe insulation.
 2. Do not use PVC fitting jackets where the surface of the insulation is above 150 degrees F.
- E. Exterior Piping:
 1. Exterior above grade water piping shall be finished with a weatherproof jacket and an aluminum jacket. Lap and seal joints as per manufacturer's instructions. Place laps to shed water.

3.4 TYPE B INSTALLATION

- A. Type B insulation shall be slipped on the pipe prior to connection, and the butt joints shall be sealed. Where the slip on technique is not possible, the insulation shall be carefully slit and applied to the pipe.
- B. All joints shall be completely butt sealed with the manufacturer's recommended adhesive.
- C. Do not apply Type B insulation in multiple layers.
- D. Type B insulation shall not be used in plenums nor firewall penetrations.
- E. This Contractor shall paint Type B insulation exterior to the building with two coats of a vinyl acrylic paint recommended by the insulation manufacturer for protection against ultraviolet degradation and shall be flexible with no cracking. It is recommended in high humid areas to coat the insulation with a vapor barrier mastic to .037 min. DFT.

3.5 TYPE C INSTALLATION

- A. Exterior
 - 1. Butter joints of insulation with non-setting adhesive. Secure with factory applied Self-Seal laps. Installation shall be as per manufacturer's guidelines.
 - 2. Finish shall be factory applied All Service Jackets. All fittings shall be finished with vapor seal mastic reinforced with white glass mesh. Minimum 0.037 thick DFT of mastic.
 - 3. Piping exposed in machine rooms shall be finished with vapor seal mastic and open weave membrane 10 x 10.
 - 4. Piping exposed to weather shall be finished with all service jacket and additional finish of 0.16 thick aluminum jacket. Aluminum jacket shall be secured with stainless bands located on maximum centers of 12 inches and at the overlap. No screws or pop rivets shall be used.
 - 5. Fittings and valves shall be finished with vapor seal mastic, reinforced with minimum 0.037" DFT of mastic, glass mesh and aluminum preformed fitting covers.

3.6 TYPE D AND E INSTALLATION

- A. Equipment Insulation Application:
 - 1. Apply insulation to fit as closely as possible to equipment.
 - 2. Stagger joints where possible.
 - 3. Bevel insulation around nameplates, ASME stamp and access plates.
 - 4. Insulation on equipment that must be opened periodically shall be constructed so insulation can be removed and replaced without damage.
 - 5. Do not install Type E insulation on aluminum surfaces or with aluminum jacket.
- B. Hot Equipment:
 - 1. Install 3/4-inch expanded metal over equipment with standing ribs or seams prior to applying insulation to eliminate ribs or seams penetrating through the insulation.
 - 2. Secure the insulation with steel bands spaced on 12-inch centers.

3. Where required, use welded studs, clips or angles as anchors for wire or bands on flat surfaces.
4. Seal joints with insulating cement.
5. Over the insulation stretch 1-inch hexagonal mesh wire and lace the edges together.
6. Apply a 1/4-inch thick coat of finishing cement and trowel smooth.
7. Smooth insulation with lagging adhesive, cover with glass cloth and a final coat of lagging adhesive.
8. On small equipment where it is not practical, omit the wire mesh and finishing cement on Type D insulation.

C. Cold Equipment

1. Cover irregular surfaces with a smoothing coat of insulating cement.
2. Secure insulation with wire or with stainless bands spaced on 12-inch centers.
3. Seal joints with vapor seal mastic.

4. Embed a layer of glass into a 1/16-inch coating of vapor seal mastic. Then coat the outside of the glass cloth with a 1/16-inch coating of vapor seal mastic.

D. Roof Drain Bodies

1. Insulate similar to cold equipment.
2. Insulated boxes around roof drain bodies are not acceptable.

3.7 TYPE F INSTALLATION

A. Ductwork Insulation Application:

1. Apply insulation tightly and smoothly to duct.
2. Secure insulation on the bottom of ducts and plenums and on the sides of plenums and other places where the insulation will sag and max 3" from any corner.
3. Impale insulation over pins or anchors located not more than 18 inches apart and hold in place with washers and clips.
4. Cut off protruding pin after clips are secured and seal with 2-mil. aluminum foil backed pressure sensitive tape.
5. Apply insulation with joints tightly butted.
6. Seal all ductwork joints, punctures and fittings with a mastic type sealant containing a vapor barrier.
7. Cover all breaks, joints, punctures and voids with a vapor seal mastic and cover with a vapor barrier material identical to vapor barrier on the insulation, where gaps exceed 2".
8. Bevel insulation around nameplates, access plates and doors.
9. Insulation shall be continuous through walls and floors except at fire dampers.

3.8 TYPE G INSTALLATION

A. Internal Lining Insulation Application:

1. Apply where specified herein.
2. Apply liner in accordance with SMACNA Duct Liner Application Standard, later edition.
3. Provide metal liner for the sound lining. Metal liner to be 24 gauge galvanized sheet metal with perforation of 3/32" diameter holes on 3/16" center. Properly fasten liner to the duct so that liner does not sag or vibrate.

3.9 METAL JACKET INSTALLATION

- A. Cover all piping insulation exposed to the exterior with metal jacket as specified herein.

3.10 HANGERS

- A. Continue insulation through pipe hangers. Provide either rigid insulation inserts or sheet metal inserts at all outside pipe hangers. Provide rigid insulation inserts for piping operating below 60 °F. and sheet metal inserts for piping above 60 °F.
- B. Provide rigid insulation (on non-insulated piping) or sheet metal inserts (on insulated piping) between the pipe and pipe hanger - shall be of a thickness equal to the adjoining insulation and shall be provided with vapor barrier where required. Insulation insert shall not be less than the following lengths:

1/2" to 2 1/2" pipe size	10 Inches Long
3" to 6" pipe size	12 Inches Long
8" to 10" pipe size	16 Inches Long
12" and over	22 Inches Long

- C. Inserts for cold piping shall have a vapor barrier facing of the same material as the adjacent pipe insulation. Seal inserts into insulation with vapor seal mastic.
- D. Sheet metal inserts shall be of steel sheet. Gauge shall conform to manufacturer's recommendation for pipe size. Sheet metal inserts shall have insulation filler of the same material as the adjacent pipe insulation.

3.11 PIPE SLEEVES

- A. Pipe insulation and vapor barrier shall be continuous through sleeves in walls and floors.
- B. Type B insulation shall not be used in sleeves through firewalls or fire rated (2-hour) floor systems. Use Type A or Type C through the sleeve instead and vapor seal the joint between the two insulations.
- C. Provide 26 gauge galvanized steel or 0.020 inch aluminum jacket over insulation on pipe passing through sleeves where sealant is required.
- D. Where penetrating interior walls, extend the metal jacket 2 inches out either side of the wall and secure each end with a metal band compressing the insulation slightly.
- E. Where penetrating floors, extend the metal jacket 2 inches below the floor and 5 inches above the floor. Secure with metal bands.

END OF SECTION

23 09 00 - DIRECT DIGITAL CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All work of this Division shall be coordinated and provided by the single Building Management System (BMS) Contractor.
- B. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 15 Sections for details.
- C. The work of this Division shall be as required by the Specifications, Point Schedules and Drawings.
- D. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.2 DEFINITIONS

- A. Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.
- B. Binary: A two-state system where an "ON" condition is represented by one discrete signal level and an "OFF" condition is represented by a second discrete signal level.
- C. Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming, and associated materials, to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.
- D. BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.
- E. Control Sequence: An BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.
- F. Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.
- G. BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.
- H. Node: A digitally programmable entity existing on the BMS network.
- I. BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable

codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.

- J. Provide: The term "Provide" and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.
- K. PC: IBM-compatible Personal Computer from a recognized major manufacturer
- L. Furnish: The term "Furnish" and its derivatives when used in this Division shall mean supply at the BMS Contractor's cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.
- M. Wiring: The term "Wiring" and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.
- N. Install: The term "Install" and its derivatives when used in this Division shall mean receive at the jobsite and mount.
- O. Protocol: The term "protocol" and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes.
- P. Software: The term "software" and its derivatives when used in this Division shall mean all of programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.
- Q. The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.
- R. Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.
- S. The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE		American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM	-	Electronically Erasable Programmable Read Only Memory

EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol
TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.3 BMS DESCRIPTION

- A. The Building Management System (BMS) shall be a complete system designed for use with the enterprise IT systems. This functionality shall extend into the equipment rooms. Devices residing on the automation network located in equipment rooms and similar shall be Johnson Controls fully compatible existing devices that mount and communicate directly Auburn IT infrastructure across campus for uploading and downloading of controller are required, alarming, metering and energy management. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the FMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN.
- B. All points of user interface are existing and shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.
- C. The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specifications together with the associated Point Sheets

and Drawings and the associated interfacing work as referenced in the related documents.

- D. The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.
- E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.
- F. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.
- G. The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:
 - 1. Operator information, alarm management and control functions.
 - 2. Enterprise-level information and control access.
 - 3. Information management including monitoring, transmission, archiving, retrieval, and reporting functions.
 - 4. Diagnostic monitoring and reporting of BMS functions.
 - 5. Offsite monitoring and management access.
 - 6. Energy management
 - 7. Standard applications for terminal HVAC systems.

1.4 QUALITY ASSURANCE

- A. General
 - 1. The Building Management System Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.
 - 2. The BMS Contractor shall be a recognized national manufacturer, installer and service provider of BMS.
 - 3. As evidence and assurance of the contractor's ability to support the Owner's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years and have successfully completed total projects of at least 10 times the value of this contract in each of the preceding five years.
 - 4. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems, and shall be the manufacturer's latest standard of design at the time of bid.
- B. Workplace Safety And Hazardous Materials
 - 1. Provide a safety program in compliance with the Contract Documents.

2. The FMS Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The Contractor shall ensure that all subcontractors and employees have written safety programs in place that covers their scope of work, and that their employees receive the training required by the OSHA have jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the Contractor or its subcontractors shall be reported to either the General Contractor or the Owner within the same day. The Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The Contractor shall sign and date a safety certification form prior to any work being performed, stating that the Contractors' company is in full compliance with the Project safety requirements.
8. The Contractor's safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the AHJ at the Project site.
9. The Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. QUALITY MANAGEMENT PROGRAM

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:
 - a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.
 - b. Manage the financial aspects of the BMS Contract.
 - c. Coordinate as necessary with other trades.
 - d. Be responsible for the work and actions of the BMS workforce on site.

1.5 REFERENCES

- A. All work shall conform to the following Codes and Standards, as applicable:
 1. National Fire Protection Association (NFPA) Standards.
 2. National Electric Code (NEC) and applicable local Electric Code.
 3. Underwriters Laboratories (UL) listing and labels.

4. UL 864 UUKL Smoke Control
 5. UL 268 Smoke Detectors.
 6. UL 916 Energy Management
 7. NFPA 70 - National Electrical Code.
 8. NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
 9. NFPA 92A and 92B Smoke Purge/Control Equipment.
 10. Factory Mutual (FM).
 11. American National Standards Institute (ANSI).
 12. National Electric Manufacturer's Association (NEMA).
 13. American Society of Mechanical Engineers (ASME).
 14. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) [user note: add ASHRAE 62 IAQ as applicable].
 15. Air Movement and Control Association (AMCA).
 16. Institute of Electrical and Electronic Engineers (IEEE).
 17. American Standard Code for Information Interchange (ASCII).
 18. Electronics Industries Association (EIA).
 19. Occupational Safety and Health Administration (OSHA).
 20. American Society for Testing and Materials (ASTM).
 21. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
 22. Americans Disability Act (ADA)
 23. ANSI/EIA 909.1-A-1999 (LonWorks)
 24. ANSI/ASHRAE Standard 195-2004 (BACnet)
- B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.
- C. All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.6 SUBMITTALS

- A. Shop Drawings, Product Data, and Samples
1. The BMS contractor shall submit a list of all shop drawings with submittals dates within 30 days of contract award.
 2. Submittals shall be in defined packages. Each package shall be complete and shall only reference itself and previously submitted packages. The packages shall be as approved by the Architect and Engineer for Contract compliance.
 3. Allow 15 working days for the review of each package by the Architect and Engineer in the scheduling of the total BMS work.
 4. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

5. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
6. The BMS Contractor shall correct any errors or omissions noted in the first review.
7. At a minimum, submit the following:
 - a. BMS network architecture diagrams including all nodes and interconnections.
 - b. Systems schematics, sequences and flow diagrams.
 - c. Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.
 - d. Samples of Graphic Display screen types and associated menus.
 - e. Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.
 - f. Control Damper Schedule including a separate line for each damper provided under this section and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
 - ~~g.~~ Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
 - ~~h.~~ Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address
 - i. Details of all BMS interfaces and connections to the work of other trades.
 - j. Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.7 RECORD DOCUMENTATION

- A. Operation and Maintenance Manuals
 1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Owner's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Compact Disc media, and include the following for the BMS provided:
 - a. Table of contents.
 - b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.
 - c. Manufacturers product data sheets or catalog pages for all products including software.
 - d. System Operator's manuals.
 - e. Archive copy of all site-specific databases and sequences.
 - f. BMS network diagrams.
 - g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

1.8 WARRANTY

- A. Standard Material and Labor Warranty:
 1. Provide a one-year labor and material warranty on the BMS.
 2. If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.
 3. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.
- B. The Building Management System shall consist of the following:
 1. Standalone Network Automation Engine(s)
 2. Field Equipment Controller(s)
 3. Input/Output Module(s)
 4. Local Display Device(s)
 5. Portable Operator's Terminal(s)
 6. Distributed User Interface(s)
 7. Network processing, data storage and communications equipment
 8. Other components required for a complete and working BMS
- C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.
- D. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
 1. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2. The System shall maintain all settings and overrides through a system reboot.
- E. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.
1. The System shall comply with the following International Code Council (ICC) Codes:
 - a. Building Officials and code Administrators International (BOMA) model code
 - b. International Conference of Building Officials (ICBO) model code
 - c. Southern Building Code Congress International (SBCCI) regulations
- F. Acceptable Manufacturers
1. Johnson Controls, Metasys

2.2 BMS ARCHITECTURE

- A. Automation Network
1. The automation network shall be based on a PC industry standard of Ethernet TCP/IP. Where used, LAN controller cards shall be standard "off the shelf" products available through normal PC vendor channels.
 2. The automation network shall be capable of operating at a communication speed of 100 Mbps, with full peer-to-peer network communication.
 3. Network Automation Engines (NAE) shall reside on the automation network.
 4. The automation network will be compatible with other enterprise-wide networks. Where indicated, the automation network shall be connected to the enterprise network and share resources with it by way of standard networking devices and practices.
- B. Control Network
1. Network Automation Engines (NAE) shall provide supervisory control over the control network and shall support the following communication protocols:
 - a. BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9
 - ◇ The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 - b. The Johnson Controls N2 Field Bus.
 2. Control networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.
 3. DDC Controllers shall reside on the control network.
 4. Control network communication protocol shall be BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135.
 5. A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
 6. The PICS shall be submitted 10 days prior to bidding.

2.3 USER INTERFACE

- A. Dedicated Web Based User Interface
 - 1. Where indicated on plans the BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS Network Automation Engines to facilitate greater fault tolerance and reliability.
 - 2. Dedicated User Interface Architecture – The architecture of the computer shall be implemented to conform to industry standards, so that it can accommodate applications provided by the BMS Contractor and by other third party applications suppliers, including but not limited to Microsoft Office Applications. Specifically it must be implemented to conform to the following interface standards.
 - a. Microsoft Internet Explorer for user interface functions
 - b. Microsoft Office Professional for creation, modification and maintenance of reports, sequences other necessary building management functions
 - c. Microsoft Outlook or other e-mail program for supplemental alarm functionality and communication of system events, and reports
 - d. Required network operating system for exchange of data and network functions such as printing of reports, trends and specific system summaries
 - 3. (EXISTING NOT REQUIRED) PC Hardware – The personal computer(s) shall be configured as follows:
 - 4. Operating System Software
 - a. Windows XP Professional
 - b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.
 - c. Provide software registration cards to the Owner for all included software.
- B. Distributed Web Based User Interface
 - 1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.
 - 2. The software shall run on the Microsoft Internet Explorer (6.0 or higher) browser.
- C. User Interface Application Components
 - 1. Operator Interface
 - a. An integrated browser based client application shall be used as the user operator interface program.
 - b. The System shall employ an event-driven rather than a device polling methodology to dynamically capture and present new data to the user.
 - c. All Inputs, Outputs, Setpoints, and all other parameters as defined within Part 3, shown on the design drawings, or required as part of the system software, shall be displayed for operator viewing and modification from the operator interface software.

- d. The user interface software shall provide help menus and instructions for each operation and/or application.
 - e. The system shall support customization of the UI configuration and a home page display for each operator.
 - f. The system shall support user preferences in the following screen presentations:
 - ◇ Alarm
 - ◇ Trend
 - ◇ Display
 - ◇ Applications
 - g. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.
 - h. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:
 - ◇ User access for selective information retrieval and control command execution
 - ◇ Monitoring and reporting
 - ◇ Alarm, non-normal, and return to normal condition annunciation
 - ◇ Selective operator override and other control actions
 - ◇ Information archiving, manipulation, formatting, display and reporting
 - ◇ FMS internal performance supervision and diagnostics
 - ◇ On-line access to user HELP menus
 - ◇ On-line access to current FMS as-built records and documentation
 - ◇ Means for the controlled re-programming, re-configuration of FMS operation and for the manipulation of FMS database information in compliance with the prevailing codes, approvals and regulations for individual FMS applications
 - i. The system shall support a list of application programs configured by the users that are called up by the following means:
 - ◇ The Tools Menu
 - ◇ Hyperlinks within the graphics displays
 - ◇ Key sequences
 - j. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of operations or system communications shall not be acceptable.
2. Navigation Trees
- a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.

- b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
 - c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display, but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.
3. Alarms
- a. Alarms shall be routed directly from Network Automation Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
 - ◇ Log date and time of alarm occurrence.
 - ◇ Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
 - ◇ Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
 - ◇ Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
 - ◇ Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This must be provided in addition to the pop up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable.
 - ◇ Any attribute of any object in the system may be designated to report an alarm.
 - b. The FMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
 - c. The FMS shall allow a minimum of 4 categories of alarm sounds customizable through user defined wav.files.
 - d. The FMS shall annunciate application alarms at minimum, as required by Part 3.
4. Reports and Summaries
- a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
 - ◇ All points in the BMS
 - ◇ All points in each BMS application
 - ◇ All points in a specific controller
 - ◇ All points in a user-defined group of points
 - ◇ All points currently in alarm
 - ◇ All points locked out
 - ◇ All BMS schedules

- ◇ All user defined and adjustable variables, schedules, interlocks and the like.
 - b. Summaries and Reports shall be accessible via standard UI functions and not dependent upon custom programming or user defined HTML pages.
 - c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.
 - d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software such as Microsoft Access, Microsoft Excel, or Crystal Reports.
5. Schedules
- a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:
 - ◇ Weekly schedules
 - ◇ Exception Schedules
 - ◇ Monthly calendars
 - b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.
 - c. It shall be possible to define one or more exception schedules for each schedule including references to calendars
 - d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard, and shall automatically reschedule equipment operation as previously defined on the exception schedules.
 - e. Changes to schedules made from the User Interface shall directly modify the Network Automation Engine schedule database.
 - f. Schedules and Calendars shall comply with ASHRAE SP135/2003 BACnet Standard.
 - g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.
6. Password
- a. Multiple-level password access protection shall be provided to allow the user/manager to user interface control, display, and database manipulation capabilities deemed appropriate for each user, based on an assigned password.
 - b. Each user shall have the following: a user name (24 characters minimum), a password (12 characters minimum), and access levels.
 - c. The system shall allow each user to change his or her password at will.
 - d. When entering or editing passwords, the system shall not echo the actual characters for display on the monitor.
 - e. A minimum of five levels of access shall be supported individually or in any combination as follows:
 - ◇ Level 1 = View Data
 - ◇ Level 2 = Command

- ◇ Level 3 = Operator Overrides
 - ◇ Level 4 = Database Modification
 - ◇ Level 5 = Database Configuration
 - ◇ Level 6 = All privileges, including Password Add/Modify
- f. A minimum of 100 unique passwords shall be supported.
- g. Operators shall be able to perform only those commands available for their respective passwords. Display of menu selections shall be limited to only those items defined for the access level of the password used to log-on.
- h. The system shall automatically generate a report of log-on/log-off and system activity for each user. Any action that results in a change in the operation or configuration of the control system shall be recorded, including: modification of point values, schedules or history collection parameters, and all changes to the alarm management system, including the acknowledgment and deletion of alarms.
7. Screen Manager
- a. The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum of 4 active display windows plus a network or user defined navigation tree.
8. Dynamic Color Graphics
- a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
- b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed.

The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.

- c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
- ◇ All graphics shall be fully scalable
 - ◇ The graphics shall support a maintained aspect ratio.
 - ◇ Multiple fonts shall be supported.
 - ◇ Unique background shall be assignable on a per graphic basis.
 - ◇ The color of all animations and values on displays shall indicate if the status of the object attribute.
- d. Operation from graphics – It shall be possible to change values (setpoints) and states in system controlled equipment by using drop-down windows accessible via the pointing device
- e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations, and defining all runtime binding.

- ◇ The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
 - ◇ In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.
 - f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
- 9. Historical trending and data collection
 - a. Each Automation Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
 - ◇ Any point, physical or calculated, may be designated for trending. Three methods of collection shall be allowed: Defined time interval
Upon a change of value
 - ◇ Each Automation Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
- 10. Trend data viewing and analysis
 - a. Provide a trend viewing utility that shall have access to all database points.
 - b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.
 - c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends
 - d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.
 - e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.
 - f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.
 - g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time based accumulation.
 - h. The Display shall support the user's ability to change colors, sample sizes, and types of markers.
- 11. Database Management
 - a. The System shall provide a Database Manager that separates the database monitoring and managing functions by supporting two separate windows.
 - b. Database secure access shall be accomplished using standard SQL authentication including the ability to access data for use outside of the Building Automation application.
 - c. The database managing function shall include summarized information on trend, alarm, event, and audit for the following database management actions:

- ◇ Backup
 - ◇ Purge
 - ◇ Restore
- d. The Database Manager shall support four tabs:
- ◇ Statistics – shall display Database Server information and Trend, Alarm (Event), and Audit information on the Metasys Databases.
 - ◇ Maintenance – shall provide an easy method of purging records from the Metasys Server trend, alarm (event), and audit databases by supporting separate screens for creating a backup prior to purging, selecting the database, and allowing for the retention of a selected number of day's data.
 - ◇ Backup – Shall provide the means to create a database backup file and select a storage location.
 - ◇ Restore – shall provide a restricted means of restoring a database by requiring the user to log into an Expert Mode in order to view the Restore screen.
- e. The Status Bar shall appear at the bottom of all Metasys Database Manager Tabs and shall provide information on the current database activity. The following icons shall be provided:
- ◇ Ready
 - ◇ Purging Record from a database
 - ◇ Action Failed
 - ◇ Refreshing Statistics
 - ◇ Restoring database
 - ◇ Shrinking a database
 - ◇ Backing up a database
 - ◇ Resetting internet information Services
 - ◇ Starting the Metasys Device Manager
 - ◇ Shutting down the Metasys Device Manager
 - ◇ Action successful
- f. The Database Manager monitoring functions shall be accessed through the Monitoring Settings window and shall continuously read database information once the user has logged in.
- g. The System shall provide user notification via taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.
- h. The Monitoring Settings window shall have the following sections:
- ◇ General – Shall allow the user to set and review scan intervals and start times.
 - ◇ Email – Shall allow the user to create and review e-mail and phone text messages to be delivered when a Warning or Alarm is generated.
 - ◇ Warning – shall allow the user to define the Warning limit parameters, set the Reminder Frequency, and link the e-mail message.

- ◇ Alarm – shall allow the user to define the Alarm limit parameters, set the Reminder Frequency, and link the e-mail message.
 - ◇ Database login – Shall protect the system from unauthorized database manipulation by creating a Read Access and a Write Access for each of the Trend, Alarm (Event) and Audit databases as well as an Expert Mode required to restore a database.
- i. The Monitoring Settings Taskbar shall provide the following informational icons:
- ◇ Normal – Indicates by color and size that all databases are within their limits.
 - ◇ Warning - Indicates by color and size that one or more databases have exceeded their Warning limit.
 - ◇ Alarm - Indicates by color and size that one or more databases have exceeded their Alarm limit.
- j. The System shall provide user notification via Taskbar icons and e-mail messages when a database value has exceeded a warning or alarm limit.

2.4 NETWORK AUTOMATION ENGINES (NAE)

- A. Network Automation Engine (NAE 35XX)
1. The Network Automation Engine (NAE) shall be a fully user-programmable, supervisory controller. The NAE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Automation Engines.
 2. Automation network – The NAE shall reside on the automation network and shall support a subnet of system controllers.
 3. User Interface – Each NAE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.
 - a. The web based UI software shall be imbedded in the NAE. Systems that require a local copy of the system database on the user's personal computer are not acceptable.
 - b. The NAE shall support a minimum of two (2) concurrent users.
 - c. The web based user shall have the capability to access all system data through one NAE.
 - d. Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one NAE.
 - e. Systems that require the user to address more than one NAE to access all system information are not acceptable.
 - f. The NAE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NAE.
 - g. Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.
 - h. The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

- ◇ Configuration
 - ◇ Commissioning
 - ◇ Data Archiving
 - ◇ Monitoring
 - ◇ Commanding
 - ◇ System Diagnostics
- i. Systems that require workstation software or modified web browsers are not acceptable.
 - j. The NAE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.
4. Processor – The NAE shall be microprocessor-based with a minimum word size of 32 bits. The NAE shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. NAE size and capability shall be sufficient to fully meet the requirements of this Specification.
 5. Memory – Each NAE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.
 6. Hardware Real Time Clock – The NAE shall include an integrated, hardware-Based, real-time clock.
 7. The NAE shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power - On/Off
 - b. Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic
 - c. Ethernet Connection Speed – 10 Mbps/100 Mbps
 - d. FC Bus – Normal Communications/No Field Communications
 - e. Peer Communication – Data Traffic between NAE Devices
 - f. Run – NAE Running/NAE in Startup/NAE Shutting Down/Software Not Running
 - g. Bat Fault – Battery Defective, Data Protection Battery Not Installed
 - h. Fault – General Fault
 - i. Modem RX – NAE Modem Receiving Data
 - j. Modem TX – NAE Modem Transmitting Data
 8. Communications Ports – The NAE shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator’s terminals.
 - a. USB port
 - b. URS-232 serial data communication port
 - c. RS-485 port
 - d. Ethernet port
 9. Diagnostics – The NAE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Automation Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.
 10. Power Failure – In the event of the loss of normal power, The NAE shall continue to operate for a user adjustable period of up to 10 minutes after which

there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

- a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.
 - b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.
11. Certification – The NAE shall be listed by Underwriters Laboratories (UL).
 12. Controller network – The NAE shall support the following communication protocols on the controller network:
 - a. The NAE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - ◇ The NAE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The NAE shall be tested and certified as a BACnet Building Controller (B-BC).
 - ◇ A BACnet Protocol Implementation Conformance Statement shall be provided for the NAE.
 - ◇ The Conformance Statements shall be submitted 10 days prior to bidding.
 - ◇ The NAE shall support a minimum of 50 control devices.

2.5 DDC SYSTEM CONTROLLERS

- A. Field Equipment Controller (FEC X610)
 1. The Field Equipment Controller (FEC) shall be a fully user-programmable, digital controller that communicates via BACnet MS/TP protocol.
 - a. The FEC shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - ◇ The FEC shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - ◇ The FEC shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - ◇ A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - ◇ The Conformance Statement shall be submitted 10 days prior to bidding.
 2. The FEC shall employ a finite state control engine to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.
 3. Controllers shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only shall not be acceptable.
 4. The FEC shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

5. The FEC shall include a removable base to allow pre-wiring without the controller.
6. The FEC shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Field Controller Bus - Normal Data Transmission
 - g. Field Controller Bus - No Data Transmission
 - h. Field Controller Bus - No Communication
 - i. Sensor-Actuator Bus - Normal Data Transmission
 - j. Sensor-Actuator Bus - No Data Transmission
 - k. Sensor-Actuator Bus - No Communication
7. The FEC shall accommodate the direct wiring of analog and binary I/O field points.
8. The FEC shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - ◇ Analog Input, Voltage Mode
 - ◇ Analog Input, Current Mode
 - ◇ Analog Input, Resistive Mode
 - ◇ Binary Input, Dry Contact Maintained Mode
 - ◇ Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - ◇ Dry Contact Maintained Mode
 - ◇ Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following:
 - ◇ Analog Output, Voltage Mode
 - ◇ Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - ◇ 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:
 - ◇ Analog Output, Voltage Mode
 - ◇ Binary Output Mode
9. The FEC shall have the ability to reside on a Field Controller Bus (FC Bus).
 - a. The FC Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard protocol SSPC-135, Clause 9.
 - b. The FC Bus shall support communications between the FECs and the NAE.
 - c. The FC Bus shall also support Input/Output Module (IOM) communications with the FEC and with the NAE.
 - d. The FC Bus shall support a minimum of 100 IOMs and FECs in any combination.
 - e. The FC Bus shall operate at a maximum distance of 15,000 Ft. between the FEC and the furthest connected device.
 - f.
10. The FEC shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

- a. The SA Bus shall be a Master-Slave/Token-Passing (MS/TP) Bus supporting BACnet Standard Protocol SSPC-135, Clause 9.
 - b. The SA Bus shall support a minimum of 10 devices per trunk.
 - c. The SA Bus shall operate at a maximum distance of 1,200 Ft. between the FEC and the furthest connected device.
11. The FEC shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the FC Bus or the SA Bus.
12. The FEC shall support, but not be limited to, the following:
- a. Hot water, chilled water/central plant applications
 - b. Built-up air handling units for special applications
- C. Terminal units
- c. Special programs as required for systems control

2.6 FIELD DEVICES

- A. Input/Output Module (IOM X710)
- 1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC.
 - 2. The IOM shall communicate with the FEC over the FC Bus or the SA Bus.
 - 3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.
 - a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).
 - c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.
 - d. The Conformance Statement shall be submitted 10 days prior to bidding.
 - 4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.
 - 5. The IOM shall have a minimum of 4 points to a maximum of 17 points.
 - 6. The IOM shall support the following types of inputs and outputs:
 - a. Universal Inputs - shall be configured to monitor any of the following:
 - ◇ Analog Input, Voltage Mode
 - ◇ Analog Input, Current Mode
 - ◇ Analog Input, Resistive Mode
 - ◇ Binary Input, Dry Contact Maintained Mode
 - ◇ Binary Input, Pulse Counter Mode
 - b. Binary Inputs - shall be configured to monitor either of the following:
 - ◇ Dry Contact Maintained Mode
 - ◇ Pulse Counter Mode
 - c. Analog Outputs - shall be configured to output either of the following:
 - ◇ Analog Output, Voltage Mode
 - ◇ Analog Output, current Mode
 - d. Binary Outputs - shall output the following:
 - ◇ 24 VAC Triac
 - e. Configurable Outputs - shall be capable of the following:

- ◇ Analog Output, Voltage Mode
- ◇ Binary Output Mode
- 7. The IOM shall include troubleshooting LED indicators to identify the following conditions:
 - a. Power On
 - b. Power Off
 - c. Download or Startup in progress, not ready for normal operation
 - d. No Faults
 - e. Device Fault
 - f. Normal Data Transmission
 - g. No Data Transmission
 - h. No Communication
- B. Network Sensors (NS-XXX700X)
 - 1. The Network Sensors (NS) shall have the ability to monitor the following variables as required by the systems sequence of operations:
 - a. Zone Temperature
 - b. Zone Humidity
 - c. Zone Setpoint
 - d. Discharge Air Temperature
 - 2. The NS shall transmit the information back to the controller on the Sensor-Actuator Bus (SA Bus) using BACnet Standard protocol SSPC-135, Clause 9.
 - 3. The NS shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.
 - a. The NS shall be tested and certified as a BACnet Smart Sensors (B-SS).
 - b. A BACnet Protocol Implementation Conformance Statement shall be provided for the NS.
 - c. The Conformance Statement shall be submitted 10 days prior to bidding.
 - 4. The Network Zone Sensors shall include the following items:
 - a. A backlit Liquid Crystal Display (LCD) to indicate the Temperature, Humidity and Setpoint
 - b. An LED to indicate the status of the Override feature
 - c. A button to toggle the temperature display between Fahrenheit and Celsius
 - d. A button to initiate a timed override command
 - e. Available in either surface mount or wall mount
 - f. Available with either screw terminals or phone jack
 - 5. The Network Discharge Air Sensors shall include the following:
 - a. 4 inch or 8 inch duct insertion probe
 - b. 10 foot pigtail lead
 - c. Dip Switches for programmable address selection
 - d. Ability to provide an averaging temperature from multiple locations
 - e. Ability to provide a selectable temperature from multiple locations

2.7 SYSTEM TOOLS

- A. System Configuration Tool (SCT)
 - 1. The Configuration Tool shall be a software package enabling a computer platform to be used as a stand-alone engineering configuration tool for a Network Automation Engine (NAE) or a Network Integration Engine (NIE).

2. The configuration tool shall provide an archive database for the configuration and application data.
3. The configuration tool shall have the same look-and-feel at the User Interface (UI) regardless of whether the configuration is being done online or offline.
4. The configuration tool shall include the following features:
 - a. Basic system navigation tree for connected networks
 - b. Integration of Metasys N1, LonWorks, and BACnet enabled devices
 - c. Customized user navigation trees
 - d. Point naming operating parameter setting
 - e. Graphic diagram configuration
 - f. Alarm and event message routing
 - g. Graphical logic connector tool for custom programming
 - h. Downloading, uploading, and archiving databases
5. The configuration tool shall have the capability to automatically discover field devices on connected buses and networks. Automatic discovery shall be available for the following field devices:
 - a. BACnet Devices
 - b. LonWorks devices
 - c. N2 Bus devices
 - d. Metasys N1 networks
6. The configuration tool shall be capable of programming the Field Equipment Controllers.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the Field Equipment Controllers.
 - b. The configuration tool shall allow the FECs to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration.
7. The configuration tool shall be capable of programming the field devices.
 - a. The configuration tool shall provide the capability to configure, simulate, and commission the field devices.
 - b. The configuration tool shall allow the field devices to be run in Simulation Mode to verify the applications.
 - c. The configuration tool shall contain a library of standard applications to be used for configuration
8. A wireless access point shall allow a wireless enabled portable PC to make a temporary Ethernet connection to the automation network.
 - a. The wireless connection shall allow the PC to access configuration tool through the web browser using the User Interface (UI).
 - b. The wireless use of configuration tool shall be the same as a wired connection in every respect.
 - c. The wireless connection shall use the Bluetooth Wireless Technology.

2.8 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:

- a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
- b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.
- c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	$\pm .5^{\circ}\text{F}$.
Room Temp	$\pm .5^{\circ}\text{F}$.
Duct Temperature	$\pm .5^{\circ}\text{F}$.
All Others	$\pm .75^{\circ}\text{F}$.

2. Room Temperature Sensors

- a. Room sensors shall be constructed for either surface or wall box mounting.
- b. Room sensors shall have the following options when specified:
 - ◇ Setpoint reset slide switch providing a ± 3 degree (adjustable) range.
 - ◇ Individual heating/cooling setpoint slide switches.
 - ◇ A momentary override request push button for activation of after-hours operation.
 - ◇ Analog thermometer.

3. Room Temperature Sensors with Integral Display

- a. Room sensors shall be constructed for either surface or wall box mounting.
- b. Room sensors shall have an integral LCD display and four button keypad with the following capabilities:
 - ◇ Display room and outside air temperatures.
 - ◇ Display and adjust room comfort setpoint.
 - ◇ Display and adjust fan operation status.
 - ◇ Timed override request push button with LED status for activation of after-hours operation.
 - ◇ Display controller mode.
 - ◇ Password selectable adjustment of setpoint and override modes.

4. Thermo wells

- a. When thermo wells are required, the sensor and well shall be supplied as a complete assembly, including wellhead and Greenfield fitting.
- b. Thermo wells shall be pressure rated and constructed in accordance with the system working pressure.
- c. Thermo wells and sensors shall be mounted in a threadolet or 1/2" NPT saddle and allow easy access to the sensor for repair or replacement.
- d. Thermo wells shall be constructed of 316 stainless steel.

5. Outside Air Sensors
 - a. Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
 - b. Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
 - c. Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.
 6. Duct Mount Sensors
 - a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.
 - b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
 - c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.
 7. Averaging Sensors
 - a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
 - b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
 - c. Capillary supports at the sides of the duct shall be provided to support the sensing string.
 8. Acceptable Manufacturers: Johnson Controls, Setra.
- C. Humidity Sensors
1. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.
 2. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.
 3. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 3% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.
 4. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless steel bushings.
 5. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.
 6. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.
 7. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac.
- D. Differential Pressure Transmitters
1. General Air and Water Pressure Transmitter Requirements:

- a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.
 - b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.
 - c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.
 - d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.
2. Low Differential Water Pressure Applications (0" - 20" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - ◇ .01-20" w.c. input differential pressure range.
 - ◇ 4-20 mA output.
 - ◇ Maintain accuracy up to 20 to 1 ratio turndown.
 - ◇ Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Setra and Mamac.
3. Medium to High Differential Water Pressure Applications (Over 21" w.c.)
- a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:
 - ◇ Differential pressure range 10" w.c. to 300 PSI.
 - ◇ Reference Accuracy: $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable Manufacturers: Setra and Mamac.
4. Building Differential Air Pressure Applications (-1" to +1" w.c.)
- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - ◇ -1.00 to +1.00 w.c. input differential pressure ranges. (Select range appropriate for system application)
 - ◇ 4-20 mA output.
 - ◇ Maintain accuracy up to 20 to 1 ratio turndown.
 - ◇ Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Johnson Controls and Setra.
5. Low Differential Air Pressure Applications (0" to 5" w.c.)

- a. The differential pressure transmitter shall be of industrial quality and transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.
 - b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:
 - ◇ (0.00 - 1.00" to 5.00") w.c. input differential pressure ranges. (Select range appropriate for system application.)
 - ◇ 4-20 mA output.
 - ◇ Maintain accuracy up to 20 to 1 ratio turndown.
 - ◇ Reference Accuracy: +0.2% of full span.
 - c. Acceptable Manufacturers: Johnson Controls and Setra.
6. Medium Differential Air Pressure Applications (5" to 21" w.c.)
- a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:
 - ◇ Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.
 - ◇ Accuracy: 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100 PSIG.
 - ◇ Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).
 - b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.
 - c. Acceptable manufacturers: Johnson Controls and Setra.
7. Water Flow Switches
- a. Water flow switches shall be equal to the Johnson Controls P74.
8. Low Temperature Limit Switches
- a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.
 - b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.
 - d. The low temperature limit switch shall be equal to Johnson Controls A70.

2.9 OUTPUT DEVICES

A. Actuators

1. General Requirements
 - a. Damper and valve actuators shall be electronic and/or pneumatic, as specified in the System Description section.
2. Electronic Damper Actuators

- a. Electronic damper actuators shall be direct shaft mount.
 - b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized Based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.
 - c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
 - d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.
 - e. Acceptable manufacturers: Johnson Controls, Mamac.
3. Electronic Valve Actuators
- a. Electronic valve actuators shall be manufactured by the valve manufacturer.
 - b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.
 - c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized Based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.
 - d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.
 - e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end

switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

f. Acceptable manufacturers: Johnson Controls

B. Control Dampers

1. The BMS Contractor shall furnish all automatic dampers. All automatic dampers shall be sized for the application by the BMS Contractor or as specifically indicated on the Drawings.
2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.
3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.
4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 60". Damper blades shall be 16-gauge minimum and shall not exceed eight (8) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. All damper bearings shall be made of reinforced nylon, stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.0 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.
5. Airfoil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g. Acceptable manufacturers are Johnson Controls D-7250 D-1250 or D-1300, Ruskin CD50, and Vent Products 5650.
6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below. Acceptable manufacturers are: Johnson Controls D-1600, Ruskin CD36, and Vent Products 5800.
7. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jackshaft shall receive at least one actuator to reduce jackshaft twist.

C. Control Relays

1. Control Pilot Relays
 - a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.
 - b. Mounting Bases shall be snap-mount.
 - c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.
 - d. Contacts shall be rated for 10 amps at 120VAC.
 - e. Relays shall have an integral indicator light and check button.
 - f. Acceptable manufacturers: Johnson Controls, Lectro

D. Control Valves

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open,

closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Chilled water control valves shall be modulating plug, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer's recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI. Valves (3-way) serving constant flow air handling unit coils with secondary circuit pumps shall be sized for a pressure drop equal to 25% the actual coil pressure drop, but no less than 2 PSI. Mixing valves (3-way) serving secondary water circuits shall be sized for a pressure drop of no less than 5 PSI. Valves for terminal reheat coils shall be sized for a 2 PSIG pressure drop, but no more than a 5 PSI drop.
3. Ball valves shall be used for hot and chilled water applications, water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units except those described hereinafter.
4. Modulating plug water valves of the single-seat type with equal percentage flow characteristics shall be used for all special applications as indicated on the valve schedule. Valve discs shall be composition type. Valve stems shall be stainless steel.
5. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.
6. Acceptable manufacturers: Johnson Controls

2.10 MISCELLANEOUS DEVICES

- E. Variable Frequency Motor Speed Control Drives
Danfoss FC100, Nema12, No Bypass, Rated for Motor being controlled.

2.11 SCOPE

- A. This specification describes the electrical, mechanical, environmental, agency and reliability requirements for three phase, adjustable frequency drives as specified herein and as shown on the contract drawings.

2.12 REFERENCES

- A. The adjustable frequency drives and all components shall be designed, manufactured and tested in accordance with the latest applicable standards.

1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. IEEE 519-1992: Guide for harmonic content and control
 2. Underwriters Laboratories (UL508C: Power Conversion Equipment)
 - a. UL
 - b. cUL
 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0: Industrial Controls & Systems for AFDs.
 4. IEC 61800-2 and -3. EN 50082-1 and -2
 - a. Fulfill all EMC immunity requirements
- B. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

2.13 SUBMITTALS

2.13.1 SUBMITTAL FOR REVIEW / APPROVAL

- A. The following information shall be submitted to the Engineer.
1. Dimensioned outline drawing.
 2. Control Schematic diagram.
 3. Power and control connection diagram(s)
- B. Submit four (4) copies of the above information.

2.13.2 SUBMITTAL FOR INFORMATION

- A. When requested by the Engineer the following product information shall be submitted:
1. Product bulletins
 2. Technical product data sheets
 3. Harmonic analysis result

2.13.3 SUBMITTAL FOR CLOSE-OUT

- A. The following information shall be submitted for record purposes prior to final payment.
1. Final as-built drawings and information for items listed section in 1.04.1.
 2. Installation information.

2.14 QUALIFICATIONS

- A. The supplier of the assembly shall be the manufacturer of the electromechanical power components used within the assembly, such as bypass contactors, power distribution circuit breakers, when specified. These parts, when specified, shall have a commonality with other manufacturer's products.
- B. For the equipment specified herein, the manufacturer shall be ISO 9002 certified.
- C. The supplier of this equipment shall have produced similar electrical equipment for a minimum period of ten (10) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Adjustable Frequency Drives shall be on the basis of Danfoss FC1000 for function and quality.

2.15 DELIVERY, STORAGE, AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

2.16 FIELD MEASUREMENTS

2.17 OPERATION AND MAINTENANCE MANUALS

- A. Five (5) copies of the equipment operation and maintenance manuals shall be provided.
- B. Operation and maintenance manuals shall include the following information:
 - 1. Instruction books
 - 2. Recommended renewal parts list.
 - 3. Drawings and information required by section 1.04.3

PART 3: PRODUCTS

3.1 ADJUSTABLE FREQUENCY DRIVES (AFD)

- A. Where shown on the drawings, adjustable frequency drives 1 through 250 HP shall have the following features:
 - 1. The AFDs shall be rated for 480 Vac (optional input voltages of 208, 240 Vac through 100 HP). The AFD shall provide microprocessor based control for three-phase induction motors. The controller's full load output current rating shall be based on variable torque application at 40° C ambient and 1-16 kHz switching frequency below 50 HP and 1-10 kHz 50 HP and above to reduce motor noise and avoid increased motor losses.
 - 2. The AFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via

a two-step operation. Adjustable Current Source AFDs are not accepted. Insulated Gate Bipolar Transistors (IGBTs) shall be used in the inverter section. Bipolar Junction Transistors, GTOs or SCRs are not accepted. The AFD shall run at the above listed switching frequencies.

3. The AFDs shall have efficiency at full load and speed that exceeds 95% for AFDs below 15 HP and 97% for drives 15 HP and above. The efficiency shall exceed 90% at 50% speed and load.
4. The AFDs shall maintain a minimum line side displacement power factor of 0.96, regardless of speed and load.
5. The AFDs shall have a one (1) minute overload current rating of 110% for variable torque applications.
6. The AFDs shall be capable of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the AFD.
7. The AFDs shall have an integral EMI/RFI filter as standard.
8. The AFDs shall limit harmonic distortion reflected onto the utility system to voltage and current levels as defined by IEEE 519-1992 for general systems applications, by utilizing the standard 3% nominal impedance integral ac three-phase line reactor. DC link chokes are not accepted.
9. Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling (PCC) being the point where the utility feeds multiple customers.
10. The system containing the AFDs shall comply with the 5% level of total harmonic distortion of line voltage and the line current limits as defined in IEEE 519-1992. If the system cannot meet the harmonic levels with the AFDs provided with the standard input line reactor or optional input isolation transformer, the AFD manufacturer shall supply an eighteen pulse, multiple bridge rectifier ac to dc conversion section with phase shifting transformer for all drives above 75 HP. This eighteen pulse rectifier converter shall result in a multiple pulse current waveform that will more nearly approximate a true sine wave to reduce voltage harmonic content on the utility line. The phase shifting transformer shall be of a single winding type to optimize its KVA rating and harmonic cancellation capability.

Harmonic filters are not accepted above 75 HP.

11. The AFDs shall be able to start into a spinning motor. The AFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the AFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.

Standard operating conditions shall be:¹

- A. Incoming Power: Three-phase, 208 / 240 / 480 (+10% to -15%) and 50/60 Hz (+/-5 Hz) power to a fixed potential DC bus level.
- B. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
- C. Speed regulation of +/- 0.5% of base speed.
- D. Load inertia dependant carryover (ride through) during utility loss.
- E. Insensitive to input line rotation.
- F. Humidity: 0 to 95% (non-condensing and non-corrosive).
- G. Altitude: 0 to 3,300 feet (1000 meters) above sea level.
- H. Ambient Temperature: -10 to 40 °C (VT).
- I. Storage Temperature: -40 to 70 °C.

13. Control Functions

- A. Frequently accessed AFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the AFD. The AFDs shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not accepted, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
- B. The keypad shall include a Hand-Off-Auto membrane selection and an Inverter/Bypass membrane selection. When in "Hand" the AFD will be started and the speed will be controlled from the up/down arrows. When in "Off", the AFD will be stopped. In "Auto", the AFD will start via an external contact closure or a communication network and the AFD speed will be controlled via an external speed reference.
- C. The keypad shall have copy / paste capability.
- D. Upon initial power up of the AFD, the keypad shall display a start up guide that will sequence all the necessary parameter adjustments for general start up.
- E. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's RS-232 port and Windows™ based software. In addition the software shall

permit control and monitoring via the AFD's RS232 port. The manufacturer shall supply a diskette with the required software. An easily understood instruction manual and software help screens shall also be provided. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.

- F. The operator shall be able to scroll through the keypad menu to choose between the following:
 - 1. Parameter Menu
 - 2. Keypad Control
 - 3. System Menu
 - 4. Expander Boards
 - 5. Monitoring Menu
 - 6. Operate Menu

- G. The following setups and adjustments, at a minimum, are to be available:
 - 1. Start command from keypad, remote or communications port
 - 2. Speed command from keypad, remote or communications port
 - 3. Motor direction selection
 - 4. Maximum and minimum speed limits
 - 5. Acceleration and deceleration times, two settable ranges
 - 6. Critical (skip) frequency avoidance
 - 7. Torque limit
 - 8. Multiple attempt restart function
 - 9. Multiple preset speeds adjustment
 - 10. Catch a spinning motor start or normal start selection
 - 11. Programmable analog output

- 14. The AFD shall have the following system interfaces:
 - A. Inputs – A minimum of six (6) programmable digital inputs, two (2) analog inputs and serial communications interface shall be provided with the following available as a minimum:
 - 1. Remote manual/auto
 - 2. Remote start/stop
 - 3. Remote forward/reverse
 - 4. Remote preset speeds
 - 5. Remote external trip
 - 6. Remote fault reset
 - 7. Process control speed reference interface, 4-20mA dc
 - 8. Potentiometer or process control speed reference interface, 0 -10Vdc
 - 9. RS232 programming and operation interface port

 - B. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one

(1) programmable analog output shall be provided, with the following available at minimum.

1. Programmable relay outputs with one (1) set of Form C contacts for each, selectable with the following available at minimum:

- a. Fault
- b. Run
- c. Ready
- d. Reversing
- e. Jogging
- f. At speed
- g. In torque limit
- h. Motor rotation direction opposite of commanded
- i. Over temperature

2. Programmable open collector output with available 24Vdc power supply and selectable with the following available at minimum:

- a. Fault
- b. Run
- c. Ready
- d. Reversing
- e. Jogging
- f. At speed
- g. In torque limit
- h. Motor rotation direction opposite of commanded
- i. Over temperature

3. Programmable analog output signal, selectable with the following available at minimum:

- a. Output frequency
- b. Frequency reference
- c. Motor speed
- d. Output current
- e. Motor torque
- f. Motor power
- g. Motor voltage
- h. DC link voltage
- i. PID controller reference value
- j. PID controller actual value 1
- k. PID controller actual value 2
- l. PID controller error value
- m. PID controller output

C. Capability of two additional expandable I/O interface cards. Upon installation, software shall automatically identify the interface card and activate the appropriate parameters. This should be done without adding any new software.

15. Monitoring and Displays

- A. The AFD's display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:

1. Run
2. Forward
3. Reverse
4. Stop
5. Ready
6. Alarm
7. Fault
8. I/O Terminal
9. Keypad
10. Bus/comm
11. Hand
12. Auto
13. Off

- B. The AFD's keypad shall be capable of displaying the following monitoring functions at a minimum:

1. Motor Speed (RPM and %)
2. Frequency reference
3. Output frequency
4. Motor current
5. Motor torque
6. Motor power
7. Motor voltage
8. DC-link voltage
9. Heat sink temperature
10. Motor run time (resetable)
11. Total operating days counter
12. Operating hours (resetable)
13. Total megawatt hours
14. Megawatt hours (resetable)
15. Voltage level of analog input
16. Current level of analog input
17. Digital inputs status
18. Digital and relay outputs status
19. Motor temperature rise
20. PID references

16. Protective Functions

- A. The AFD shall include the following protective features at minimum:

1. Over current
2. Over voltage
3. System fault
4. Under voltage
5. Input line supervision

6. Output phase supervision
7. Under temperature
8. Over temperature
9. Motor stalled
10. Motor over temperature
11. Motor under load
12. Logic voltage failure
13. Microprocessor failure
14. Brake chopper supervision
15. DC Injection braking

- B. The AFD shall provide ground fault protection during power-up, starting, and running. AFD's with no ground fault protection during running are not accepted.

17. Diagnostic Features

A. Active Faults

1. The last 10 faults shall be recorded and stored in sequential order
2. Fault code and description of fault shall be displayed on the keypad.
3. Fault or alarm LED shall blink
4. Display drive data at time of fault
5. In the event several faults occur simultaneously, the sequence of active faults shall be viewable.
6. During a fault, the drive must be able to identify the following:
 - Drive Speed
 - Running hours
 - Running Days
 - Amps during fault
 - Motor Power
 - Motor Torque
 - DC bus Voltage
 - Drive Temperature

B. Fault History

1. The last 30 faults shall be recorded and stored in sequential order.
2. Display drive data at time of fault

18. Additional features included in the AFDs:

- A. The following indicating lights shall be provided on the keypad. .
1. Drive Ready
 2. Drive Run
 3. Drive Fault
- B. The current withstand rating of the drive shall be 100,000 AIC. .
- C. Communication card for interface with Johnson Controls Metasys control system.

- D. The AFD shall have a cooling fan that is field replaceable using non-screw accessibility.

19. Enclosure

- A. The AFD shall be designed in a NEMA Type 12 enclosure.
- B. The AFD shall have complete front accessibility with easily removable assemblies.
- C. Cable entry shall be bottom entry.

20. The AFD manufacturer shall maintain, as part of a national network, engineering service facilities within 250 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.

PART 4: EXECUTION

4.1 FACTORY TESTING

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
 - 1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
 - 2. All final assemblies shall be tested at full load with application of line-to-line and line-to-ground bolted faults. The Adjustable Frequency Drive shall trip electronically without device failure.
 - 3. After all tests have been performed; each AFD shall undergo a burn-in test. The drive shall be burned in at 100% inductive or motor load without an unscheduled shutdown.
 - 4. After the burn-in cycle is complete, each AFD shall be put through a motor load test before inspection and shipping.
- B. All testing and manufacturing procedures shall be ISO 9001 certified.

4.2 FIELD QUALITY CONTROL

- A. Provide the services of a qualified manufacturer's employed Field Service Engineer or authorized service representative to assist the Contractor in installation and start-up of the equipment specified under this section. Field Service personnel shall be factory trained with periodic updates and have experience with the same model of AFD's on the job site. Sales representatives will not be accepted to perform this work. The manufacturer's service representative shall provide technical direction and assistance to

the Contractor in general assembly of the equipment, installation as specified in manufacturer's installation instructions, wiring, application dependant adjustments, and verification of proper AFD operation.

- B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative.
 - 1. Inspection and final adjustments.
 - 2. Operational and functional checks of AFDs and spare parts.
 - 3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the AFD in accordance with those instructions.

4.3 MAINTNANCE / WARRANTY SERVICE

- A. Standard warranty is twenty-four (24) months from the date of shipment and covers the factory repair or replacement of the defective unit.

4.4 LOCAL CONTROL PANELS

- A. All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.
- B. In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.
- C. All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
- D. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
- E. All wiring shall be neatly installed in plastic trays or tie-wrapped.
- F. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

4.5 POWER SUPPLIES

- A. DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.
- B. Input: 120 VAC +10%, 60Hz.
- C. Output: 24 VDC.
- D. Line Regulation: +0.05% for 10% line change.
- E. Load Regulation: +0.05% for 50% load change.
- F. Ripple and Noise: 1 mV rms, 5 mV peak to peak.
- G. An appropriately sized fuse and fuse block shall be provided and located next to the power supply.

- H. A power disconnect switch shall be provided next to the power supply.
- F. Thermostats
 - 1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

PART 5 – PERFORMANCE / EXECUTION

5.1 BMS SPECIFIC REQUIREMENTS

- A. Graphic Displays
 - 1. Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.
 - 2. User shall access the various system schematics via a graphical penetration scheme and/or menu selection. .
- B. Custom Reports:
 - 1. Provide custom reports as required for this project:
- C. Actuation / Control Type
 - 1. Primary Equipment
 - a. Controls shall be provided by equipment manufacturer as specified herein.
 - b. All damper and valve actuation shall be electric.
 - 2. Air Handling Equipment
 - a. All air handlers shall be controlled with a HVAC-DDC Controller
 - b. All damper and valve actuation shall be electric.

5.2 INSTALLATION PRACTICES

- A. BMS Wiring
 - 1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.
 - 2. All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations.
 - 3. The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the incorrect selection of cable, cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.
 - 4. Class 2 Wiring

- a. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.
 - b. Conduit is not required for Class 2 wiring in concealed accessible locations. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements.
5. Class 2 signal wiring and 24VAC power can be run in the same conduit. Power wiring 120VAC and greater cannot share the same conduit with Class 2 signal wiring.
 6. Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.
- B. BMS Line Voltage Power Source
1. 120-volt AC circuits used for the Building Management System shall be taken from panel boards and circuit breakers provided by Division 16.
 2. Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.
 3. DDC terminal unit controllers may use AC power from motor power circuits.
- C. BMS Raceway
1. All wiring shall be installed in conduit or raceway except as noted elsewhere in this specification. Minimum control wiring conduit size 1/2".
 2. Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.
 3. All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
 4. Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.
- D. Penetrations
1. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
 2. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
 3. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
 4. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

.BMS Identification Standards

5. Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location.

Cable types specified in Item A shall be color coded for easy identification and troubleshooting.

E. BMS Panel Installation

1. The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.
2. The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

F. Input Devices

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.

G. HVAC Input Devices – General

1. All Input devices shall be installed per the manufacturer recommendation
2. Locate components of the BMS in accessible local control panels wherever possible.
3. The mechanical contractor shall install all in-line devices such as temperature wells, pressure taps, airflow stations, etc.
4. Input Flow Measuring Devices shall be installed in strict compliance with ASME guidelines affecting non-standard approach conditions.
5. Outside Air Sensors
 - a. Sensors shall be mounted on the North wall to minimize solar radiant heat impact or located in a continuous intake flow adequate to monitor outside air conditions accurately.
 - b. Sensors shall be installed with a rain proof, perforated cover.
6. Water Differential Pressure Sensors
 - a. Differential pressure transmitters used for flow measurement shall be sized to the flow-sensing device.
 - b. Differential pressure transmitters shall be supplied with tee fittings and shut-off valves in the high and low sensing pick-up lines.
 - c. The transmitters shall be installed in an accessible location wherever possible.
7. Medium to High Differential Water Pressure Applications (Over 21" w.c.):
 - a. Air bleed units, bypass valves and compression fittings shall be provided.
8. Building Differential Air Pressure Applications (-1" to +1" w.c.):
 - a. Transmitters exterior sensing tip shall be installed with a shielded static air probe to reduce pressure fluctuations caused by wind.
 - b. The interior tip shall be inconspicuous and located as shown on the drawings.
9. Duct Temperature Sensors:

- a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
 - b. The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
 - c. For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
 - d. The sensor shall be mounted to suitable supports using factory approved element holders.
10. Space Sensors:
- a. Shall be mounted per ADA requirements.
 - b. Provide lockable tamper-proof covers in public areas and/or where indicated on the plans.
11. Low Temperature Limit Switches:
- a. Install on the discharge side of the first water or steam coil in the air stream.
 - b. Mount element horizontally across duct in a serpentine pattern insuring each square foot of coil is protected by 1 foot of sensor.
 - c. For large duct areas where the sensing element does not provide full coverage of the air stream, provide additional switches as required to provide full protection of the air stream.
- H. HVAC Output Devices
1. All output devices shall be installed per the manufacturers recommendation. The mechanical contractor shall install all in-line devices such as control valves, dampers, airflow stations, pressure wells, etc.
 2. Actuators: All control actuators shall be sized capable of closing against the maximum system shut-off pressure. The actuator shall modulate in a smooth fashion through the entire stroke. When any pneumatic actuator is sequenced with another device, pilot positioners shall be installed to allow for proper sequencing.
 3. Control Dampers: Shall be opposed blade for modulating control of airflow. Parallel blade dampers shall be installed for two position applications.
 4. Control Valves: Shall be sized for proper flow control with equal percentage valve plugs. The maximum pressure drop for water applications shall be 5 PSI. The maximum pressure drop for steam applications shall be 7 PSI.
 5. Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

5.2 TRAINING

- A. The BMS contractor shall provide the following training services:

1. One day of on-site orientation by a system technician who is fully knowledgeable of the specific installation details of the project. This orientation shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, and a walk through of the facility to identify panel and device locations.

5.3 COMMISSIONING

- A. Fully commission all aspects of the Building Management System work.
- B. Acceptance Check Sheet
 1. Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.
 2. Submit the check sheet to the Engineer for approval
 3. The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.
- C. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

END OF SECTION

23 21 13 - HVAC PIPING

1.0 GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the HVAC piping systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the HVAC piping systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.
- D. Refer to Section 23 25 00, "Water Treatment Systems", for information regarding required chemicals, etc.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide complete operating mechanical piping systems including pipe, tube, fittings, and appurtenances as indicated and in compliance with these Specifications.
- B. Applications: Applications of piping systems include, but are not limited to, the systems as listed below:

System	Working Pressure	Operating Temperatures
[Chilled Water]		
High	350 psig	65 to 100°F
Medium	300 psig	65 to 100°F
Low	150 psig	65 to 100°F
[Heating Water]		
High	350 psig	100 to 180°F
Medium	300 psig	100 to 180°F
Low	150 psig	100 to 180°F
[Condensate Drainage]	--	40 to 60°F

1.3 QUALITY ASSURANCE

- A. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe

ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe.

2.0 PRODUCTS

2.1 PIPING MATERIALS

- A. General: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.
1. Steel Pipe: ASTM A53, ASTM A106, or ASTM A120, black or hot-dipped galvanized as specified.
 2. Copper Tube: ASTM B88, Types "K", Type "L", or Type "M" copper water tube as defined by the Copper and Brass Research Association.
 3. Pre-insulated Steel Pipe: ASTM A53, ASTM A106, ASTM A120, and ANSI B31.1.

2.2 PIPING / TUBING FITTINGS

- A. General: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.
1. Cast Iron Flanged Fittings: ANSI B16.1, Class 125 or Class 250, black or galvanized as specified, including bolting and gasketing.
 2. Cast Iron Threaded Fittings: ANSI B16.4 or ASTM A126, Class 125 or Class 250, black or galvanized as specified.
 3. Malleable Iron Threaded Fittings: ANSI B16.3, Class 150 or Class 300, black or galvanized as specified.
 4. Malleable Iron Threaded Unions: ANSI B16.39, select for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze, or brass), plain or galvanized as specified.
 5. Threaded Pipe Plugs: ANSI B16.14.
 6. Steel Flanges/Fittings: ANSI B16.5, including bolting, gasketing, and butt weld end connections.
 7. Forged Steel Socket-welding and Threaded Fittings: ANSI B16.11, rated to match schedule of connected pipe.

8. Wrought Steel Butt-welding Fittings: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns; rated to match connected pipe.
 9. Pipe Nipples: Fabricated from same pipe as used for connected pipe, except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1/2". Do not thread nipples full length (no all-thread nipples).
 10. Wrought Copper/Bronze Solder-Joint Fittings: ANSI B16.22 suitable for working pressure up to 250 psig.
 11. Grooved End Fittings: ASTM A47 or ASTM A536 joined with Victaulic Style 77 couplings and Grade "E" gaskets.
 12. Flanged Fittings: Comply with ANSI B16.15 for bolt-hole dimensioning, materials, and flange-thickness.
 13. Flange Bolts: Bolts shall be carbon steel ASTM A307 Grade A hexagon head bolts and hexagonal nuts. Where one or both flanges are cast iron, furnish Grade B bolts. Cap screws utilized with flanged butterfly valves shall be ASTM A307 Grade B with hexagon heads.
 14. Flange Bolt Thread Lubricant: Lubricant shall be an anti-seize compound designed for temperatures up to 1000°F and shall be Crane Anti-Seize Thread Compound or approved equal.
 15. Polyvinyl Chloride (PVC) Fittings: ASTM D2665, Carlon, Vylon "Z" high strength sewer fittings.
 16. Copper Drainage Fitting: DWV copper drainage fittings.
- B. Miscellaneous Piping Materials/Products:
1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.
 2. Brazing Materials: American Welding Society, AWS A5.B, Classification BCup-5.
 3. Gaskets for Flanged Joints: 1/8" thick gaskets. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.
 4. Insulating (Dielectric) Unions: Provide dielectric unions at all pipe connections between ferrous and nonferrous piping. Unions shall be "Delvin" as made by Pipeline Seal and Insulator Company or "EPCO" as made by Epco Sales, Inc. and shall have nylon insulation or equal.
 5. Push-on-Joints: ANSI A21.11, rubber compression-type, "Tyton Joint" as manufactured by US Pipe or equal.

3.0 EXECUTION

3.1 PIPING INSTALLATION

A. General:

1. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.
2. Systems: Install piping parallel or perpendicular to lines of building, true to line and grade, and with sufficient hangers to prevent sags between hangers. Provide fittings at changes in direction. Piping in finished areas shall be concealed, except in mechanical rooms. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.
3. Expansion and Contraction: Install loops, offsets, sizing joints, and expansion joints, as necessary, to avoid strain resulting from expansion and contraction of piping systems on fixtures and equipment. Provide mechanical grooved connections required by the application to reduce vibration at equipment connections. Provide expansion joints in piping systems by mechanical grooved connections where required.
4. Piping in Shafts: Mechanical joints for mechanical piping systems are not to be installed in locations that will not be accessible after construction is complete. (i.e. victaulic fittings are not to be used on piping systems in shafts. The piping in this area is to be welded.)

B. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up.

C. Copper Pipe: Cut copper pipe square and ream to remove burrs. Clean fitting socket and pipe ends with sand cloth or wire brush.

E. Final Connections to Equipment Furnished by Owner or Under Other Divisions of These Specifications: Where equipment is to be furnished under other Divisions of these Specifications or by the Owner, such equipment will be delivered to the site, uncrated, assembled, and set in-place under those other Divisions of these Specifications or under the separate contracts. Any required automatic control valves shall also be provided under those other Divisions of these Specifications or other separate contracts. Make all final connections of hot water, condenser water, gas, domestic water, waste, and vent as required. Provide valves, unions, strainers, check valves, and traps as required for proper operation of systems and equipment. Equipment not shown on the Architectural Drawings or noted by the Architect or Engineer shall not be included in the scope of this requirement.

F. Excavation, Installation, and Backfill for Underground Pipe:

1. Layout: Pipes shall be laid and pipe joints made in presence of the General Contractor and field measurements, layouts, batter board alignment, grade establishments, and similar locations shall be performed by a Professional

Engineer in the employ of the Contractor. The Contractor's engineer shall be on the job during all underground work. A "Bench-Mark" reference shall be provided by the General Contractor.

2. Pipe Grading: Lay and maintain all pipes at required lines and grades during the course of the Work.
3. Trench: Excavate the trench to the depth required. Properly brace and de-water the trench and keep it free of water during installation, testing pipe, and backfilling. No water shall be discharged onto the street or freeway without approval by the Owner.
4. Excavation: The trench shall be at least 18" wider than the maximum diameter of the pipe or largest bell and the pipe shall be laid in the center of the trench. The trench shall be excavated to a depth sufficient to provide for pipe cushions or supports as specified. Trench width may be increased as required and piling left in place until sufficient compacted backfill is in place. Properly sheet and brace all open trenches to render them secure and remove all such sheeting and bracing before completing the backfill. Comply with all applicable national, state, and local codes and regulations. The quantity of excavation required to install sheeting and the installation and removal of sheetings and bracings will not be regarded as Extra Work. All costs incurred for this excavation and the installation of sheeting shall be included in the Contract Price.
5. Grading: Upon completion of excavation and prior to the laying of the pipe, the trench bottom shall be brought up to the required elevation with a pipe cushion, except where the cushion has been eliminated by the General Contractor. Pipe cushions shall be select material deposited in the trench and shall be compacted, leveled off, and shaped to obtain a smooth compacted bed along the laying length of the pipe. Pipe cushion material shall be as follows:
 - a. Open and Closed Loop Condenser Water and Hot Water Heating Piping: Material for pipe cushion shall comply with local codes and conform to the geo-technical report. In absence of local code requirements and/or geo-technical report, the cushion shall be bank sand or select backfill material approved by the General Contractor.
6. Anchors: Cast iron pipes shall have concrete anchors at each change in direction and/or as directed. Any change in direction exceeding 15 degrees shall be anchored. Concrete anchors shall rest against solid (virgin) ground with the required area of bearing on pipe and ground to provide suitable anchoring.
7. Backfill: Backfill trenches only after piping has been inspected, tested, and approved by the General Contractor. Backfill shall be provided as recommended in the geo-technical report included in these Contract Documents, or, in the absence of a geo-technical report, as required by site conditions. Refer to Division 2 or elsewhere in the Contract Documents for additional trenching and backfill requirements.
8. Existing Surfaces: Restore existing streets, driveways, and sidewalks damaged during the excavation work to acceptable condition, subject to approval by the Owner, Architect, and/or Engineer.

9. Safety: Provide street and sidewalk excavations with approved barricades, warning lights, and cover plates as required by the local authorities.

3.2 CHILLED WATER & HEATING WATER PIPING

- A. General: On each floor, provide isolating valves on core water supply and return mains to permit half of the floor to be isolated while maintaining service to the other half of the floor.
- B. Aboveground Pipe: 5" and larger: Black steel, ASTM A53, Schedule 40; 4" and smaller: Copper type "L"
- C. Underground Hot Water Piping **within building footprint**: 5" and larger: Black steel, ASTM A53, Schedule 40; 4" and smaller: Copper type "L". ***This applies inside the building only. Refer to section 232115 for site piping.***
- D. Underground Chilled Water Piping **within building footprint**: 5" and larger: Cement Lined Ductile Iron; 4" and smaller: Copper type "L". ***This applies inside the building only. Refer to section 232115 for site piping.***
- E.
- F. Fittings:
 1. Service Pressure at or Less Than 150 psig:
 - a. Fittings, 2" in diameter and smaller, threaded, Class 150 rated, black, banded, malleable iron.
 - b. Fittings, 2-1/2" in diameter and larger, factory-fabricated, Class 150, weld-type.
 - c. Flanges, Class 150, forged steel weld neck.
 2. Taps and Branches: "Weld-O-Lets", "Thread-O-Lets", or "Branch-Lets" may be employed at locations where taps or branches join line pipe, provided the tap or branch does not exceed 1/2 the size of the line pipe. Factory-fabricated wye and tee fittings may be welded into the main.
 3. Service Pressure Greater Than 150 psig:
 - a. Fittings, 2" in diameter and smaller, threaded, 300 psig, black, banded, malleable iron.
 - b. Fittings, 2-1/2" in diameter and larger, factory-fabricated, weld-type, rated for greater than 300 psig.
 - c. Flanges, 300 psig, weld neck, welding flanges at valves and all flanged connections.
- G. Cold-springing: Cold-springing of piping will not be permitted.
- H. Automatic Air Vents:

1. An automatic air vent shall be installed at the air separator and piped to the floor drain, at a minimum. All other system high points at other locations as required, shall be manually vented. Vents shall be designed to eliminate air from the system automatically and/or manually without permitting the passage of any water and shall be similar and approved equal to the following:
 - a. 150 psig working pressure service - Sarco Type 13W or approved equal.
 - b. 300 and 400 psig working pressure service - Sarco Type 13WH or approved equal.
2. Automatic air vents shall have a 3/4" ips inlet connection and 3/8" outlet. Provide 3/8" OD hard drawn, Type "L" copper tubing from vent outlet for overflow in case of defective action. Copper tubing shall run to a suitable drain. Provide 3/4" stop valve in vent line for servicing of automatic air vent.

3.3 CONDENSATE DRAINAGE

- A. General: Provide a condensate drain pipe to connect each cooling unit drain pan or funnel and to extend to and discharge into an open type drain in the sanitary plumbing system. Funnel type floor drain requirements are to be coordinated with the Plumbing Contractor. Provide union or solder joint at connection to heat pumps.
- B. Assembly: Use hard drawn Type "M" or DWV copper tubing with matching fittings, or Schedule 40, galvanized steel made up with Class 125, galvanized, threaded fittings. Assemble fittings to form a trap with depth equal to or greater than operating pressure of the unit served. Drains shall be of the size not less than the full size of the drain pan connection. Air handling unit drains shall have deep seal traps to permit unit pan drainage. The deep seal trap shall be installed for each blow-through or draw-through air handling unit to maintain the water seal.

3.4 CHEMICAL TREATMENT PIPING FOR OPEN & CLOSED LOOPS SYSTEMS

- A. Chemical treatment piping systems shall be selected and installed based on the recommendations of the chemical treatment contractor. Refer to specification 23 25 00 for additional information.
- B. Where a fluid cooler water treatment by-pass loop is installed, all valves utilized in increasing system pressure shall be marked to identify position.
- C. Fluid cooler valves are not to be utilized to increase system pressure for the water treatment by-pass loop if the flow conditions to the fluid cooler cannot be maintained.

3.5 CLEANING, FLUSHING, TESTING, AND INSPECTING

- A. Cleaning & Flushing: The mechanical contractor shall adhere to Auburn University Water Treatment procedures as laid out in Appendix J of the Auburn University Design and Construction Standards and as follows:
 1. It is to be performed in conjunction with and under the technical direction of the Utilities & Energy Water Treatment department.
 2. General Guidelines– Closed Loop Treatment

- a. Submittals - Provide product data for all chemical treatment materials, chemicals and equipment. Product data shall include chemical explanation, MSDS, layouts of feeding equipment and equipment detail sheets.
- b. Quality Assurance
 - i. Retain the resources of the chemical water treatment contractor who is already under contract with the client or has been prequalified by the client.
 - ii. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of industrial water treatment for at least five years, whose major business is in the field of water treatment, and who has full time service personnel within the area of the job site. Laboratory facilities shall be available. Service personnel shall be degreed specialists in the fields of mechanical or chemical engineering or chemistry.
 - iii. Furnish and install all equipment and material on this project in accordance with the requirements of the authority having jurisdiction, suitable for its intended use on this project, approved by the U.S. Environmental Protection Agency (EPA), and local Department of Environmental Protection, and so certified by the manufacturer.
 - iv. If not already known, analyze the water from the local water supplier to be used on the project, before establishing treatment procedures.
 - v. The cleaning sequence will not be deemed completed until fully signed off and agreed upon by the Auburn University Water Treatment Department, as well as, the Plant Operations Group.
- c. Safety
 - All chemical and analytical reagents supplied by the vendor shall meet all applicable government regulations. The bidders shall submit an MSDS for all proposed products with the initial technical proposal. The vendor shall be responsible for providing up to date MSDS for all chemicals supplied including reagents.
 - ii. The mechanical contractor shall be responsible for the safe cleanup of any chemical spills relating to products supplied by the vendor and caused by failure or malfunction of the chemical feed equipment or due to the actions of the field service personnel. Cleanup shall be performed in accordance with all current government regulations and good safety practices. Vendor shall maintain a 24 hour hot line for emergency situations. Bidder shall provide the phone number and procedure to access the hot line including estimated response time in the event of an emergency.
- d. Technical Services
 - i. Mechanical contractor shall be responsible for handling of all water treatment chemicals.
 - ii. All chemical deliveries shall be made to the point of use by the vendor or an ahead of time agreed up on location such as the mechanical contractors lay down yard. The contractor shall remove, following local, state and federal governances all chemical containment systems as instructed by the vendor.
- e. Underground Laterals - Chilled Water/Ductile Lined
 - i. Materials
 - Pump Strainer shall be fine mesh (3/64-inch maximum).
 - Sterilization Chemicals shall be non-oxidizing biocide which has halogen like effects such as 2,2-dibromo-3-nitropropionamide, also known as DBNPA.
 - Use GE Betz Spectrus NX108 or equivalent.

- Water Treatment Chemical shall be GE Betz Corrrshield MD407 or equivalent.
- ii. Preparation
 - Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
 - Contractor will notify the University Project Lead three (3) working days prior to filling for pressure testing and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
 - Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6”) they do not require sterilization, however, they do require flushing with system chilled water before they are put into service.
 - Contractor shall install a two (2”) inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.
- iii. Sterilization/Flushing Sequence
 - If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
 - Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of biocide for sterilization or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
 - Biocide shall be added to pipe at a concentration of 50 ppm based on total water volume in the pipe.
 - Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.
 - At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
 - Circulate the solution for at least twenty four (24) hours or as recommended by the University Project Lead, whichever is less. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified pump curves shall be utilized to determine pump flow. Biocide shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.
 - **MINIMUM CLEANING WATER**

<i>Pipe Size (in)</i>	<i>Flow (gpm)</i>
-----------------------	-------------------

2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Following cleaning, drain systems as quickly as possible. Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
 - Remove strainer(s).
 - Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.
- iv. Water Treatment
- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- v. Flushing Sequence for Lines Less than 6" in Diameter
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- vi. Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- vii. System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.2, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
- viii. Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- ix. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University Project Lead deems it necessary for underground main protection; mainly in the case of extended lay-up periods.

f. Underground Laterals – Hot Water

i. Materials

- Pump Strainer shall be fine mesh (3/64-inch maximum).
- Cleaning and Sterilization Chemicals shall be liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products. Use GE Betz Ferroquest FQ7101 or equivalent.
- Water Treatment Chemical shall be GE Betz Corrsshield NT402 or equivalent.

ii. Preparation

- Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
- Contractor will notify the University Project Lead three (3) working days prior to filling and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
- Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6") they do not require cleaning, however, they do require flushing with system hot water before they are put into service.
- Contractor shall install a two (2") inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.

iii. Cleaning/Flushing Sequence

- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of cleaning chemical or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- System cleaner shall be added to the piping section at a concentration as recommended by University Project Lead following the hydro test. A water volume equal to the calculated amount of cleaner to be added shall be drained from the pipe to allow for addition of cleaner.
- Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.

- At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
- Circulate the solution for at least twenty four (24) hours or Less if recommended by University Project Lead. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified pump curves shall be utilized to determine pump flow. Cleaner shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.

- **MINIMUM CLEANING WATER**

Pipe Size (in) Flow (gpm)

a.

2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Twenty four (24) hours following the start of the cleaning process, two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis. Following cleaning, drain systems as quickly as possible.
 - Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
 - Two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis following city water flushing.
 - Remove strainer(s).
 - Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.
- iv. Water Treatment
- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- v. Flushing Sequence for Lines Less than 6" in Diameter
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested,

sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.

- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.6, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
- Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University Project Lead deems it necessary for underground main protection; mainly in the case of extended lay-up periods.

B. Piping Tests:

1. General: Perform tests before piping is concealed from view. Tests may be performed in sections. Tests shall be witnessed by the General Contractor and local inspectors and the test results presented to the Engineer for acceptance and approval prior to concealing piping from view. Provide all necessary equipment for testing, including pumps and gauges.
2. Test water systems hydrostatically to a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 4 hours. Repair all leaks, replacing materials as necessary and repeat tests until systems are proven tight.

C. Inspecting: Visually inspect each run of each system for completion of joints, adequate hangers, supports, and inclusion of accessories and appurtenances.

D. Chemical Treating: Refer to Section 23 25 00, "Water Treatment Systems", for additional requirements on flushing and cleaning of systems.

E. Identification: Refer to Section 23 05 53, "HVAC Equipment and Piping Identification" for nameplates and labeling requirements.

END OF SECTION

23 21 14 - VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the valves associated with the piping systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the valves specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide valves as specified and indicated.

1.3 QUALITY ASSURANCE

- A. Acceptable Manufacturers: The model numbers listed in the Specifications establish a level of quality and material. The following manufacturers are acceptable, subject to compliance with the requirements of these Specifications.
 - 1. General Valves: Jenkins Bros. Valves, Crane Company, Stockham Valves and Fittings, Walworth Company, Kennedy Valve, Kitz, Nibco, or approved equal
 - 2. Ball Valves: Jenkins Bros. Valves, Jamesbury Corporation, Nibco, Stockham Valves and Fittings, Apollo, Kitz, approved equal.
 - 3. Backflow Preventers: Watts Regulator Company, Febco, Hersey Products, Inc., Wilkins, or approved equal.
 - 4. Refrigerant Valves: Mueller Brass Company, Henry Valve Company, Superior Valve Company, approved equal.
 - 5. Check Valves: Jenkins Bros. Valves, Crane Company, Muesco, Inc., APCO/Valve & Primer Corporation, Williams-Hager, Clow Pipeline Products, Valve Division, Nibco, Crane, Stockham, Milwaukee, Kitz, or approved equal.
 - 6. Butterfly Valves: Jenkins Bros. Valves, Jamesbury Corporation, Nibco, Stockham Valves and Fittings, Apollo, Keystone, Demco, Grinnell, Centerline, Kitz, or approved equal.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: All valves shall be similar to numbers listed. All similar type and size valves shall be products of one manufacturer.
- B. Refrigerant Valves: Valves manufactured specifically for use in refrigerant systems shall be used in such systems.

- C. Butterfly Valves: All butterfly valves shall be full tapped and threaded lug type, manufacturer certified for bubble-tight, dead end shut off from either direction at design working pressure and temperature. Valves 2 1/2 through 5" in size shall have lever type operators. Valves 6" and larger shall have enclosed, self-locking worm gear type operators, waterproof, and factory-lubricated. Gear segment shall be manganese bronze or ductile iron with a steel or ductile iron worm and oil impregnated bronze bushings or worm shaft. Operator shall have built in adjustable mechanical stops and position indicators. Valves used for balancing shall be certified suitable for continuous throttling service.
- D. Ball Valves: Valves shall be furnished with blowout-proof stems. Valves used for chilled water service shall be insulated as specified for the pipe in which the valve is installed. All ball valves shall be full-line size to prevent flow restriction through the ball.
- E. Gate Valves: All bronze gate valves shall have packing boxes with adequate depth to allow space for sufficient amounts of stem packing. Malleable iron handwheels and gland followers shall be furnished on all bronze gate valves. All gate valves shall have non-asbestos stem packing suitable for pressure and service. OS&Y and IBBM gate valves shall be furnished with a stem lubrication fitting on all sizes. All gate valves shall be designed to permit repacking while the valve is in line.

2.2 VALVES

- A. Valves located on primary water supply and return shall be offset butterfly type with metal seats.
- B. Valves for service at or less than 150 PSIG:
 - 1. Block (Stop) Valves: Ball valves 2" and smaller shall be red brass, cast bronze, or yellow forged bronze with brass, stainless steel, or bronze ball and stem, 150 psig nonshock WOG at 200°F, Jenkins Fig. No. 900T. Valves 2 1/2" and larger shall be butterfly type, 200 psig nonshock WOG at 200°F, ANSI Class 150 with ductile iron lug body. The replaceable resilient elastomer seat shall be Buna N or EPDM. The disc shall be silicon or aluminum bronze and shaft shall be No. 316 or No. 416 stainless steel. Secondary O ring seals shall be provided at the top and bottom of the upper and lower shafts to guarantee zero leakage to the shaft, Jenkins Fig. No. 232EL/EG or No. 632E.
 - 2. Balancing Valves: Valves shall comply with the general requirements specified for block valves. Valves used for balancing shall have adjustable memory stops or position indicators. Valves 2" and smaller shall be Jenkins Fig. No. 900TE. Valves 2 1/2" and larger shall be Jenkins Fig. No. 232EL.
 - 3. Gate Valves: As a general rule, gate valves shall not be used for sizes 2 1/2" and smaller. If necessary, with prior approval from the Construction Manager, valves 2-1/2" and smaller shall be Jenkins Fig. No. 47-U, 200 psig WOG bronze body with screwed bonnet and ends. Valves 3" and larger shall be Jenkins Fig. No. 651-A, 200 psig WOG.
 - 4. Globe Valves: Valves 2" and smaller shall be Jenkins Fig. No. 546-P, bronze body, bronze rising stem, screw in bonnet, renewable seat, and screwed or solder ends. Valves 2 1/2" and larger shall be Jenkins Fig. No. 613, 200 psig WOG, outside screw and yoke (OS&Y), iron body, bronze-trimmed, renewable seat, Pressure Class 125, with ANSI B16.1 flanged ends.
- C. Valves for Service Over 150 PSIG:

1. Block Stop Valves: Ball valves 2" and smaller shall be red brass cast bronze or yellow forged bronze with brass, stainless steel, or bronze ball and stem, 300 psig nonshock WOG at 200°F with Teflon packing and gaskets, Jenkins Fig. No. 900T. Valves 2 1/2" and larger shall be 300 psig nonshock WOG, with Class 300 ANSI B16.5 flanges, full tapped and threaded cast steel lug body. Valves shall have 300 pounds body drilling and shall be suitable for service indicated on the Plans. Disc shall be cast steel and the shaft shall be No. 416 stainless steel. Secondary O ring or gland seals at the top and bottom of the upper and lower shafts shall guarantee zero leakage to the shaft. Seals and backing rings shall be TFE or Viton. Seal retainer rings shall be No. 316 stainless steel, Dezurik No. 645.
 2. Balancing Valves: Valves shall comply with the general requirements specified for block valves. Valves used for balancing shall have adjustable memory stops or position indicators.
 3. Gate Valves: As a general rule, gate valves shall not be used for sizes 2 1/2" and smaller. If necessary, with prior approval from the Construction Manager, valves 2-1/2" and smaller shall be Jenkins Fig. No. 270-U, 300 pounds WOG, bronze body, rising stem, with screwed bonnet and screwed ends. Valves 3" through 12" shall be Jenkins Fig. No. 204, 500 pounds WOG, OS&Y valves with Class 250 ANSI B16.1 flanged ends, cast iron body and bronze trim.
 4. Globe Valves: Valves 2" and smaller shall be Jenkins Fig. No. 556-P, 400 pounds WOG, bronze body and trim, rising stem, union bonnet, renewable seat, and screwed ends. Valves 2 1/2" through 8" shall be Jenkins Fig. No. 923, 500 pounds WOG, iron body, bronze trim rising stem, OS&Y Class 250 ANSI B16.1 flanged ends.
- D. Check Valves: Chilled, hot, condenser, and domestic water pipes 2 1/2" and larger shall be Williams-Hager Fig. No. 375, spring-loaded, quiet type. Valve nonshock pressure temperature rating shall be as specified for piping in which it is installed. Valve shall be full-threaded, lug body, or flanged body. Valves 2" and smaller shall be Jenkins Fig. No. 92A. Threaded valves installed at pump discharge shall have its shaft perpendicular to the pump shaft. Valves located in pumped sewage pipes and in storm pipes shall be Crane No. 383 outside weight, 200 pounds WOG, iron body, bronze trimmed, with swing check design.
- E. Valves for Water Make Up Connections: Valves 2" and smaller shall be Jenkins Fig. No. 900T. Valves 2 1/2" and larger shall be Jenkins Fig. No. 632B or No. 632E, butterfly valve operator furnished per Paragraph 2.01/C.
- F. Relief Valve: Temperature and pressure, self-closing, lever operated with thermo-bulb extension, 3/4", ANSI B2.1 taper thread male inlet connection, 210°F (98.8°C) and 125 psig setting, ANSI Z1.22, Type No. 40XL Watts Regulator Company.
- G. Combination Pressure Reducing and Relief Valve for Make up Water: Bell and Gossett Model Number 3, dual unit.
- H. Reduced Pressure Backflow Preventer: Backflow preventer shall be Watts Regulator No. 909 Series, 2 1/2" and larger shall be provided with dual "Y" pattern spring-loaded check valves and independent relief valve located between checks. Backflow preventers shall be rated for pressure up to 150 psig working pressure at 140°F (60°C) and sized according to the maximum design flow.
- I. Domestic Water Pressure Reducing Valves: Watts 223S or Clayton 90G 01. Pressure and flow schedule as indicated on the Drawings.

- J. Valves for Gas Connections: Valves 2" and smaller shall be Crane Fig. 254; valves 2 1/2 to 5" shall be Walworth Fig. 1797 F; and valves 6 to 12" shall be Walworth Fig. 1718 F.

2.3 FIRE PROTECTION VALVES

- A. Check Valves: Valves 2" and smaller shall be threaded end Jenkins Fig. No. 92A. Valves 2 1/2" and larger shall be Jenkins Fig. No. 729 flanged, iron body, bronze mounted (IBBM) swing check, 175 psig WOG, with renewable composition disc and bronze seat ring, Underwriters' Laboratories, Inc. (UL) and/or Factory Mutual (FM) approved as required. Where ball drip is required, provide Jenkins Fig. No. 624 with Grinnell Fig. 1686 plain discharge.
- B. OS&Y Valves: Valves 2" and smaller shall be Jenkins Fig. No. 275U, 175 psig WOG, threaded, all bronze, gate valve, UL approved. Valves 2 1/2" and larger shall be Jenkins Fig. No. 825A, 175 psig WOG, flanged, gate valve, IBBM, solid wedge, UL and FM approved. Provide OS&Y valves with tamper switches installed where indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Except as otherwise indicated, comply with the following requirements.
- B. Ball Valves: Provide ball valves on chilled water pipes at each runout to a piece of equipment, at each coil, and elsewhere as shown on the Drawings.
- C. Valve Stems: Install valves with stems pointed up, in the vertical position where possible, but in no case with stems pointed downward from a horizontal plane.
- D. Chain Operators: In central plant and in fan or mechanical rooms where chilled water and condenser water valves are installed over 8' above floor, provide chain operators.
- E. Swing Check Valves: Swing check valves shall be installed in horizontal piping only.
- F. Unions and Companion Flanges: Provide unions or companion flanges where required to facilitate dismantling of valves and equipment.
- G. Access Doors and Panels: Verify the location and quantity of access doors or panels required to provide full valve access.

END OF SECTION

SECTION 23 21 15 - HVAC BELOW GRADE AND EXPOSED SITE PIPING

1.0 GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the HVAC below grade site piping systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the HVAC site piping systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide complete operating mechanical piping systems including pipe, tube, fittings, and appurtenances as indicated and in compliance with these Specifications.
- B. Applications: Applications of piping systems include, but are not limited to, the systems as listed below:

<u>System</u>	<u>Working Pressure</u>	<u>Operating Temperatures</u>
Chilled Water		
High	350 psig	35 to 100°F
Medium	300 psig	35 to 100°F
Low	150 psig	35 to 100°F
Heating Water		
High	350 psig	70 to 250°F
Medium	300 psig	70 to 250°F
Low	150 psig	70 to 250°F

1.3 QUALITY ASSURANCE

- A. Welding: Qualify welding procedures, welders, and operators in accordance with ANSI B31.1, Paragraph 127.5, for shop and job site welding of piping work. Make welded joints on the piping system with continuous welds, without backing rings and with pipe ends beveled before welding. Gas cuts shall be true and free from burned metal. Before welding, surfaces shall be thoroughly cleaned. The piping shall be carefully aligned and no weld metal shall project inside the pipe.

2.0 PRODUCTS

2.1 PIPING MATERIALS

~~A. **General: Provide pipe and tube of type, joint, grade, size, and weight (wall thickness, schedule or class) indicated for each service. Comply with applicable governing regulations and industry standards.**~~

~~1. **Ductile Iron: ANSI/AWWA C151/A21.51-02 with mechanical joints and internal cement liner**~~

~~2. **Steel Pipe: ASTM A53, ASTM A106, or ASTM A120, black or hot-dipped galvanized as specified.**~~

2.2 PIPING / TUBING FITTINGS

A. General: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, and equipment connections. Where not otherwise indicated, comply with governing regulations, industry standards, and where applicable, with pipe manufacturer's instructions for selections.

1. Ductile Iron: AWWA C110 & AWWA C111 **with restraint mechanical joints fittings** with gaskets. **No unrestrained joints shall be used.**

2. Wrought Steel Butt-welding Fittings: ANSI B16.9, **only long radius elbows shall be used.**

B. Miscellaneous Piping Materials/Products:

1. Welding Materials: Comply with ASME Boiler and Pressure Vessels Code, Section II, Part C, for welding materials.

2. Brazing Materials: American Welding Society, AWS A5.B, Classification BCup-5.

3. Gaskets for Flanged Joints: 1/8" thick gaskets. Ring-type shall be used between raised face flanges and full face-type between flat face flanges with punched bolt holes and pipe opening. Gaskets shall be Garlock Style 3400 compressed non-asbestos or equal.

2.3 BELOW GRADE AND EXPOSED PRE-INSULATED PIPE CONDUIT SYSTEM

A. General: Furnish a complete system of factory fabricated piping and fittings for the specified service.

B. Manufacturers: Basis of design is **Thermacor**. Other acceptable manufacturers include Energy Task Force, Perma-Pipe and Rovanco.

C. Service & Piping Materials:

1. Below Grade Chilled Water Piping – Class 350 cement lined Ductile Iron

2. Below Grade Heating Water Piping – Schedule 40 Steel

- D. Insulation: polyurethane foam or injected into the annular space between carrier pipe and jacket and bonded to both. Insulation shall be rigid, closed cell polyurethane with 2.0 to 3.0 pounds per cubic foot density and coefficient of thermal conductivity (K-Factor) not to exceed 0.16 and shall conform to ASTM C-591. **Insulation thickness shall be determined by carrier pipe length and shall not be less than 1.5”.**
- E. Jacketing: ~~High impact seamless polyvinyl chloride(PVC) class 12454B compound conforming to ASTM 1784, Type 1, Grade 1 for pipe sizes 12” and smaller.~~ High density polyethylene(HDPE) casing Type III, category 5, class C, conforming to ASTM D-1248 **for all pipe sizes.**
- F. End Seals: Provide high temperature black mastic end seal on each end of each length of pre-insulated pipe. **End seals shall be factory applied, sealed to jacket and pipe with pressure test certification.** Provide extra mastic end seal material during installation for field cut pipe. At no time during installation should insulation be directly exposed to elements. **Straight run joints shall be field insulated to match the system, covered with a HDPE sleeve and sealed with heat shrink tape per manufacturer’s recommendations. All material shall be furnished by the preinsulated pipe manufacturer.**
- G. Provide all necessary expansion loops, expansion elbows, anchors, wall sleeves and all necessary accessories for field assembly and insulation of fittings and straight joints.
- H. Any piping that is exposed above grade provide integral electrically heated heat trace freeze protection.
- I. Any exposed piping exposed to sunlight shall have UV coating.

2.4 ISOLATION VALVES

- A. General: Furnish all valves located below grade with **cast iron valve box with bell bottom** and appropriate access. **Valve box shall be by East Jordan Iron Works, Neenah Foundry or approved equal.**
- B. Provide gate valves for each new branch line to isolate the new branch line from the utility main.
- C. Gate Valve:
 - 1. Conform to AWWA Standard C515
 - 2. Resilient wedge gate valve with non-rising stem and 2 inch square operating nut
 - 3. Valve shall be **ductile iron** body epoxy-coated interior and exterior surfaces. Epoxy shall be in conformance with AWWA C550 and be NSF 61 Certified
 - 4. Stem shall be bronze with integral collars. Stem shall have two O-rings above collar and one O-ring below collar
 - 5. **Valve manufacturer shall provide a letter stating that the valve can handle continuous temperature of 225°F and excursion up to 250°F.**
 - 6. **Provide minimum 2” pre-molded rigid close cell foam insulation with vapor barrier.**
 - 7. Manufacturer: Basis of design is M&H ~~Series 700~~, or approved equal. **by Glow, Kennedy or Mueller**

3.0 EXECUTION

3.1 PIPING INSTALLATION

~~A. General:~~

- ~~1. Industry Practices: Install pipe, tube, and fittings in accordance with recognized industry practices which will achieve permanently leak-proof piping systems, capable of performing each indicated service without failure or degradation of service. Install each run with a minimum of joints and couplings, but with adequate and accessible unions or flanged connections to permit disassembly for maintenance/ replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align accurately at connections. Coordinate piping locations with other trades to avoid conflict. Give ductwork preference unless directed otherwise by the Engineer.~~
- ~~2. Systems: Provide fittings at changes in direction. Where pipes of different sizes join, provide reducing elbows, tees, or couplings. Bushings will not be acceptable.~~
- ~~3. Expansion and Contraction: Install loops, offsets, sizing joints, and expansion joints, as necessary, to avoid strain resulting from expansion and contraction of piping systems on fixtures and equipment. Provide mechanical grooved connections required by the application to reduce vibration at equipment connections. Provide expansion joints in piping systems by mechanical grooved connections where required.~~

~~B. Steel Pipe: Ream steel pipe after cutting and before threading. Thread with clean-cut taper threads of length to engage all threads in fittings and leave no full-cut threads exposed after make-up.~~

C. Excavation, Installation, and Backfill for Underground Pipe:

1. Layout: Pipes shall be laid and pipe joints made in presence of the General Contractor and field measurements, layouts, batter board alignment, grade establishments, and similar locations shall be performed by a Professional Engineer in the employ of the Contractor. The Contractor's engineer shall be on the job during all underground work. A "Bench-Mark" reference shall be provided by the General Contractor.
2. Pipe Grading: Lay and maintain all pipes at required lines and grades during the course of the Work.
3. Trench: Excavate the trench to the depth required. Properly brace and de-water the trench and keep it free of water during installation, testing pipe, and backfilling. No water shall be discharged onto the street or freeway without approval by the Owner.

4. Excavation: The trench shall be at least 18" wider than the maximum diameter of the pipe or largest bell and the pipe shall be laid in the center of the trench. The trench shall be excavated to a depth sufficient to provide for pipe cushions or supports as specified. Trench width may be increased as required and piling left in place until sufficient compacted backfill is in place. Properly sheet and brace all open trenches to render them secure and remove all such sheeting and bracing before completing the backfill. Comply with all applicable national, state, and local codes and regulations. The quantity of excavation required to install sheeting and the installation and removal of sheetings and bracings will not be regarded as Extra Work. All costs incurred for this excavation and the installation of sheeting shall be included in the Contract Price.
5. Grading: Upon completion of excavation and prior to the laying of the pipe, the trench bottom shall be brought up to the required elevation with a pipe cushion, except where the cushion has been eliminated by the General Contractor. Pipe cushions shall be select material deposited in the trench and shall be compacted, leveled off, and shaped to obtain a smooth compacted bed along the laying length of the pipe. Pipe cushion material shall be as follows:
 - ~~6. ***Anchors: Pipes shall have concrete anchors at each change in direction and/or as directed. Any change in direction exceeding 15 degrees shall be anchored. Concrete anchors shall rest against solid (virgin) ground with the required area of bearing on pipe and ground to provide suitable anchoring.***~~
7. Backfill: Backfill trenches only after piping has been inspected, tested, and approved by the General Contractor. Backfill shall be provided as recommended in the geo-technical report included in these Contract Documents, or, in the absence of a geo-technical report, as required by site conditions. Refer to Division 2 or elsewhere in the Contract Documents for additional trenching and backfill requirements. ***Valves shall not be backfilled until approved by AU facilities representatives witness of pressure test and valve operation.***
8. Existing Surfaces: Restore existing streets, driveways, and sidewalks damaged during the excavation work to acceptable condition, subject to approval by the Owner, Architect, and/or Engineer.
9. Safety: Provide street and sidewalk excavations with approved barricades, warning lights, and cover plates as required by the local authorities.

3.2 CLEANING, FLUSHING, TESTING, AND INSPECTING

- A. Cleaning & Flushing: The mechanical contractor shall adhere to Auburn University Water Treatment procedures as laid out in Appendix J of the Auburn University Design and Construction Standards and as follows:
 1. It is to be performed in conjunction with and under the technical direction of the Utilities & Energy Water Treatment department.
 2. General Guidelines– Closed Loop Treatment

- a. Submittals - Provide product data for all chemical treatment materials, chemicals and equipment. Product data shall include chemical explanation, MSDS, layouts of feeding equipment and equipment detail sheets.
- b. Quality Assurance
 - i. Retain the resources of the chemical water treatment contractor who is already under contract with the client or has been prequalified by the client.
 - ii. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of industrial water treatment for at least five years, whose major business is in the field of water treatment, and who has full time service personnel within the area of the job site. Laboratory facilities shall be available. Service personnel shall be degreed specialists in the fields of mechanical or chemical engineering or chemistry.
 - iii. Furnish and install all equipment and material on this project in accordance with the requirements of the authority having jurisdiction, suitable for its intended use on this project, approved by the U.S. Environmental Protection Agency (EPA), and local Department of Environmental Protection, and so certified by the manufacturer.
 - iv. If not already known, analyze the water from the local water supplier to be used on the project, before establishing treatment procedures.
 - v. The cleaning sequence will not be deemed completed until fully signed off and agreed upon by the Auburn University Water Treatment Department, as well as, the Plant Operations Group.
- c. Safety
 - All chemical and analytical reagents supplied by the vendor shall meet all applicable government regulations. The bidders shall submit an MSDS for all proposed products with the initial technical proposal. The vendor shall be responsible for providing up to date MSDS for all chemicals supplied including reagents.
 - ii. The mechanical contractor shall be responsible for the safe cleanup of any chemical spills relating to products supplied by the vendor and caused by failure or malfunction of the chemical feed equipment or due to the actions of the field service personnel. Cleanup shall be performed in accordance with all current government regulations and good safety practices. Vendor shall maintain a 24 hour hot line for emergency situations. Bidder shall provide the phone number and procedure to access the hot line including estimated response time in the event of an emergency.
- d. Technical Services
 - i. Mechanical contractor shall be responsible for handling of all water treatment chemicals.
 - ii. All chemical deliveries shall be made to the point of use by the vendor or an ahead of time agreed up on location such as the mechanical contractors lay down yard. The contractor shall remove, following local, state and federal governances all chemical containment systems as instructed by the vendor.
- e. Underground Laterals - Chilled Water/Ductile Lined
 - i. Materials
 - Pump Strainer shall be fine mesh (3/64-inch maximum).
 - Sterilization Chemicals shall be non-oxidizing biocide which has halogen like effects such as 2,2-dibromo-3-nitrilopropionamide, also known as DBNPA.

- Use GE Betz Spectrus NX108 or equivalent.
 - Water Treatment Chemical shall be GE Betz Corrrshield MD407 or equivalent.
- ii. Preparation
- Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
 - Contractor will notify the University Project Lead three (3) working days prior to filling for pressure testing and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
 - Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6") they do not require sterilization, however, they do require flushing with system chilled water before they are put into service.
 - Contractor shall install a two (2") inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.
- iii. Sterilization/Flushing Sequence
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
 - Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of biocide for sterilization or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
 - Biocide shall be added to pipe at a concentration of 50 ppm based on total water volume in the pipe.
 - Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.
 - At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
 - Circulate the solution for at least twenty four (24) hours or as recommended by the University Project Lead, whichever is less. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified pump curves shall be utilized to determine pump flow. Biocide shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.

- **MINIMUM CLEANING WATER**

<i>Pipe Size (in)</i>	<i>Flow (gpm)</i>
2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Following cleaning, drain systems as quickly as possible. Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
 - Remove strainer(s).
 - Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.
- iv. Water Treatment
- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- v. Flushing Sequence for Lines Less than 6" in Diameter
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- vi. Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- vii. System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.2, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
- viii. Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- ix. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University Project Lead deems it

necessary for underground main protection; mainly in the case of extended lay-up periods.

f. Underground Laterals – Hot Water

i. Materials

- Pump Strainer shall be fine mesh (3/64-inch maximum).
- Cleaning and Sterilization Chemicals shall be liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products. Use GE Betz Ferroquest FQ7101 or equivalent.
- Water Treatment Chemical shall be GE Betz Corrshield NT402 or equivalent.

ii. Preparation

- Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
- Contractor will notify the University Project Lead three (3) working days prior to filling and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
- Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6") they do not require cleaning, however, they do require flushing with system hot water before they are put into service.
- Contractor shall install a two (2") inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.

iii. Cleaning/Flushing Sequence

- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of cleaning chemical or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- System cleaner shall be added to the piping section at a concentration as recommended by University Project Lead following the hydro test. A water volume equal to the calculated amount of cleaner to be added shall be drained from the pipe to allow for addition of cleaner.

- Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.
- At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
- Circulate the solution for at least twenty four (24) hours or Less if recommended by University Project Lead. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified pump curves shall be utilized to determine pump flow. Cleaner shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.

• **MINIMUM CLEANING WATER**

Pipe Size (in) Flow (gpm)

a.	
2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Twenty four (24) hours following the start of the cleaning process, two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis. Following cleaning, drain systems as quickly as possible.
- Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
- Two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis following city water flushing.
- Remove strainer(s).
- Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.

iv. Water Treatment

- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
- Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.

v. Flushing Sequence for Lines Less than 6" in Diameter

- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the

pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.

- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.6, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
- Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University Project Lead deems it necessary for underground main protection; mainly in the case of extended lay-up periods.

B. Piping Tests:

1. General: Perform tests before piping is concealed from view. Tests may be performed in sections. Tests shall be witnessed by the General Contractor and local inspectors and the test results presented to the Engineer for acceptance and approval prior to concealing piping from view. Provide all necessary equipment for testing, including pumps and gauges.
2. Test water systems hydrostatically to a pressure of 150 psig or 1-1/2 times working pressure, whichever is greater, for a period of 4 hours. Repair all leaks, replacing materials as necessary and repeat tests until systems are proven tight.

C. Inspecting: Visually inspect each run of each system for completion of joints, adequate hangers, supports, and inclusion of accessories and appurtenances.

END OF SECTION

23 21 23 - HVAC PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the water source heat pump systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the water source heat pump systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.
- D. Refer to Section 23 25 00, "Water Treatment Systems", for information regarding required chemicals, etc.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide pumps as specified and indicated.
- B. Work of Other Sections:
 - 1. Refer to Division 26 for electrical connection work required in conjunction with pump motors (not work of this Section), controllers, and alarms.
 - 2. Refer to Section 23 07 00, "HVAC Insulation", for piping and equipment thermal insulation work required in conjunction with pumps.

1.3 QUALITY ASSURANCE

- A. Basis of design is Grundfos. Other acceptable manufacturers are Bell & Gossett, Aurora, T ACO, Myers, Patterson, PACO, Weil, and Worthington.
- B. Electrical Standards: Provide electric motors and products which have been listed and labeled by Underwriters' Laboratories, Inc. (UL) and comply with National Electrical Manufacturers' Association (NEMA) standards.
- C. Certification, Pump Performance: Provide pumps whose performance, under specified conditions, is certified by the manufacturer.

PART 2 - PRODUCTS

2.1 CHILLED AND HEATING HOT WATER PUMPS

A. Base-Mounted Vertical Inline Pumps

1. General: Vertical inline pumps, where used, shall have the capacities required for the application. Pump performance shall be shown on curves of pressure versus flow. Operating point shall be at a minimum efficiency of 75% and impeller diameter shall not materially exceed 85% of the maximum size that the casing will accept. Pump discharge velocities shall not exceed 12' per second for chilled water nor for heating water service. Total dynamic head shall be a maximum at no flow and decrease from no flow to design flow. Shut off head shall be more than 110% of design head but less than 140% of design head. Pumps shall have dynamically balanced impellers. Pumps shall be free of flashing and cavitation at all flow rates from 25 to 125% of design flow under the suction conditions of the pump installation. The impeller selected for compliance with design requirements shall not exceed 85% of maximum diameter for the selected pump casing size. The percent of maximum diameter shall be noted on the Shop Drawing submittal.
2. Features: Pumps shall have 300 psig minimum casings, enclosed suction impellers, SAE 1045 steel shafts for packing gland pumps, stainless steel shafts for mechanical steel pumps, cast iron casing wearing rings, bronze impeller wearing rings, cast iron deflectors, stainless steel impeller key, coated fiber parting gasket, steel casing studs and bolts, and internal drilled passages to lantern rings. Mechanical seals shall be used on all chilled and heating water pumps.
3. Performance: Pumps having motors larger than 10 HP shall be capacity tested after final assembly. Provide for each pump, a certified shop performance test curve indicating capacity, head, horsepower, and efficiency at flow rates from shutoff to 125% of design flow. When the pumps are shipped from the factory, the manufacturer shall transmit three copies of a certified letter stating that the pumps have been dynamically balanced, pressure tested, and capacity tested. The certified shop performance test curves shall accompany the certified letter. No pump shall be installed before its test data has been reviewed by the Engineer.
4. Seals: The mechanical seals shall be as manufactured by John Crane Company, Environamic Inc., or Durometallic Inc. and shall be suitable for the service specified:
 - a. Seals for stuffing box working pressures 150 psig and below shall be John Crane Company Type 1 or Type 2. Equivalent seals manufactured by Environamics Inc. or Durometallic Inc. are acceptable

- b. Seals for stuffing box working pressures greater than 150 psig shall be John Crane Company Type 1B. Equivalent seals manufactured by Environamics Inc. or Durometalic Inc. are acceptable.
 - c. After the pumps are in operation for 90 days, the Contractor shall check the seals and replace any that are defective.
5. Bearings: Pumps shall have grease-lubricated ball bearings, grease fittings, and relief plugs. Bearings shall be 40,000 hours minimum life below 200 psig suction pressure and 20,000 hours for suction pressures above 200 psig.
6. Base: Base shall have cast iron or fabricated steel drip lip bases, coupling guard, provisions for grouting, anchor bolts, and collection of all seal leakage. The base shall have machined surfaces for the motor and pump mounting surfaces. Motor mounting shall permit horizontal adjustment. A threaded outlet of 3/4" minimum size shall be provided in the base at the pump end for field piping of drainage to drain. The base shall be of sufficient strength to prevent vibration, warping, or misalignment of the pump and motor when installed without grouting. The base shall be rigidly bolted to the concrete base. After final alignment, all pumps 25 HP and over shall have the pump and motor doweled to the base. In addition, the minimum requirements of the fabricated structural steel base shall be as follows:
- a. Pumps with 20 HP and smaller motors shall have steel bases adequately stiffened as required to prevent "oil-canning".
 - b. Pumps with 25 HP and larger motors shall have bases constructed of structural shapes and formed steel section. The main structural member and formed steel sections shall have a depth of at least 1/2 the overall length of the base, but not less than 4". Standard or factory bases that do not meet this requirement shall be certified by the pump manufacturer to be constructed with sufficient strength to prevent vibration, warping, and misalignment of the pumps. The base shall be filled with concrete or grout after installation on the isolation base. Concrete and grout shall be provided by this Contractor.
7. Motors: Pumps shall have drip-proof motors suitable for electrical service with a service factor of 1.15 and a rated temperature rise of 104°F (40°C). Motors and pumps shall be factory-mounted and aligned on bases. Motors shall not overload when operation is from 0 to 125% of design flow on the pump characteristic curve.

2.2 CIRCULATING PUMPS

- A. General: In-line circulating pumps shall be cast iron body construction of the size, type, and capacity required by the application. Pumps shall be fitted

with a dynamically balanced, brass enclosed type impeller with mechanical seal. Mechanical seal shall be Type 1 or Type 2 material, Code BP-1D1 as manufactured by John Crane Company or an approved equal, suitable for service specified. Motor shall have a maximum speed of 1750 rpm. Pumps, casings, flanges, and seals shall be suitable for operation with the working pressures and temperatures required. The working pressure applies to the entire pump assembly.

PART 3 - EXECUTION

3.1 INSPECTION

- A. General: Installer shall examine the bases upon which and conditions under which pumps are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PUMPS

- A. General: Install pumps in accordance with manufacturer's written instructions and recognized industry practices to ensure that pumps comply with requirements and serve intended purposes. Comply with NEMA standards and requirements of NEC.
- B. Alignment: Check alignment and, where necessary, realign shafts of motors and pumps within tolerances recommended by manufacturer.
- C. Vibration Isolation: Install units on vibration mounts as required or specified. Comply with manufacturer's indicated installation method and with other applicable Sections of this Division.
- D. Lubrication: All pumps installed are to be lubricated per the manufacturers' recommendations.

3.3 ELECTRICAL CONNECTIONS

- A. Grounding: Provide positive electrical pump and motor grounding in accordance with applicable requirements of the NEC.

3.4 FIELD QUALITY CONTROL

- A. Field Test: Upon completion of pump installation and after motor has been energized from normal power source, bleed air from pump casing and test pump to demonstrate compliance with requirements. When possible, field-correct malfunctioning units then retest to demonstrate compliance. Replace units that cannot be satisfactorily corrected.

- B. Start-up: During start-up and system flushing, construction strainers shall be installed. After start-up and completion of piping system flush, construction strainers are to be removed and final strainer sets installed.

END OF SECTION

23 25 00 - WATER TREATMENT SYSTEMS

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the water treatment systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the water treatment system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Perform water analysis and provide water treatment products, holding reservoirs, equipment, and labor for testing, cleaning, flushing, and dispensing products to control water quality for each system.
- B. Chemicals: Provide, at no change in Contract amount, chemicals required for operating and testing water treatment systems prior to acceptance by the Owner. In addition to the chemicals provided during construction, provide spare chemicals that the Owner can use that will last for a 90 day period. The 90 day period will begin after final acceptance of the system by the Engineer. Final acceptance will be established during the Commissioning walk through of the system conducted by the Engineer with the installing Contractor.
- C. Instructions: Provide operation and maintenance instructions for each water treatment system; include one set in each Owner's Manual and deliver one set to Owner's operating personnel.
- D. Testing Equipment and Reagents: Furnish suitable water treatment testing equipment for each system, complete with apparatus and reagents necessary for operation by the Owner.
- E. Service Representative: Furnish the services of a qualified service representative to instruct Owner's operating personnel in proper operation and maintenance of water treatment equipment, systems, and tests required. Service representative shall return to the site biweekly during first month of operation. At such times, the service representative shall check and adjust water treatment system operation, check efficiency of chemicals and chemical applications, and instruct and advise operating personnel.
- F. Replacement and Rework: Replace defective or nonconforming materials and equipment with new materials and equipment, at no change in Contract amount, for one year after successful start up of the system. All warranty work shall be FOB as installed at the project site.

1.1 QUALITY ASSURANCE

- A. Retain the resources of the chemical water treatment contractor who is already under contract with the client.
- B. The water treatment chemical and service supplier shall be a recognized specialist, active in the field of industrial water treatment for at least five years, whose major business is in the field of water treatment, and who has full time service personnel within the area of the job site. Laboratory facilities shall be available. Service personnel shall be degreed specialists in the fields of mechanical or chemical engineering or chemistry.
- C. Furnish and install all equipment and material on this project in accordance with the requirements of the authority having jurisdiction, suitable for its intended use on this project, approved by the U.S. Environmental Protection Agency (EPA), and local Department of Environmental Protection, and so certified by the manufacturer.
- D. If not already known, analyze the water from the local water supplier to be used on the project, before establishing treatment procedures.
- E. The cleaning sequence will not be deemed completed until fully signed off and agreed upon by the Auburn University Water Treatment Department, as well as, the Plant Operations Group.

1.4 SUBMITTALS

- A. Test Reports: Submit test reports certified by an officer of the firm, on water treatment company letterheads, of samples of each treated water system specified. Comply with "Standard Methods" for reporting.
- B. Shop Drawings: Submit Show Drawings for each water treatment system. Show wiring, piping and tubing sizes, fittings, accessories, valves, and connections.

1.5 SAFETY

- A. All chemical and analytical reagents supplied by the vendor shall meet all applicable government regulations. The bidders shall submit an MSDS for all proposed products with the initial technical proposal. The vendor shall be responsible for providing up to date MSDS for all chemicals supplied including reagents.
- B. The mechanical contractor shall be responsible for the safe cleanup of any chemical spills relating to products supplied by the vendor and caused by failure or malfunction of the chemical feed equipment or due to the actions of the field service personnel. Cleanup shall be performed in accordance with all current government regulations and good safety practices. Vendor shall maintain a 24 hour hot line for emergency situations. Bidder shall provide the phone number and procedure to access the hot line including estimated response time in the event of an emergency.
- C. Mechanical contractor shall be responsible for handling of all water treatment chemicals.
- D. All chemical deliveries shall be made to the point of use by the vendor or an ahead of time agreed up on location such as the mechanical contractor's laydown yard. The contractor shall remove, following local, state and federal governances all chemical containment systems as instructed by the vendor.

2.0 PRODUCTS

- 2.1** The mechanical contractor shall adhere to Auburn University Water Treatment procedures as laid out in Appendix J of the Auburn University Design and Construction Standards and as follows:

2.2 CLOSED LOOP SYSTEMS

A. Underground Laterals - Chilled Water/Ductile Lined

i. Materials

- Pump Strainer shall be fine mesh (3/64-inch maximum).
- Sterilization Chemicals shall be non-oxidizing biocide which has halogen like effects such as 2,2-dibromo-3-nitropropionamide, also known as DBNPA.
- Use GE Betz Spectrus NX108 or equivalent.
- Water Treatment Chemical shall be GE Betz Corshield MD407 or equivalent.

ii. Preparation

- Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
- Contractor will notify the University Project Lead three (3) working days prior to filling for pressure testing and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
- Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6") they do not require sterilization, however, they do require flushing with system chilled water before they are put into service.
- Contractor shall install a two (2") inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.

iii. Sterilization/Flushing Sequence

- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of biocide for sterilization or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- Biocide shall be added to pipe at a concentration of 50 ppm based on total water volume in the pipe.
- Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.
- At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
- Circulate the solution for at least twenty four (24) hours or as recommended by the University Project Lead, whichever is less. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified

pump curves shall be utilized to determine pump flow. Biocide shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.

- MINIMUM CLEANING WATER

<i>Pipe Size (in)</i>	<i>Flow (gpm)</i>
2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Following cleaning, drain systems as quickly as possible. Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
 - Remove strainer(s).
 - Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.
- iv. Water Treatment
- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- v. Flushing Sequence for Lines Less than 6" in Diameter
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- vi. Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- vii. System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.2, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
- viii. Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- ix. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University Project

Lead deems it necessary for underground main protection; mainly in the case of extended lay-up periods.

B. Underground Laterals – Hot Water

i. Materials

- Pump Strainer shall be fine mesh (3/64-inch maximum).
- Cleaning and Sterilization Chemicals shall be liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products. Use GE Betz Ferroquest FQ7101 or equivalent.
- Water Treatment Chemical shall be GE Betz Corrshield NT402 or equivalent.

ii. Preparation

- Contractor shall provide a minimum notice of fourteen (14) days to the water treatment vendor to allow for delivery of chemicals.
- Contractor will notify the University Project Lead three (3) working days prior to filling and cleaning of new water pipes. The new piping system shall not be connected/operated until the chemical clean-up is performed.
- Contractor shall determine supply and return diameters. If the supply and return lines are less than six inches (6") they do not require cleaning, however, they do require flushing with system hot water before they are put into service.
- Contractor shall install a two (2") inch bypass inside the mechanical room before the building isolation valves to aid in cleaning, flushing and treatment of the laterals.

iii. Cleaning/Flushing Sequence

- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
- All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
- Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start of the addition of cleaning chemical or flushing. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
- System cleaner shall be added to the piping section at a concentration as recommended by University Project Lead following the hydro test. A water volume equal to the calculated amount of cleaner to be added shall be drained from the pipe to allow for addition of cleaner.
- Place the re-circulation pump at the low point of the area to be cleaned so that adequate venting can occur at the high point of the system.
- At the high point crossover, contractor to provide a ball valve and sample point for ease of water testing and for venting air from the system.
- Circulate the solution for at least twenty four (24) hours or Less if recommended by University Project Lead. Balance valves shall be included to ensure pump is operated with sufficient head. Valve shall be manually modulated to obtain proper flow from pump. Pump differential head and certified pump curves shall be utilized to determine pump flow. Cleaner shall be circulated to maintain a minimum pipe flow as shown in the following table. Flow rate shall be determined based on the largest diameter piping in the system.

- **MINIMUM CLEANING WATER**
Pipe Size (in) Flow (gpm)

2	45
4	100
6	250
10	500
14	960
15 thru 30	1,250

- Twenty four (24) hours following the start of the cleaning process, two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis. Following cleaning, drain systems as quickly as possible.
 - Flush with clean water until the University Project Lead or the chemical vendor verifies the water is back to city water quality.
 - Two twelve (12) ounce bottles of system water shall be gathered for laboratory analysis following city water flushing.
 - Remove strainer(s).
 - Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required. Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial.
- iv. Water Treatment
- Within 48 hours following the completion of the cleaning sequence, the water treatment chemicals shall be added and circulated as recommended by the University Project Lead.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
- v. Flushing Sequence for Lines Less than 6" in Diameter
- If filling of the pipe is to occur as the pipe sections are constructed, then sterilization shall be accomplished as the pipe is constructed, otherwise, sterilization can be done at the end of each job as long as no water is put into the pipe for any reason. Once a section of pipe between isolation valves is complete, the piping shall be hydro tested, sterilized and treated, in that order. Under no circumstance shall the pipe remain untreated for more than one week after initial filling.
 - All water shall be metered into the pipe and amounts shall be tabulated and given to University Project Lead to indicate the volume of water in each pipe section between isolation valves. Pipe quantities and sizes shall also be tabulated to verify piping is filled completely.
 - Two twelve (12) ounce bottles of the system water shall be taken for laboratory analysis prior to the start flushing process. University Project Lead will be responsible for providing the sample bottles to the mechanical contractor.
 - System water is to be introduced to the new pipe and allowed to fill the lines and flush until it runs clear at the bypass outlined in Section 2.6, Paragraph B, Subparagraph 4 above, in the mechanical room risers of the new or retrofitted building.
 - Two additional twelve (12) ounce bottles shall be gathered for laboratory analysis once treated water is in the pipe.
 - Under no circumstance shall cross overs or ball valves be left underground. Where crossovers and valves are used, they must be removed, plugged, sealed and adequately insulated prior to burial, except in the case where the University

Project Lead deems it necessary for underground main protection;mainly in the case of extended lay-up periods.

3.0 PERSONNEL TRAINING

- A. Operator Training: Train Owner's personnel in use and operation of heating water, chilled water and condenser water treating systems, including preparation of chemical solution, if applicable, and charging of the chemical solution reservoir. A Program Administration Manual shall be furnished encompassing all systems covered in this Section of the Specifications.

END OF SECTION

23 30 00 - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the duct systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the duct systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included:
 - 1. Provide sheet metal ductwork as specified herein.
- B. Types: The types of ductwork specified in this Section include, but are not necessarily limited to the following:
 - 1. Air conditioning cooling and/or heating supply and return air systems
 - 2. Outdoor air supply systems
 - 3. Mechanical exhaust systems
 - 4. Air relief systems
 - 5. Kitchen exhaust systems
 - 6. Boiler breeching and boiler flue
- C. Supply Air Ductwork Downstream of Heat Pumps: Ductwork shall be sheet metal designed for velocities up to 1,500 fpm or a friction rate of 0.10 inches water column per 100 feet of duct, whichever is most stringent. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 1" W.C. pressure class.
- D. VAV Supply Air Ductwork Upstream of Terminal Units (round or flat oval): Ductwork shall be sheet metal designed for velocities up to 2,800 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 3" W.C. pressure class.
- E. VAV Supply Air Ductwork Upstream of Terminal Units (rectangular): Ductwork shall be sheet metal designed for velocities up to 2,300 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 3" W.C. pressure class.
- F. Supply Air Ductwork Downstream of Terminal Units: Ductwork shall be sheet metal ductwork designed for velocities up to 1,500 fpm or a friction rate of 0.10 inches water column per 100 feet of duct, whichever is most stringent. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 1" W.C. pressure class.

- G. Outside Air Ductwork (fan forced): Ductwork shall be sheet metal ductwork designed for velocities up to 2,500 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 1" W.C. pressure class.
- H. Outside Air Ductwork (passive): Ductwork shall be sheet metal ductwork designed for velocities up to 1,000 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork.
- ~~I. **Stairwell Pressurization Ductwork: Ductwork shall be sheet metal ductwork designed for velocities up to 3,000 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork.**~~
- J. Restroom and General Exhaust Ductwork: Ductwork shall be sheet metal ductwork designed for velocities up to 1,500 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork. Ductwork shall be 1" W.C. pressure class.
- ~~K. **Smoke Exhaust and Relief Air Ductwork: Ductwork shall be sheet metal ductwork designed for velocities up to 3,000 fpm. The ductwork shall meet the latest SMACNA Standards for construction and stiffening based on the maximum pressure in the ductwork.**~~
- ~~L. **Grease exhaust ductwork shall be designed for velocities up to 2,500 FPM. The ductwork shall meet the latest SMACNA standards for construction and stiffening based on the maximum pressure in the ductwork. Grease exhaust duct material and installation shall meet the requirements of NFPA 96 and shall be either 16 GA black carbon steel or 18 GA stainless steel, sloping at a minimum of 1/4" / foot back toward the hood. All grease exhaust duct shall be welded and leak-tested. Cleanouts should be provided at least every 12 feet and at each change in direction.**~~
- M. Flexible Ductwork: Ductwork connections to HVAC terminal units and air devices shall be made with flexible ductwork connection where shown on the Drawings. Additional connections may be made using flexible ductwork at the Contractors opinion, where approved in writing, in advance, by the Engineer.
- N. Ductwork Insulation: Refer to section 23 07 00, "HVAC Insulation", for duct insulation.
- O. Ductwork Accessories: Refer to Section 23 33 00, "Ductwork Accessories", for accessories and specialties related to ductwork systems and installation.

1.3 QUALITY ASSURANCE

- A. Design and Installation Standards:
1. SMACNA HVAC Duct Construction Standards, latest edition.
 2. ASHRAE Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE 70-72) , Method of Testing for Rating the air flow performance of outlets and inlets.
 3. ADC Standard 1062R2, Air Diffusing Equipment Test Code.
 4. AMCA Standard 210, Test Code for Air Moving Devices.

5. NFPA 90-A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2002 edition.
- B. Fire and Smoke Rating Test Standards: ASTM E84, NFPA 255 and UL 723.

1.4 SUBMITTALS

- A. Shop Drawings: Submit dimensioned layouts of ductwork showing both the accurately scaled ductwork and its relation to space enclosure. Show modifications of indicated requirements, made to conform to local shop practice and how those modifications ensure that the free area, materials, and weights are not reduced. The shop drawings must be submitted at ¼" = 1'-0" or larger scale and shall include all equipment connected to the duct systems, drawn to scale, based on the equipment submittals. All ductwork and equipment must indicate bottom elevations, referenced to finished floor below (bottom of duct = X'-Y" AFF, e.g.)

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

- A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discolorations, and other imperfections, including those which would impair painting.
- B. Gauges, Rectangular Ductwork: Fabricate galvanized steel ductwork from the minimum gauges for sizes up to the corresponding maximum long-side dimensions as indicated in SMACNA Duct Construction Standards.
- C. Gauges, Round Ductwork: Fabricate lock-form quality galvanized steel ductwork from the minimum gauges for diameters up to the corresponding maximum dimensions as indicated in SMACNA Duct Construction Standards.
- D. Fiberglass Duct board: Fiberglass duct board is NOT an acceptable means of air transport.

2.2 MISCELLANEOUS DUCT MATERIALS

- A. General: Provide miscellaneous materials and products of the types and sizes indicated and where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.
- B. Duct Sealant: Provide non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for the fabrication/installation detail) as compounded and recommended by the manufacturer specifically for sealing joints and seams in ductwork.
- C. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim, and angles for support of ductwork.
- D. Duct Liner Adhesive: Comply with ASC-A-7001 by The Adhesive and Sealant Council, Inc. (per SMACNA standards).

- E. Duct Liner Fasteners: Comply with SMACNA.
- F. Flexible Ductwork: Insulated flexible ductwork shall be Wiremold Type VTCK. Approved equal flexible ductwork by Certainteed Corporation, Flexaust Company, Genflex or Owens-Corning Fiberglass will be acceptable. Provide either 45 degree angle taps with manual volume dampers or "spin-in" taps with manual volume dampers at main duct tap as shown on Drawings.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Standards: Round and rectangular sheet metal ductwork shall be constructed in accordance with SMACNA "HVAC Duct Constructions Standards", latest Edition, ASHRAE Guide and Data Book, "Handbook of Fundamentals", latest edition, specifically Chapter 25 and NFPA Standard 90-A, "Standard for the Installation of Air Conditioning and Ventilating Systems".
- B. All ductwork required for the heating, ventilating and air conditioning systems shall be constructed and erected in a first class workmanlike manner. This work shall be guaranteed for a period of one year from and after the date of acceptance of the job against noise, chatter, whistling, vibration, and free from pulsation under all conditions of operation.
- C. The interior surface of all ductwork shall be smooth with no parts projecting into the air stream unless specified to do so. All seams and joints shall be external. The inside of all ductwork shall be thoroughly cleaned and all fans operated to remove any debris prior to connection of air devices.
- D. All holes in ducts for damper rods and other necessary devices shall be either drilled or machine punched (not pin punched), and shall not be any larger than necessary. All duct openings shall be provided with sheet metal caps if the openings are to be left unconnected for any length of time.
- E. Where ducts, exposed to view (including equipment rooms), pass through walls, floors or ceilings, furnish and install sheet metal collars around the duct.
- F. Sheet metal plenums shall be constructed and reinforced in accordance with SMACNA standards. Where plenums are connected to louvers, the plenum bottom shall be sloped to drain to the louver.
- G. Ductwork which is exposed to weather shall have soldered joints and seams and shall be painted with a suitable epoxy coating. In lieu of solder joints, the use of duct-mate or TDC manufactured flanges are acceptable.

3.2 COORDINATION

- A. Prior to submitting ductwork shop drawings, the Division 23 Contractor shall fully coordinate the routing and height of all ductwork with all other trades and with ceiling heights, lighting fixtures and building construction.

3.3 GENERAL DUCTWORK FABRICATION

- A. Duct Gauge and Reinforcing:

1. Rectangular Ductwork: Minimum metal gauges and reinforcement shall be in accordance with SMACNA HVAC Duct Construction Standards (SDCS) Tables 1-3 through 1-13. Minimum aluminum gauges and reinforcement shall be in accordance with SDCS Tables 1-14 through 1-16. Reinforcing shall be installed per SDCS Fig. 1-9 through 1-12.
2. Round Ductwork: Minimum metal gauges for longitudinal and spiral seam round ductwork shall be in accordance with SDCS Table 3-2. Minimum aluminum gauges for longitudinal and spiral seam round ductwork shall be in accordance with SDCS Table 3-3. Longitudinal seam ductwork larger than 12" diameter shall not be permitted unless welded seams are used.
3. Cross-breaking: Cross-break or transverse bead all flat surfaces which are more than 12" wide. Transverse beading shall be on 12" centers and shall be a minimum of 1/8" deep at the center of the bead and 3/8" wide at the base of the bead.
4. Minimum Gauges: The metal gauges listed in the SDCS for round and rectangular ductwork are the minimum recommended. It shall be the Contractor's responsibility to select a metal gauge heavy enough to withstand the physical abuse of installation.

B. Duct Joints And Seams:

1. General: Make all joints airtight. The distance between transverse joints on any size duct shall not exceed 5'.
2. Rectangular Ductwork: Transverse joints and longitudinal seams in ductwork shall be constructed in accordance with SDCS Fig. 1-4 and 1-5. Drive slips may be used on rectangular ductwork on short sides only, up to 18" maximum. Gauge of drive slips shall be at least as heavy as ductwork on which they are installed. Bend drive slips over at least 3/4" at corners. Corner closures shall be in accordance with SDCS Fig. 1-13 through 1-18. All longitudinal seams shall be "Pittsburgh Lock" or button punch snap lock at corner seams and grooved seam or seam welded in sides between corners, in accordance with SDCS Fig. 1-5. At the Contractor's option, transverse joints may be transverse duct flange joints or Ductmate EP12/11 prefabricated galvanized "Ductmate" sections. The proposed gasket material, flange, corner piece and Ductmate details shall be submitted for approval.
3. Round Ductwork: Transverse joints for round ductwork shall be beaded sleeve type constructed in accordance with SDCS Fig. 3-2, properly secured and sealed. Draw bands shall not be used on round ductwork. Longitudinal and spiral seams shall be constructed in accordance with SDCS Fig. 3-1.
4. Ductwork Sealing: Seal all longitudinal and transverse ductwork joints and seams using SMACNA ductwork sealant and 3" wide open weave tape to provide positive seal. Sufficient sealant shall be used to completely imbed the cloth.

C. Connections and Take-offs:

1. Rectangular Ductwork: Parallel flow branches shall be constructed using radius elbow take-offs in accordance with SDCS Fig. 2-7. Branch duct connections shall be 45 degree entry expanded taps constructed in accordance with SDCS Fig. 2-8. Duct-mounted coil connections shall be constructed in accordance with SDCS Fig. 2-11.
2. Round Ductwork: Connections and takeoffs shall be made using 90 degree conical taps, 45 degree lateral taps or wye fittings constructed in accordance with SDCS Fig. 3-4 and 3-5. Use of 90 degree tees shall not be allowed.
3. Spin-in Fittings: Spin-in fittings may be used for duct taps to air supply and exhaust devices and shall include quadrant dampers even though a volume damper may be

specified for the air device. Spin-in fittings shall be sealed at the duct tap with a gasket and compression fit or sealed with duct sealant. The location of spin-in fittings in the ducts shall be determined after terminal units are hung and the location of the light fixtures is known so as to minimize flexible duct lengths and sharp bends. Spin-ins shall be installed with their damper axis parallel to airflow. A minimum of 18" must be provided between fittings.

4. Flexible Joints In Ductwork: Provide flexible connections where ductwork connects to air-handling units, fans, and similar powered equipment items and where required for expansion and contraction of the ductwork or the building structure. A minimum of one inch (1") slack shall be provided in all flexible connection to insure vibration isolation. Flexible joints are not required where equipment is connected with flexible duct. Flexible connections shall be rigidly connected to metal work on each side and shall be airtight. Bond flanges of flexible duct connectors to ducts and housings to provide airtight connections. Seal seams and penetrations to prevent air leakage.
- D. Elbows and Tees:
1. Rectangular Ductwork: Provide radius or square elbows in ductwork, where shown on the Drawings. Where radius elbows are shown, radius elbows must be provided. Where square elbows are shown, square or radius elbows may be provided, at the Contractor's option. Elbows shall be constructed in accordance with SDCS Fig. 2-2. Turning vanes are required in all square elbows of 46 degrees or greater angle. Turning vanes are not required in radius elbows. Turning vanes shall be single vane type without a trailing edge and shall be constructed and installed in accordance with SDCS Fig. 2-3 and 2-4.
 2. Round Ductwork: Provide radius elbows of the stamped or segmented type constructed in accordance with SDCS Fig. 3-3. Segmented elbows shall have a minimum of three segments for 45 degree elbows and five segments for 90 degree elbows.
- E. Offsets and Transitions: Where duct width increases, maximum angle of slope shall be 20 degrees (one inch (1") in 2.7"). Where duct width decreases, maximum angle of slope shall be 30 degrees (one inch (1") in 1.7"). Offsets and transitions shall be constructed in accordance with SDCS Fig. 2-9 and 2-10.
- F. Air Device Connections: Make connections to air devices and fabricate air device plenums as detailed on the Drawings and in accordance with SDCS Fig. 2-16 through 2-18.

3.4 DUCTLINER

- A. General: Ductliner shall only be used at unit discharge. All other areas shall utilize wrapped duct insulation. The liner shall be applied to the inside of the duct with heavy density side to the air stream and shall be secured in the duct with adhesive, completely coating the clean sheet metal. All joints in the insulation shall be "battered" and firmly butted tightly to the adjoining liner using fireproof adhesive. Where a cut is made for duct taps, etc., the raw edge shall be accurately and evenly cut and shall be thoroughly coated with fireproof adhesive. On ducts over 24" in width or depth, the liner shall be further secured with mechanical fasteners. The fasteners shall be A.J. Gerrard Company pronged straps, or approved equal, secured to the ducts by fireproof adhesive. The clips shall be 18" maximum spacing and shall be pointed up with fireproof adhesive. Liner shall be accurately cut and ends thoroughly coated with fireproof adhesive so that when the duct section is installed, the liner shall make a firmly butted and tightly sealed joint. Where ducts are lined exterior insulation will not be needed unless otherwise noted,

except that the two insulations shall lap not less than 24". Ductliner for velocities over 2,000 fpm shall be as specified except a perforated metal liner shall be used over ductliner for securement, in lieu of fasteners. Ductliner installation and fasteners shall comply with SDCS Fig. 2-22 through 2-25.

3.5 DUCTWORK INSTALLATION

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight and noiseless systems, capable of performing each indicated service. Install each run with a minimum of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers, and anchors of the type which will hold ducts true-to-shape and prevent buckling.
- B. Inserts: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in the work.
- C. Completion: Complete fabrication of work at the project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. Run Location: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, grams, details, and notations or, if not otherwise indicated, run ductwork in the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.

Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building. Limit clearance to 0.5" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork to assure 1.0" clearance of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work.

- E. Coordination: Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of the ductwork system.
- F. Hangers and Supports:
 - 1. General: All ductwork supports shall be per Section IV of the SMACNA "HVAC Duct Construction Standards - First Edition" with all supports directly anchored to the building structure. Supports shall be on maximum 8'-0" centers with additional supports as required to prevent sagging.
 - 2. Attachment to Structure: Provide hanger attachment to the building structure as specified in Section 15100, "Basic Materials and Methods", and in accordance with SDCS Fig. 4-1 through 4-3.
 - 3. Hangers: Hangers shall be strap or rod sized in accordance with SDCS Table 4-1 and 4-2. Strap hanger attachment to rectangular duct shall consist of a turning strap under the duct a minimum of one inch (1") and securing the strap with one screw into the bottom of the duct and one screw to the side of the duct. Rectangular duct supported on trapeze hangers shall be attached to the trapeze. Round duct attachments shall be constructed in accordance with SDCS Fig. 4-4.

4. Horizontal Ducts: Ducts larger than 50" in their greatest dimension shall be supported by means of hanger rods bolted to angle iron or half round trapeze hangers. Duct shall have at least one pair of supports 8'-0" on centers according to the following:

<u>Angle Length</u>	<u>Angle</u>	<u>Rod Diameter</u>
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8'-0"	2" x 2" x 1/8"	5/16"
10'-0"	3" x 3" x 1/8"	3/8"

5. Vertical Ducts: Ducts shall be supported where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to 60". Above 60", the angles must be increased in strength and sized on an individual basis considering space requirements.

G. Flexible Ductwork:

1. General: Flexible ductwork shall be provided as shown on Drawings. Flexible ducts shall be installed in a fully extended condition free of sags and kinks, using only the minimum length required to make the connection, subject to the maximum lengths herein and below. Bends in any length of flexible duct shall not exceed 45 degrees for HVAC terminal unit connections or 135 degrees for air device connections and shall not exceed that recommended by the flexible ductwork manufacturer. Unless otherwise shown on the Drawings, the length of any one run of flexible ductwork shall not exceed 2 feet to terminal units or 6 feet to air devices.
2. Supports: Where flexible duct extension exceeds 48", horizontally, a support shall be provided. Duct shall be suspended on 48" centers with a minimum two inch (2") wide flat banding material. Refer to SDCS Fig. 3-9 and 3-10 and Page 3-17 for additional requirements.
3. Terminal Unit Flexible Duct Connections: The terminal ends of the duct core shall be secured by stainless steel worm gear type clamps. The fittings on terminal units and on sheet metal duct shall be coated with sealant, then the flexible duct core slipped over duct and the clamp tightened, and the connections shall be sealed with duct sealant. Insulation of flexible duct shall be slipped over connection to point where insulation abuts terminal unit or insulation on duct and attached with self-locking nylon straps. The insulation connections shall then be sealed using foil duct tape to provide vapor barrier. Refer to SDCS Page 3-13 and 3-15 for additional requirements.
4. Air Device Flexible Duct Connections: All joints and connections shall be made by turning back the insulation and securing the inner liner with self-locking nylon straps and sealing with two wraps of duct tape. The insulation shall then be placed over the joint, attached with a self-locking nylon strap and sealed on the exterior with an approved foil duct tape. Refer to SDCS Page 3-13 and 3-15 for additional requirements.

H. Duct Mounted Devices:

1. Install duct mounted sensors and control devices furnished under Section 23 09 00, "Building Controls". Provide access doors at each duct mounted control device. Coordinate location of devices and installation requirements with the Section 23 09 00 Contractor.
2. Install duct type smoke detectors furnished under Division 26. Provide access doors at each sampling tube assembly. Coordinate location of detectors and installation requirements with Division 26.

3. Provide duct test ports in ductwork as required to properly balance all air systems. Test ports shall be located per ANSI/ASHRAE Standard III to allow accurate pitot-tube traverse measurements in ductwork.

3.6 CLEANING AND PROTECTION

- A. General: Clean ductwork internally, section-by-section of dust and debris as it is installed. Clean external surfaces of foreign substances which might cause corrosive deterioration of the metal or, where ductwork is to be painted, might interfere with painting or cause paint damage.
- B. Repairs: Strip protective paper from stainless ductwork surfaces and repair finish or replace ductwork portion wherever it has been damaged.
- C. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris until such time that connections are to be completed.

END OF SECTION

23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the registers, grilles, and diffusers. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the duct systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide ductwork accessories as required for the project including the following:
 - 1. Extractors,
 - 2. Turning vanes,
 - 3. Monitors,
 - 4. Splitter dampers,
 - 5. Access doors,
 - 6. Straightening grids
 - 7. Fire dampers.

1.3 QUALITY ASSURANCE

- A. SMACNA Compliance: Comply with applicable portions of Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) Duct Construction Standards (latest edition).
- B. ASHRAE Standards: Comply with American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to construction of ductwork accessories.

1.4 SUBMITTALS

- A. Shop Drawings: Show modifications of indicated requirements, if applicable, made to conform to local shop practice and show how these modifications ensure that the materials and weights are not reduced and that the fabricated units are equivalent to the specified requirements in every significant way.

PART 2 - PRODUCTS

2.1 DUCTWORK ACCESSORIES, FABRICATION AND MATERIALS

- A. General: Provide ductwork accessories that comply with the Section 15891, "Ductwork", and other applicable product requirements of ductwork materials noted in this Section.

2.2 FLEXIBLE CONNECTIONS

- A. General: Flexible connections shall be UL-labeled, 30 ounces glass fabric-lined with insulation and coated on both sides with neoprene, complete with attachment accessories, "Vent-Glass" by Vent-Fabrics, Inc. or approved equal.

2.3 DUCTWORK HARDWARE

- A. General: Damper operators for concealed inaccessible ductwork shall be Young Regulator Company, Catalog No. 700 or No. 315, as shown. Non-insulated accessible ductwork shall be Young Regulator Company, Catalog No. 433. Accessible insulated ductwork shall be Young Regulator Company, Catalog No. 443. Approved equal units by Duo-Dyne or Vent Fabrics, Inc. will be acceptable.

2.4 DIRECTIONAL, VOLUME CONTROL, AND FIRE DAMPERS

- A. General: Provide all direction and volume control and fire dampers shown or noted on Drawings. All damper control devices shall be installed so as to be fully concealed in finished rooms and spaces.
- B. Control Dampers:
 - 1. Splitter Dampers: Splitter dampers shall be not less than 16 gauge. Splitter dampers shall be 1-1/2 times the width of narrowest duct leaving split, except not less than 12" long and shall have not more than 1/4" less height than duct in which it is installed. Splitter dampers having area less than 2.25 square feet shall be adjusted by means of a locking quadrant mounted on end of shaft. Splitter dampers having larger area shall be adjusted by means of one or more push rods in accordance with Figure 2-5, SMACNA "Low Velocity Duct Construction Standards".
 - 2. Extractors: Provide extractors of the size and type required, with hex-key operated adjustable blades, and with gang operated galvanized steel blades on one-inch centers.
 - 3. Pressure Taps: Where rectangular take-offs of branches from main ducts are used with 45 degree entry, provide manual volume regulators with lockable operators and nylon bushings on both sides of damper blade rod.
 - 4. Round Taps: Where taps to main ducts or their branches are made, provide 45 degree angle taps or 90 degree spin-in taps with manual volume dampers with nylon bushings on both sides of damper blade rod.
 - 5. Multi-leaf Dampers: Where multi-leaf dampers are required, provide opposed blade-type in accordance with Figure 2-12, SMACNA "Low Velocity Duct Construction Standards".

- C. Fire Dampers: Provide fire dampers at duct penetrations of floors, smoke partitions, fire walls, and where required by the applicable building codes or authority having jurisdiction. Fire dampers shall comply with state and local codes, be inspected and approved by an approved inspection agency and be labeled at the factory in accordance with Uniform Building Code Standard 43, Section 43.714.
 - 1. Provide one-hour rated dampers where penetrations are in required one-hour fire rated assemblies.
 - 2. Provide 1-1/2 hour rated dampers where penetrations are in required 2-hour fire rated assemblies.
 - 3. Provide 3 hour rated dampers where penetrations are in required 4-hour fire rated assemblies; 4-hour occupancy separating walls are accepted.

2.5 FLASHING AND COUNTER-FLASHING

- A. General: Flashing and counter-flashing shall be as specified in other Divisions of these Specifications.

2.6 DUCT ACCESS DOORS

- A. General: Provide hinged duct access doors, gasketed and with insulation where ductwork is indicated to be insulated. Provide construction per SMACNA Standards. Access doors shall be at least 15" x 15".
- B. Inspection Plates: Provide inspection plates as required. Provide a minimum opening of 4" x 4" with a 6" x 6" cover plate. The cover plate shall be one gauge heavier than the ductwork, gasketed and secured with a minimum of eight sheetmetal screws.

2.7 MISCELLANEOUS DUCTWORK MATERIALS

- A. General: Provide miscellaneous materials for ductwork accessories, including hinges, refrigerator latches, sash locks, bolts and wing nuts, gaskets and pitot tubes as recommended by the ductwork accessories manufacturer for the application indicated.

2.8 TURNING VANES

- A. Construct turning vanes in accordance with SMACNA Standards (current edition).

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Access Doors: Install access doors so that the doors open against the system air pressure wherever feasible and that their latches are operable from either side, except where the duct is too small to be entered. Provide access to each

- fire damper link to permit resetting. Comply with the applicable building codes or authority having jurisdiction and NFPA 96.
- B. Inspection Plates: Install plates at each primary zone damper and where otherwise required for inspection of operable mechanisms within the duct systems.
 - C. Multileaf Dampers: Install multileaf volume dampers in each zone duct of multizone units and as otherwise required for balancing.
 - D. Splitter Dampers: Install splitter dampers at all divisions of ductwork for proper air pattern control.
 - E. Turning Vanes:
 - 1. Install turning vanes for all rectangular mitered elbows. Install turning vanes in accordance with SMACNA Standards.
 - 2. Turning vanes for Ducts with air velocity less than 2500 FPM: Use single wall type vanes for ducts having width equal to or less than 12 inches.
 - 3. Use double wall type vanes for (2" radius, 2-1/8" spacing) for ducts having widths greater than 12 inches.
 - 4. If duct sizes change in a mitered elbow, use single wall type vanes with a trailing edge extension.
 - 5. Turing vanes for Ducts with air velocity greater than 2500 FPM: Use double wall type vanes (4-1/2" radius, 3-1/4" spacing).

3.2 TESTING

- A. General: Check installed ductwork accessories for required operation and leak-proof performance during the system's operational test. Repair or replace faulty accessories, as required to obtain proper operation and leak-proof performance.

END OF SECTION

23 34 00 - FANS AND HOODS

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the fan and hood systems. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the fan and hood systems specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide U.L. listed fans and ventilators as required by code and as specified.

1.3 QUALITY ASSURANCE

- A. Basis of design is Cook. Other acceptable manufacturers are ACME, Broan, Buffalo, Carnes, Greenheck, Penn, and Woods.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Ratings: Fans shall be licensed to bear the AMCA certified ratings seal. Ratings of fans shall be based on 70°F and 29.92" of Hg atmospheric pressure. Air handling equipment shall be sized in conformance with applicable codes and good engineering practice. Roof-mounted units shall be located in coordination with the Architect to ensure proper sight lines.
- B. Construction: Fan construction shall be in accordance with AMCA classes of construction for the intended duty. Fan wheels, shafts, and drives shall be statically and dynamically balanced at the factory as a unit. Balance reports shall be factory-certified to the Construction Manger.
- C. Drives: Provide drives with a minimum belt horsepower capacity of 120% of the motor nameplate horsepower.
- D. Motor Sheaves: Motor sheaves shall be Browning Type, MVP, or approved equal, adjustable type with double-locking feature. Motor sheaves shall be selected for the

rated fan rpm and shall be adjustable to as close as 10% above and below the rated fan speed.

- E. Fan Sheaves: Provide adjustable or nonadjustable sheaves with removable machined bushings. Sheaves shall be machined on surfaces. Sheaves with over three grooves shall be dynamically balanced and the manufacturer shall so designate on each sheave. Fan sheaves with three grooves or less shall be statically balanced and weights required for balancing shall be welded to the sheaves. Manufacturers shall be Browning, Eaton, Yale, Towne, Dodge Manufacturing Company, or Fort Worth Steel and Machinery Company.
- F. Belts: Provide standard "V-groove" belts suitable for the service intended with the required capacities. The belts shall be closely matched and tagged prior to delivery to the job site. If the belts do not appear to be properly matched during operation, they shall be rechecked and, if necessary, replaced. Belts shall be as manufactured by Gates, Durkee-Atwood, Goodyear, Browning, or Uniroyal.
- G. Bearings: Provide SKF, Sealmaster, Timken, or Fafnir externally or internally-mounted, grease-lubricated, self-aligning ball bearings. Bearings shall have grease type zerk fittings.
- H. Motor Mount: Motors shall be mounted on an adjustable base rigidly supported on the fan and shall have extended shaft to accommodate the adjustable pitch sheave.

2.2 CENTRIFUGAL FANS

- A. General: Provide centrifugal fans of the single-width, single-inlet type with either forward or backward curved fan blades, and adjustable belt drives.
- B. Motors: Provide standard drip-proof motors. Provide cast iron housings for motors larger than 10 hp, riveted or spot-weld wheels with steel rims and hub plates.
- C. Fan: Blades shall be die cut, die-formed, and hubs shall be machined close-grained cast iron. Steel housings shall have lock-seam construction with discharge reinforcement and shall be adjustable with continuous inlet collars. Provide weatherproof enclosure for motors and drive, if units are exposed to weather.

2.3 CEILING EXHAUST FANS

- A. General: Provide direct driven ceiling exhaust fans as required. Fan shall be acoustically insulated and have a maximum sound level rating as scheduled.
- B. Motor: Motor shall be suitably grounded and mounted on rubber-in-shear vibration isolators and speeds shall not exceed that scheduled.
- C. Accessories:
 - 1. Provide totally noise-free, integral back draft damper, with no metal to metal contact.
 - 2. Inlet grille shall be white molded plastic with egg-crate or perforated shape and provide 85% free open area.
 - 3. Provide terminal box on the housing with cord, plug, and receptacle inside the housing.

2.4 — GREASE EXHAUST FANS

- ~~A. General: Fan shall be a spun aluminum, roof mounted, belt driven, upblast centrifugal exhaust ventilator, specifically designed and tested for use in applications requiring the exhaust of grease laden air.~~
- ~~B. Certifications: Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.~~
- ~~C. Construction: The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have a one piece inlet spinning and continuously welded curb cap corners for maximum leak protection. The windband shall have a rolled bead for added strength. A two piece top cap shall have stainless steel quick release latches to provide access into the motor compartment without the use of tools. An integral conduit chase shall be provided into the motor compartment to facilitate wiring connections. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Lifting lugs shall be provided to help prevent damage from improper lifting. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM. Unit shall be shipped in ISTA certified transit tested packaging.~~
- ~~D. Wheel: Wheel shall be centrifugal backward inclined, constructed of 100 percent aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.~~
- ~~E. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.~~
- ~~F. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greasable ball type in a cast iron pillow block housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.~~
- ~~G. Belts & Drives: Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150 percent of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.~~
- ~~H. Grease Capture: Provide with grease capture and containment system.~~

2.5 — ROOF MOUNTED SMOKE EXHAUST FANS

- ~~A. General: Provide belt driven, axial type up-blast propeller roof exhaust fan, UL 705 listed.~~

- ~~1. The fan construction shall meet the specification for U.L. Listed "Power Ventilators for Smoke Control Systems". This includes the IRI requirements of 500 °F air for a minimum of 4 hours, the SBCCI "Standard Fire Prevention Code" requirements of 1000 °F air for a minimum of 15 minutes, and the Snow Load Test for butterfly dampers in UL 793.~~
- ~~B. Motor: Motors shall be permanently lubricated, heavy-duty type, and located outside of the air stream.~~
- ~~C. Fan: Propellers shall be constructed of fabricated steel, fabricated aluminum or cast aluminum blades and hubs. Propellers shall be securely fastened to fan shaft. Propellers shall be statically and dynamically balanced.~~
- ~~D. Curb: The fan shall be furnished with a 14" high, insulated curb.~~
- ~~E. Options and Accessories: Outlet screen to prevent debris from getting inside discharge and dampers, butterfly dampers with weather tight gaskets, 165 °F fusible link damper lifters, magnetic damper latches, bolt tube with heat shields, high temperature bearings and extended lubrication lines.~~

PART 3 - EXECUTION

3.1 VENTILATION AND EXHAUST FANS

- A. General: Ventilating and exhaust fans not having integral vibration isolation shall be mounted on or suspended by vibration isolators as specified under Section 23 05 48. Where ductwork is connected to fans, Contractor shall provide UL labeled flexible duct connections.
- B. Curbs: Factory-fabricated roof curbs, caps, and similar items, shall be supplied and installed by Mechanical Contractor. Coordinate installation with Roofing Contractor.

3.2 SYSTEMS

- A. Refer to Section 23 05 53, "Mechanical Identification" for applicable painting, nameplate, and labeling requirements.
- B. Placement of fans and noise levels generated by the fans shall be taken into consideration. Refer to specification 23 34 00 for additional information.

END OF SECTION

23 37 00 - REGISTERS, GRILLES, AND DIFFUSERS

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the registers, grilles, and diffusers. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the registers, grilles, and diffusers specified herein, as indicated on the drawings, and as required to provide complete and operating systems.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide air outlets and inlets as required for the finished or non-tenant areas of the project including the following:
 - 1. Ceiling air registers, grilles, diffusers
 - 2. Wall mounted registers and grilles
 - 3. Linear lay-in slot diffusers
 - 4. Architectural linear diffusers

1.3 QUALITY ASSURANCE

- A. Basis of design is Titus. Other acceptable manufacturers are Krueger, Anemostat, Carnes, Metal Aire, Price, or Tuttle & Bailey.
- B. NFPA Compliance: Comply with NFPA 90, as applicable to air diffuser construction and installation.
- C. Air Distribution Equipment: Maximum space temperature variation shall not exceed 2°F through the conditioned area from 2' above the floor to 7' above the floor. The air outlets shall be selected by the manufacturer to suit the volume, throw, and noise level criteria described in these Specifications, and maintain maximum terminal velocities of 50 fpm, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 AIR OUTLETS AND INLETS

- A. General: Provide air outlets and inlets of the size, shape, and type, constructed of materials and components, and with finishes as required. Apply corrosion resistant treatment to surfaces prior to applying prime coat.

- B. Ceiling Diffusers: Provide diffusers with corrosion resistant treated surfaces and finished in baked enamel unless otherwise required. Where applicable, provide adapters with diffusers to permit connection to round supply duct.
- C. Registers and Grilles:
 - 1. General: Provide registers that contain a key-operated multi-louvered opposed blade damper operable from the face side.
 - 2. Supply Air Register: Provide supply air registers of the double deflection type.
 - 3. Return Air Grilles and Return Air Registers: Provide grilles and registers as required.
- D. Supply Linear Diffuser:
 - 1. Provide supply linear diffuser with length and width as required. The supply diffuser shall be installed above the ceiling and located as indicated on the Architectural and Mechanical Drawings.
 - 2. The diffuser shall be designed, tested, and constructed in a manner so as to comply with the performance criteria and sound level requirements specified elsewhere in these Specifications. Plenum shall be constructed of at least 24 gauge galvanized steel and shall be reinforced as required. The air volume, length and duct connection size shall be as required. Coordinate the attachment, support, and similar features of the supply plenum with the ceiling Subcontractor.
 - 3. The plenum shall be painted flat black on interior surfaces and the exposed surfaces as viewed from below the ceiling system shall be painted flat black.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and recognized industry practices to ensure that products serve intended functions.
- B. Duct Connection to Diffuser:
 - 1. Where flexible duct is connected to ceiling diffusers, the contractor shall use one of these three methods:
 - a. Insulated flexible duct with Titus FlexRight flexible duct support, UL listed, to form duct elbow.
 - b. A sheet metal elbow, externally insulated.
 - c. Insulated flexible metal duct consisting of flexible metal core of corrugated aluminum with external insulation.
 - 2. In all cases duct connection/elbow shall be made with a bend that has not less than one duct diameter centerline radial.
- C. Coordination: Coordinate with other trades, including ductwork, and ductwork accessories, as necessary to interface air outlets and inlets properly with other work.

3.2 FIELD CONTROL QUALITY CONTROL

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- A. Test installed devices to demonstrate satisfactory compliance with specified and indicated requirements.

END OF SECTION

23 57 19 - PLATE AND FRAME HEAT EXCHANGERS

PART 1 - GENERAL

1.1 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the heat exchanger system. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the heat exchanger system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.
- D. Refer to Section 23 25 00, "Water Treatment Systems", for information regarding required chemicals, etc.

PART 2 - PRODUCTS

2.1 QUALITY ASSURANCE

- A. Manufacturer: Basis of Design is Alfa Laval. Approved alternate manufacturers are Bell and Gossett, Mueller, Tranter and SONDEX.
- B. Capacity: Submittal data must contain manufacturer certified performance data which meets or exceeds the capacity requirements indicated on the drawings. In addition, the heat exchanger selection shall be such that an additional 20% capacity can be achieved by adding additional plates.

2.2 HEAT EXCHANGER SYSTEM

- A. Plate and frame heat exchangers shall be designed, fabricated and tested for operation in accordance with the A.S.M.E. Unfired Pressure Vessel Code, Section VIII, Division 1, including latest addendum and code stamped where required.
- B. Plate and frame heat exchanger shall be free standing, unitized frame and multi-plate.
- C. Frame shall be adequately sized to allow for opening and cleaning the plates. Frames shall be provided with top and bottom guide bars for support and alignment of plates. Top guide bar shall have smooth finished stainless steel surface for roller bearing support of moveable end frame and ease of transport for plate suspension. Bottom guide bar shall also have smooth finished carbon steel surface.
- D. Fixed and movable end frames shall be reinforced, flat plate SA-516-70 carbon steel design. Movable frame shall be supported from the top guide bar by a roller bearing and guided by the bottom guide bar.
- E. End frames shall be provided with holes to facilitate lifting with bar. Three (3) heavy steel floor base plates for anchor bolts shall be provided.

- F. Tightening bolts shall be SA-193-B7 zinc plated carbon steel with fixed SA-194-2H carbon steel nut. Free nuts shall be heavy SA-194-2H carbon steel with heavy-duty carbon steel washers.
- G. Plates shall be fabricated of 304 stainless steel. All plates shall have provisions for attaching to the upper guide bar from either the top or bottom end. All plates to have internal metal to metal contact points (minimum 150/square feet). Plates thickness shall be selected to withstand full operating pressure in one channel with zero pressure in the adjoining channel. Plate thickness shall not be less than 0.5 mm. Plate design shall provide an enclosing groove for the entire gasket. The gasket groove shall have tapered sides to assure positive seating of the compressed gasket. The gasket groove shall be configured to assure that the compressed gasket does not extend above the top of the groove to preclude blow-out of the gasket. End plates shall be provided at the fixed and movable frames.
- H. Nozzles shall consist of a lap joint flanged connection in 150 psig rating.
- I. Gaskets shall be molded one piece, nitrile rubber, securely cemented into the continuous groove in each plate. Inactive port gasket areas shall be vented to the exterior in such a manner that no mixing can occur between fluids. Gaskets shall be designed to be sealed by compression until metal-to-metal contact between plates is secured after tightening of the pack. All gaskets shall be similar except special end gaskets between end plates and frames.
- J. The plate pack shall be completely enclosed in a removable painted, rust protected carbon steel metal shroud designed to protect the plate pack from debris and damage.
- K. All exterior steel surfaces shall be sharp steel shot blasted to SSPC-S-6-63 followed by one coat of two part epoxy spray enamel baked at 250°F.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with manufacturer's instructions for installation, except as otherwise indicated. Locate heat exchangers, as necessary, to maintain a maximum pressure of 125 psig in the system.
- B. Identification: Refer to Section 23 05 53, "HVAVC Equipment and Piping Identification" for applicable painting, nameplate, and labeling requirements.
- C. System Maintenance: Install weld-o-lets at the cooling tower side of the heat exchanger to enable future back-flushing capabilities.
- D. Arrange piping so as to provide for required access to equipment, disassembly for cleanings, and installation of additional plates.
- E. Back-flushing: Install additional piping on either side of the heat exchanger to facilitate back-flushing the heat exchanger in the event the exchanger gets clogged.

3.2 START-UP

- A. General: Comply with manufacturer's instructions for filling and start-up of operation, but not less than the following:
 - 1. Ensure water treatment chemicals have been added to system.
 - 2. Adjust temperature controls and verify operation.

3.3 Testing and Adjusting and Cleaning:

- A. Performance Test: Provide plate and frame heat exchanger performance tests and report.
- B. Pressure Testing: Test plate heat exchanger with connected piping system. Verify pressure differential across both sides of heat exchanger is per design.
- C. Cleaning: The cooling tower and both piping loops (on either side of the heat exchanger) shall be back-flushed and cleaned to remove all construction dirt and debris prior to system testing and adjusting.

END OF SECTION

23 73 00 - CHILLED WATER AIR HANDLING UNITS

1.0 GENERAL

1.01 SUMMARY

- A. The General Provisions, Supplemental General Provisions, section 23 01 00, Division 1 Specifications and Special Provisions apply to all Work specified in this Section.
- B. This section describes the basic materials and installation methods for the boiler system. Comply with other Division 23 sections and drawings as applicable. Refer to other divisions for coordination of work.
- C. Furnish and install all components of the air handling unit system specified herein, as indicated on the drawings, and as required to provide complete and operating systems.
- D. Refer to Section 23 25 00, "HVAC Water Treatment", for information regarding required chemicals, etc.

1.02 DESCRIPTION OF WORK

- A. Provide variable air volume chilled water air handling unit and all associated components and specialties as specified herein, on the drawings, or as otherwise required to maintain the design chilled water supply conditions.

1.03 QUALITY ASSURANCE

- A. Manufacturer: Basis of design is Trane. Approved alternate manufacturers are Carrier, McQuay, or Johnson Controls, Inc.
- B. Submittals must be provided including equipment dimensions, installation, clearance, performance at specified conditions, etc.

2.0 PRODUCTS

2.01 AIR HANDLING UNITS

- A. Units shall consist of the components listed below and shall perform in accord with capacities as scheduled on the drawings.
- B. Casing: Includes all sections of air handling unit: coil section, fan sections, access sections, sections of blow through units downstream of cooling coils, etc. Refer to SECTION 23 30 00 for discharge plenums which attach to air handling unit vertical discharge opening.
 - 1. Wall and roof panels shall be minimum 2" thick acoustical type constructed of minimum solid galvanized exterior panel (min. 16 ga.) and a solid interior panel (min. 20 ga). Acoustical fill shall be glass fiber insulation, 1.5 pounds per cubic foot minimum density. Fill shall comply with the following U.L. Fire Resistance Ratings:

Flame Spread	10 - 20
Fuel Contributed	10 - 15

Smoke Developed 0 – 20

2. Floor construction shall be structural longitudinal and perimeter base rail with 20 gage solid galvanized inner and 16 gage galvanized outer panels.
 3. Access door panels shall be constructed identically to the wall panels. Doors shall be of gasketed to provide an airtight perimeter of the door. The latches shall be wedge lever type, minimum 2 per door. The door hinges shall be lift off type.
 4. Air Handler shall be double wall construction with no through metal in the casings or doors.
- C. Fans:
1. Fans shall deliver the scheduled capacities. Fans shall be airfoil type. Fans shall be furnished complete including: motor, motor mount, inlet bells (if applicable), 2" deflection spring type vibration isolation, discharge section (if applicable), drive mechanisms and all other accessories required and/or specified to produce the intended result.
 2. Fans shall be forward curved type with variable speed drive.
- D. Water coil(s) shall be constructed in accordance with ARI Standard 410-87. Coils shall have aluminum fins mechanically bonded to seamless copper tubes with copper headers and return bends. Coils shall be leak tested under water at 350 PSI of dry air.
- E. Drain pan(s) shall be #304 stainless steel. Drain pans shall form positive built-in slope of the trough to the drain connection. Drain pan shall drain dry to preclude the buildup of microbial slime or fungus. Each cooling coil shall have a drain pan under the entire coil extended at least 6" past the leaving air side of the coil and minimum of 2 1/2" deep. When air handling units are furnished with stacked coils, upper drain pans shall have a minimum of two 1" drain connections piped to the lower pan and secured to prevent vibration. All condensate piping shall be of hard drawn copper tubing.
- F. Filter section and frame shall accommodate high efficiency filters. Filter section shall have full height hinged access doors and holding frames shall be welded in place. Frames shall include spring clips for filter retention.
- G. Each air handling unit shall be constructed and shall operate for all conditions of air flow to provide acceptable an NC levels (max NC 35) in the occupied tenant space immediately adjacent to the fan room.
- H. The unit manufacturer shall submit sound power levels of each air handling unit. Acoustic performance shall be based on data obtained in accordance with ANSI Standard SI-32, for discharge sound power levels and radiated sound power levels. Aerodynamic performance data shall be in accordance with ARI Standard 430. Maximum sound power levels shall not exceed:

	<u>63</u>	<u>125</u>	<u>250</u>	<u>500</u>	<u>1k</u>	<u>2k</u>	<u>4k</u>
Discharge PWL's (re.10 ⁻¹² W)	88	88	87	86	85	85	85
Inlet/cabinet PWL's	88	85	85	84	83	81	81

3.0 INSTALLATION

3.01 AIR HANDLING UNITS

- A. Install the air handling unit(s) where indicated on the drawings, observing required clearances. See related specification sections concerning ductwork, piping and electrical work to assure proper connection of services to the unit. Follow the manufacturer's written instructions concerning start-up and installation. The unit shall not be started or run without filters in place.
- B. Contractor shall arrange piping to units so as to provide required access to equipment.
- C. Install clean filters in unit at time of air balance. Provide temporary filters during construction.

END OF SECTION 23 73 00

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes fan coil units and accessories.

1.2 SUBMITTALS

- A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality control test reports.
- D. Operation and maintenance data.

1.3 QUALITY ASSURANCE

- A. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
 - 1. Trane Co. (The); Unitary Products Group
 - 2. Carrier Corporation, a United Technologies company
 - 3. Daikin McQuay

2.2 FAN COIL UNITS

- A. Description: Factory packaged and tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

- B. Coil Section Insulation: 1 inch thick, [coated glass fiber] [foil-covered, closed-cell foam] [matte finish, closed cell foam] complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
 - 1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame spread index of 25 and smoke developed index of 50 when tested according to ASTM E 84.
- E. Main and Auxiliary Drain Pans: [Stainless steel] [Insulated galvanized steel with plastic liner] formed to slope from all directions to the drain connection as required by ASHRAE 62.[Drain pans shall be removable].
- F. Chassis: Galvanized steel where exposed to moisture. Floor mounting units shall have leveling screws.
- G. Cabinet: Steel with baked enamel finish in manufacturer's standard paint color as selected by Owner.
 - 1. Vertical Unit Front Panels: Removable, steel, with integral stamped steel discharge grille and channel formed edges, cam fasteners, and insulation on back of panel.
 - 2. Horizontal Unit Bottom Panels: Fastened to unit with cam fasteners and hinge and attached with safety chain; with integral stamped cast aluminum discharge grilles.
 - 3. Steel recessing flanges for recessing fan coil units into ceiling or wall.
- H. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
 - 1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.
- I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.
- J. Fan and Motor Board: Removable.
 - 1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted steel wheels, and aluminum, painted steel, or galvanized steel fan scrolls.
 - 2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Electric Motors for Mechanical Equipment."
 - 3. Wiring Termination: Connect motor to chassis wiring with plug connection.

- K. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
1. Two-way, modulating pressure independent control valve for chilled-water coil.
 2. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
 - a. Length: 24 inches.
 - b. Minimum Diameter: Equal to fan coil unit connection size.
 3. Two Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600 psig minimum CWP rating and blowout-proof stem.
 4. Calibrated Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250-deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
 5. Automatic Flow Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F, with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
 6. Y-Pattern Hydronic Strainers: Cast iron body (ASTM A 126, Class B); 125 psig working pressure; with threaded connections, bolted cover, perforated stainless steel basket, and bottom drain connection. Include minimum NPS 1/2 hose end, full port, ball type blowdown valve in drain connection.
 7. Wrought-Copper Unions: ASME B16.22.
- L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.3 DUCTED FAN COIL UNITS

- A. Description: Factory packaged and tested units rated according to ARI 440, ASHRAE 33, and UL 1995.
- B. Coil Section Insulation: 1 inch thick [coated] [foil faced] glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame spread index of 25 and smoke developed index of 50 when tested according to ASTM E 84.
- C. Drain Pans: [Stainless steel] [Insulated galvanized steel with plastic liner] formed to slope from all directions to the drain connection as required by ASHRAE 62.1.

- D. Chassis: Galvanized steel where exposed to moisture, with baked enamel finish and removable access panels.
- E. Cabinets: Steel with baked enamel finish in manufacturer's standard paint color.
1. Supply Air Plenum: Sheet metal plenum finished and insulated to match the chassis with mill finish, aluminum, double deflection grille.
 2. Return Air Plenum: Sheet metal plenum finished to match the chassis.
 3. Mixing Plenum: Sheet metal plenum finished and insulated to match the chassis with outdoor and return air, formed steel dampers.
 4. Dampers: Galvanized steel with extruded vinyl blade seals, flexible metal jamb seals, and interlocking linkage.
- F. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
1. Pleated Cotton Polyester Media: 90 percent arrestance and 7 MERV.
- G. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering water temperature of 220 deg F. Include manual air vent and drain.
- H. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted steel wheels, and painted steel or galvanized steel fan scrolls.
1. Motors: Comply with requirements in Division 23 Section "Electrical Motors for Mechanical Equipment."
- I. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.
1. Two-way, modulating pressure independent control valve for chilled-water coil.
 2. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.
 - a. Length: 24 inches.
 - b. Minimum Diameter: Equal to fan coil unit connection size.
 3. Two Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600 psig minimum CWP rating and blowout-proof stem.
 4. Calibrated Orifice Balancing Valves: Bronze body, ball type; 125 psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.

5. Automatic Flow Control Valve: Brass or ferrous metal body; 300 psig working pressure at 250 deg F; with removable, corrosion resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
 6. Y-Pattern Hydronic Strainers: Cast iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless steel basket, and bottom drain connection. Include minimum NPS 1/2 hose end, full port, ball type blowdown valve in drain connection.
 7. Wrought-Copper Unions: ASME B16.22.
- J. Control devices and operational sequence are specified in Division 23 Sections "Direct Digital Control (DDC) System".
- K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan coil units to comply with NFPA 90A.
- B. Suspend fan coil units from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Seismic Controls for Mechanical Piping and Equipment."
- C. Install new filters in each fan coil unit within two weeks after Substantial Completion.
- D. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:
 1. Install piping adjacent to machine to allow service and maintenance.
 2. Connect piping to fan coil unit factory hydronic piping package. Install piping package if shipped loose.
 3. Connect condensate drain to indirect waste.
 - a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.
- E. Connect supply and return ducts to fan coil units with flexible duct connectors specified in Division 23 Section "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

LIFE SAFETY AND CODE REQUIREMENTS

OCCUPANCY CLASSIFICATION

INTERNATIONAL BUILDING CODE 2015 - MIXED OCCUPANCY, MULTISTORY, SEPARATED ASSEMBLY A-3, STORAGE GROUP S-1 AND STORAGE GROUP S-2

ALLOWABLE HEIGHT AND AREA

IBC TABLE 504.3 AND TABLE 504.4

CONSTRUCTION - TYPE II B	ALLOWABLE HEIGHT	ALLOWABLE AREA	ACTUAL AREA/HEIGHT
GROUP A-3 (MOST RESTRICTIVE)	3 STORIES/55 FT.	32,702 S.F.	15,195 S.F./52'-4"

TYPE OF CONSTRUCTION

INTERNATIONAL BUILDING CODE 2015: TYPE II B
REQUIRED FIRE-RESISTANCE RATINGS FOR BUILDING ELEMENTS (IBC TABLE 601)

	TYPE II B
STRUCTURAL FRAME	0
BEARING WALLS	
EXTERIOR	0
INTERIOR	0
NON BEARING WALLS AND PARTITIONS	
EXTERIOR	0
INTERIOR	0
FLOOR CONSTRUCTION	0
ROOF CONSTRUCTION	0

FIRE SEPARATION AND RESISTANCE RATINGS

NEW BUILDING OCCUPANCY SEPARATION FROM EXISTING STRUCTURE - 2 HOUR FIRE WALL ASSEMBLY SPRINKLER AND S-2 SEPARATIONS AS PER TABLE 706.4

EXTERIOR WALL FIRE RESISTANCE RATING BASED ON FIRE SEPARATION DISTANCE - 1 HOUR ASSEMBLY AND S-2 SEPARATIONS AS PER TABLE 602, MORE THAN 5 FT TO LESS THAN 10 FT.

PERCENTAGE OF OPENINGS IN RATED EXTERIOR WALLS = 25% AS PER TABLE 705.8

OCCUPANCY SEPARATION REQUIREMENTS A-3 TO S-2; NO SEPARATION, S-1 TO S-2; 1 HOUR

PLUMBING FIXTURES

AS PER TABLE 2902.1 - IBC 2015

GROUP CLASSIFICATION	802 PERSONS	WATER CLOSETS SEE SECTION 419.2 OF THE IPC FOR URINALS REQUIRED		WATER CLOSETS SUPPLIED		URINALS SUPPLIED	LAVATORIES REQUIRED		LAVATORIES SUPPLIED		BATHS OR SHOWERS REQUIRED	BATHS OR SHOWERS SUPPLIED	DRINKING FOUNTAINS REQUIRED	DRINKING FOUNTAINS SUPPLIED	OTHER REQUIRED	OTHER SUPPLIED
		MALE	FEMALE	MALE	FEMALE	MALE	MALE	FEMALE	MALE	FEMALE	0	0	2	2	1 SERV SINK	1 SERV SINK
ASSEMBLY GROUP A-3	802 PERSONS	4	7	4	7	4	3	3	3	3	0	0	2	2	1 SERV SINK	1 SERV SINK

INTERIOR FINISHES

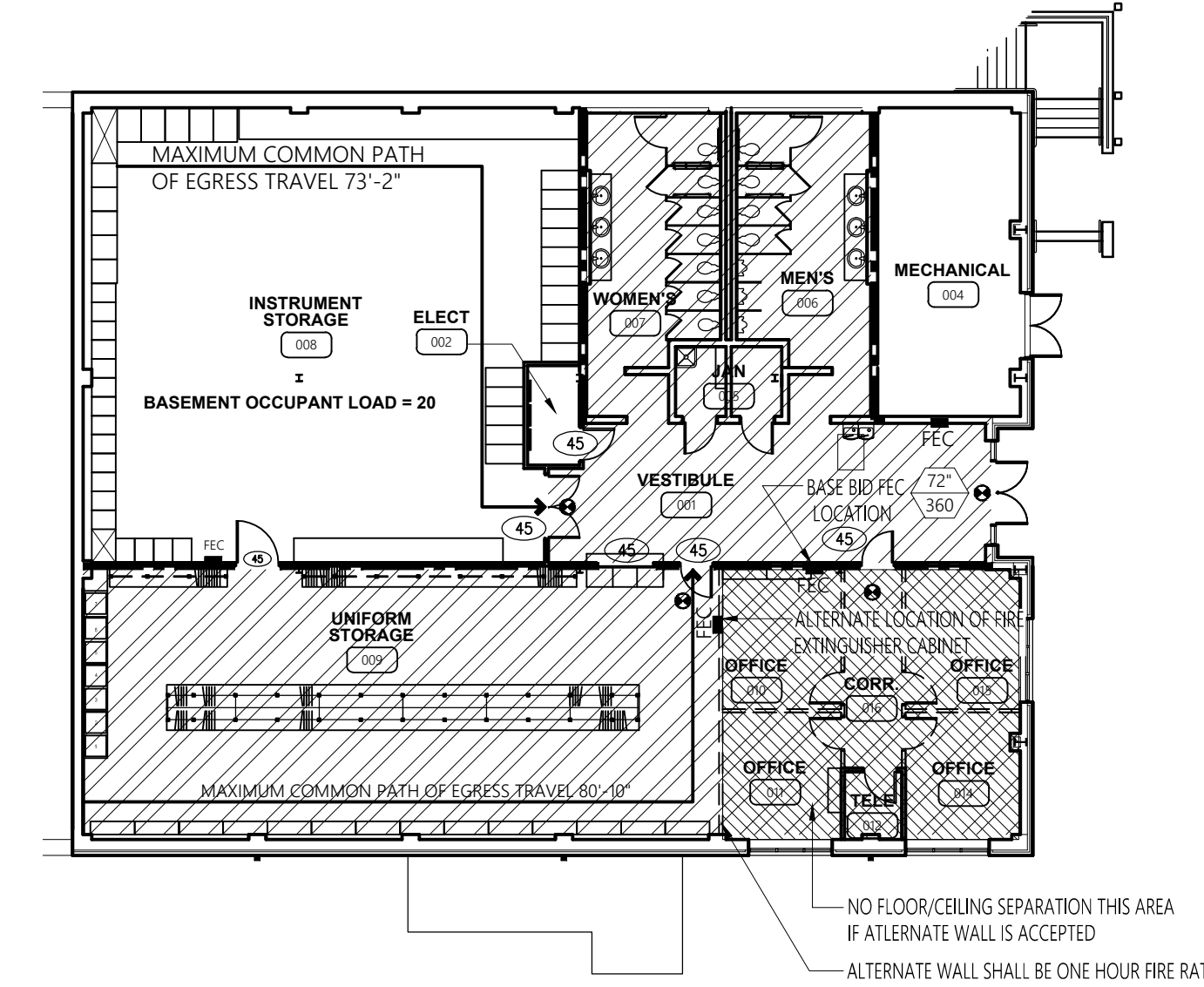
IBC TABLE 803.11 CEILING AND WALL FINISHES

GROUP	SPRINKLERED		
	EXIT ENCL. & PASSAGEWAYS	CORRIDORS	ROOMS AND ENCL. SPACES
GROUP A	B	B	C
GROUP S	C	C	C
GROUP B	B	C	C

IBC SECTION 804 - FLOOR FINISHES SHALL BE NOT LESS THAN TYPE II IN ALL AREAS IN AN UNSPRINKLERED BUILDING FOR GROUP A, B AND S OCCUPANCY.

CODE REFERENCES

INTERNATIONAL BUILDING CODE, BUILDING (IBC-B)	2015 EDITION
INTERNATIONAL BUILDING CODE, MECHANICAL (IBC-M)	2015 EDITION
INTERNATIONAL BUILDING CODE, FUEL GAS (IBC-FG)	2015 EDITION
INTERNATIONAL BUILDING CODE, PLUMBING (IBC-P)	2015 EDITION
NATIONAL FIRE ALARM AND SIGNALING CODE NFPA 72	2013 EDITION
NATIONAL ELECTRICAL CODE (NEC)	2014 EDITION
AMERICANS WITH DISABILITIES ACT	2010 EDITION
ANSI/ASHRAE/IESNA STANDARD 90.1	2013 EDITION



1 BASEMENT FLOOR LIFE SAFETY PLAN
LS.1 SCALE: 1/16" = 1'-0"

FIRE PROTECTION SYSTEMS

AUTOMATIC FIRE SPRINKLER PROTECTION IS REQUIRED, PER IBC SECTION 903.2.1.3 CONDITION 2. MANUAL FIRE ALARM SHALL BE REQUIRED IF FIRE SPRINKLER DOES NOT ACTIVATE OCCUPANT NOTIFICATION APPLIANCES ON SPRINKLER FLOW. (IBC 907.2.1, EXCEPTION 1)

DESIGN OCCUPANT LOAD

OCCUPANT LOAD FACTORS (IBC TABLE 1004.1.2) :

BUSINESS GROUP B..... 100 G.S.F./PERSON ASSEMBLY GROUP A..... 7 N.S.F./PERSON
STORAGE GROUP S..... 300 G.S.F./PERSON

AREA	LOAD FACTOR	PERSONS
OFFICE	570 G.S.F. /100 G.S.F.	6
STORAGE/MECH.	5,612 G.S.F. /300 G.S.F.	19
ASSEMBLY CONCENTRATED	4,641 N.S.F. /7 N.S.F.	663
ASSEMBLY FIXED SEATING		114
TOTAL PERSONS		802

NUMBER OF MEANS OF EGRESS

TWO EXITS OR EXIT ACCESS (MEANS OF EGRESS) IS REQUIRED AT FIRST FLOOR OCCUPANCY.

ARRANGEMENT OF MEANS OF EGRESS

THE EXITS ARE ARRANGED SO THAT THEY MEET THE SEPARATE AND REMOTE REQUIREMENTS OF THE IBC.

MARKING OF MEANS OF EGRESS

ALL MEANS OF EGRESS SHALL BE PROVIDED WITH ACCEPTABLE EXIT SIGNS WHICH DESIGNATE THE EXITS AND THE DIRECTION OF TRAVEL TO THE EXITS ACCORDING TO IBC SECTION 1013. RAISED CHARACTER AND BRAILLE EXIT SIGNS PER ICC A117.1 SHALL BE INSTALLED AT EXIT DOORS.

EGRESS WIDTH AND TRAVEL DISTANCE

SECTION 1017 - MAXIMUM EXIT ACCESS DISTANCE IS 250 FEET SPRINKLERED. MINIMUM CORRIDOR WIDTH IS 44 INCHES.

EMERGENCY LIGHTING

ADEQUATE EMERGENCY LIGHTING IS REQUIRED ACCORDING TO IBC SECTION 1006.

ACCESSIBILITY

ALL AREAS COMPLY WITH ACCESSIBILITY REQUIREMENTS OF THE IBC, AND ADA 2010

UTILITIES

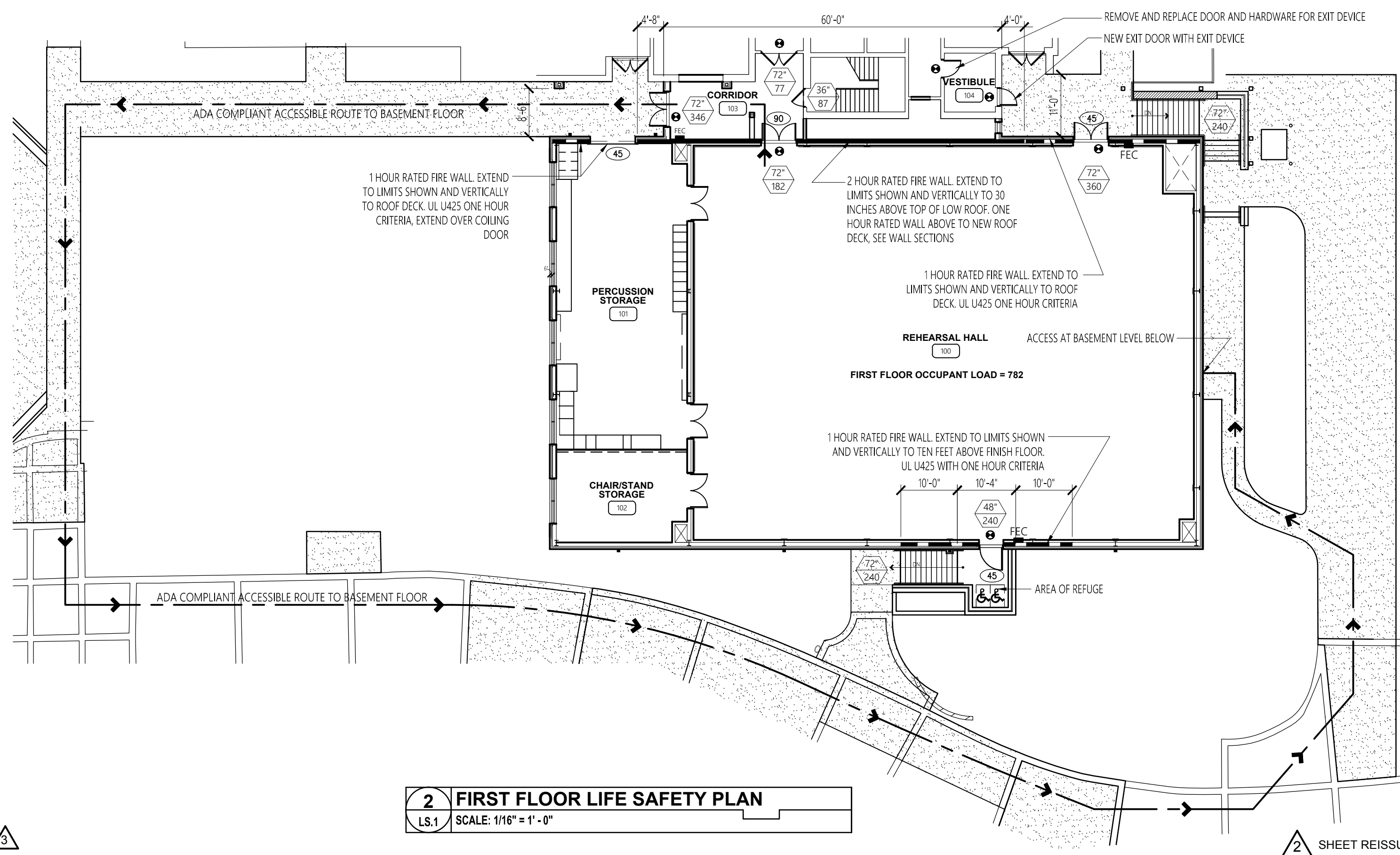
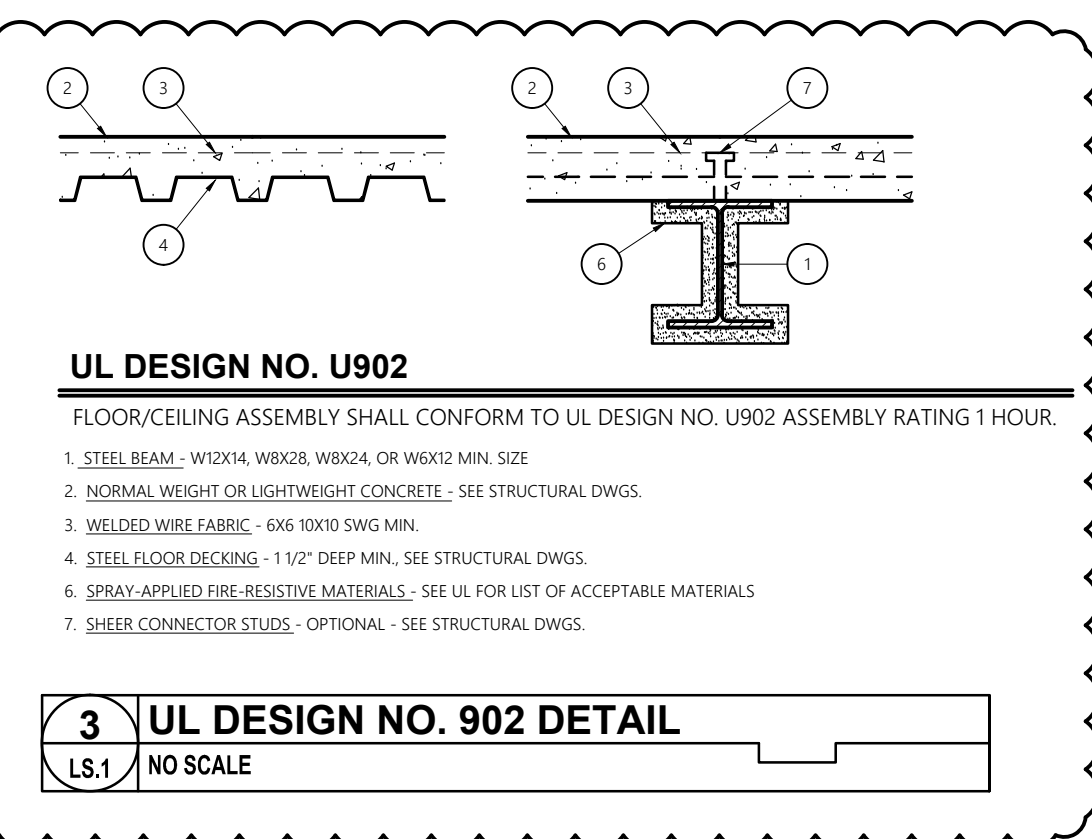
ALL ELECTRICAL SERVICES SHALL COMPLY WITH NFPA 70 - NATIONAL ELECTRICAL CODE. ANY AND ALL NATURAL GAS SERVICE SHALL COMPLY WITH THE 2015 INTERNATIONAL FUEL GAS CODE. ALL PLUMBING SYSTEM INSTALLATION MUST COMPLY WITH THE PROVISIONS OF THE 2015 INTERNATIONAL PLUMBING CODE.

HEATING, VENTILATING & AIR CONDITIONING EQUIPMENT

ALL HVAC EQUIPMENT SHALL COMPLY WITH THE PROVISIONS OF THE 2015 INTERNATIONAL MECHANICAL CODE FOR INSTALLATION OF AIR CONDITIONING AND VENTILATION SYSTEMS, AND OR INSTALLATION OF WARM AIR HEATING AND AIR CONDITIONING SYSTEMS AS APPLICABLE.

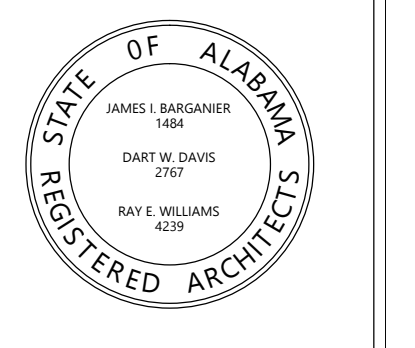
SYMBOLS LEGEND

	EXIT SIGN		SEMI-RECESSED FIRE EXTINGUISHER CABINET WITH ABC TYPE EXTINGUISHER
	EXIT WIDTH AND EXIT CAPACITY		ONE HOUR FIRE RATED EXTERIOR WALL
	ONE HOUR FIRE RATED FLOOR/CEILING UL ASSEMBLY D902 WITH INTUMESCENT COATING OPTION 6E OR 6F FOR BEAMS SEE 3/LS.1 FOR DETAIL		TWO HOUR FIRE RATED EXTERIOR WALL
			ONE HOUR FIRE RATED INTERIOR BARRIER
			ADA COMPLIANT ACCESSIBLE ROUTE



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Safety is our first priority.
Think Safety. Act Safely.

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

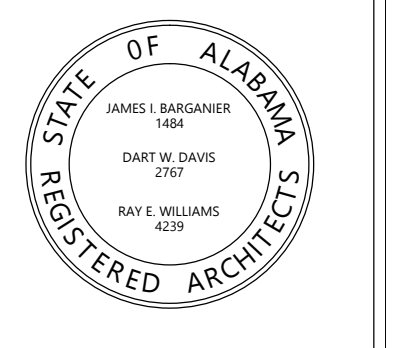
GOODWIN HALL - RENOVATION AND BAND REHEARSAL HALL ADDITION
Project Number 15-255

SHEET TITLE:
LIFE SAFETY PLANS AND CODE STUDY

DRAWN BY:
CHECKED BY:
DATE:
6-14-2017
FILE NUMBER:
PROJECT NUMBER:
16-111
SHEET NUMBER:

LS.1

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



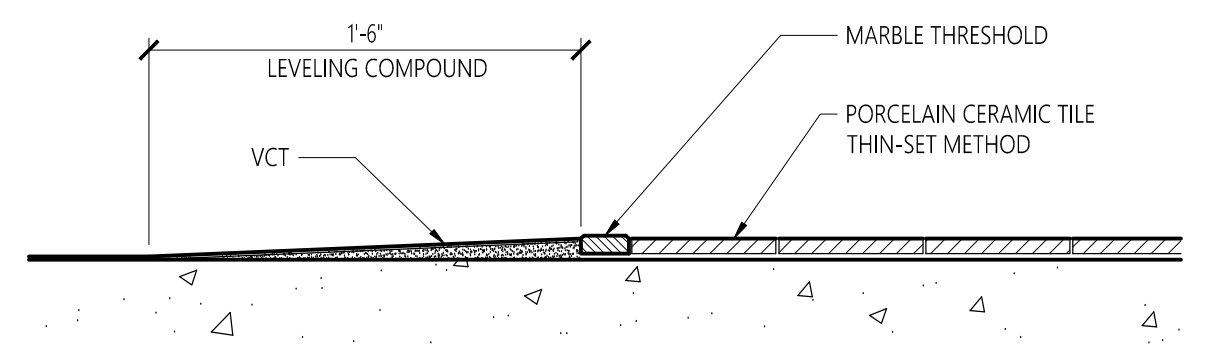
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

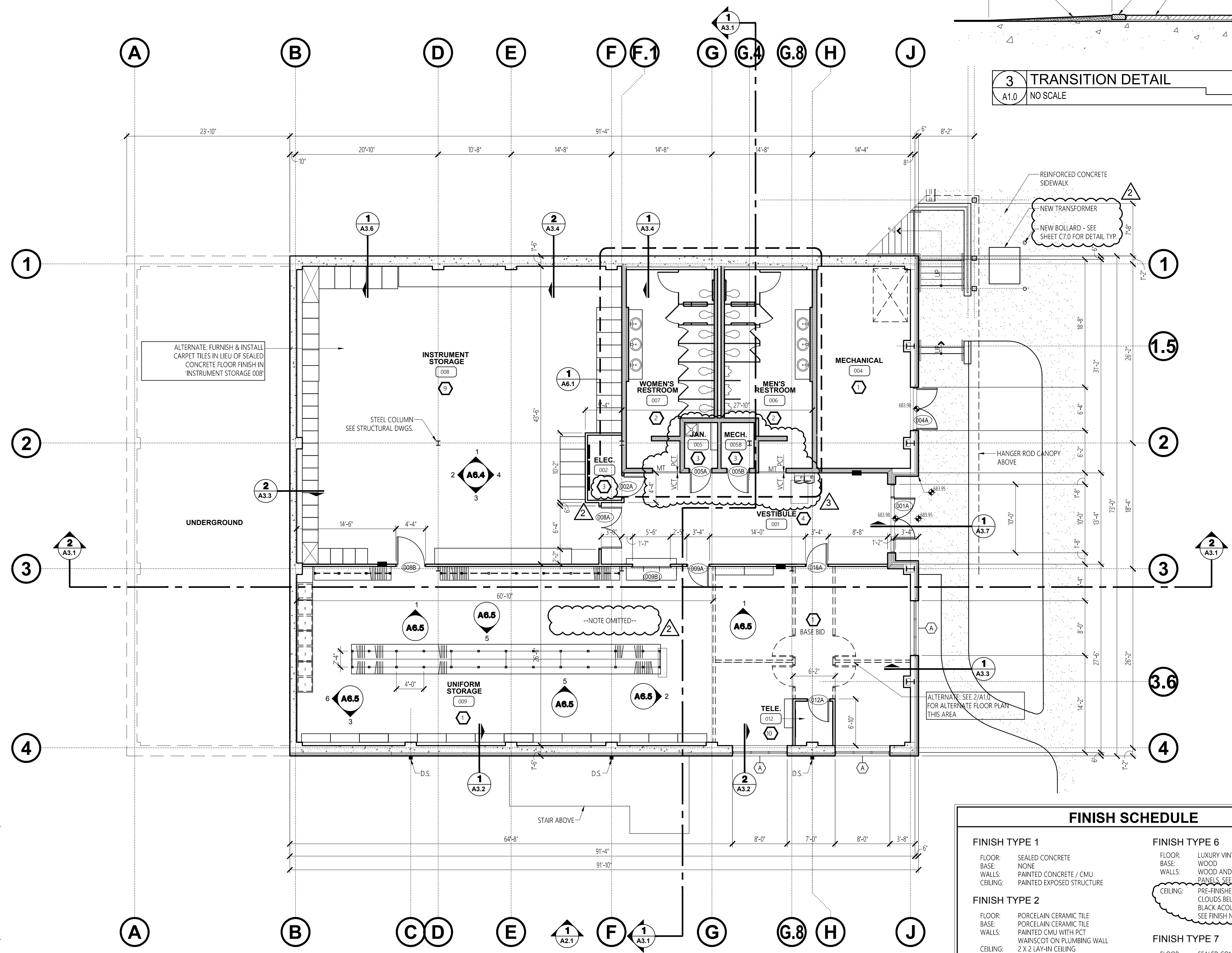
SHEET TITLE:
BASEMENT FLOOR PLAN

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A1.0



3 TRANSITION DETAIL
A1.0 NO SCALE



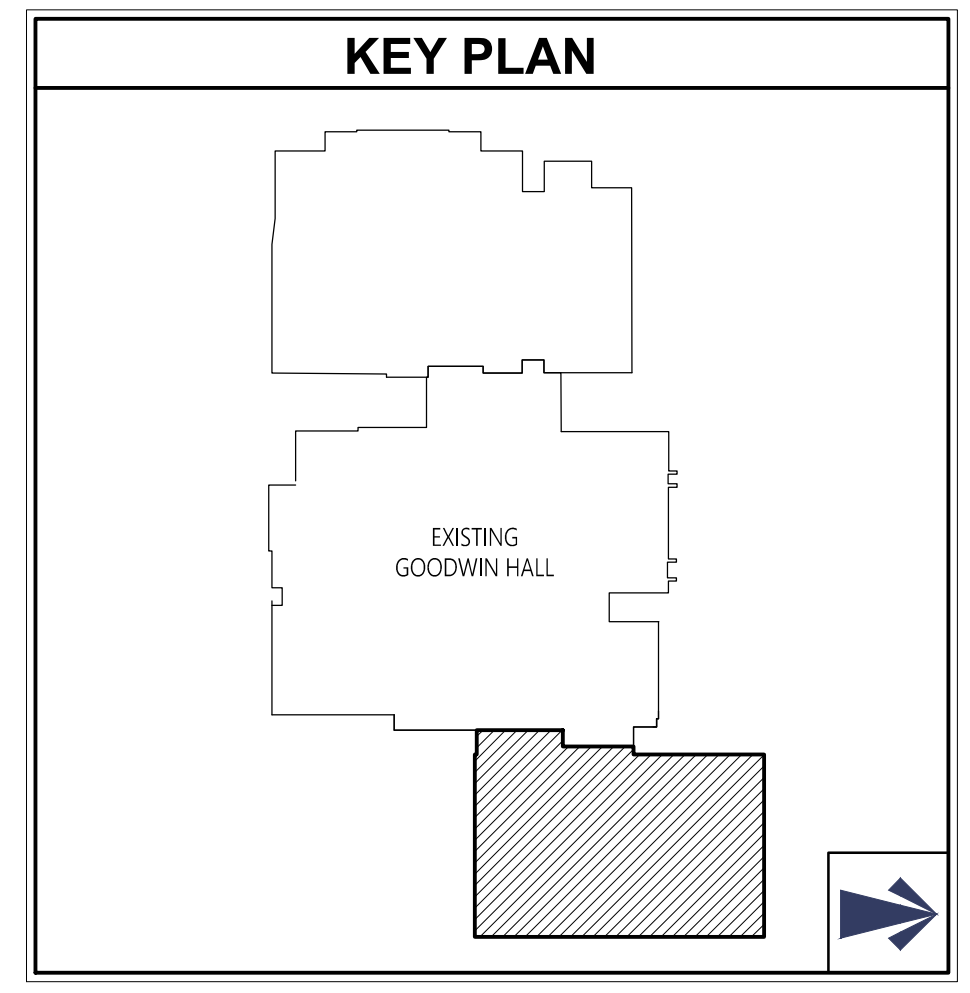
1 BASEMENT FLOOR PLAN
A1.0 SCALE: 1/8" = 1'-0"

GENERAL NOTES

1. --NOTE OMITTED--

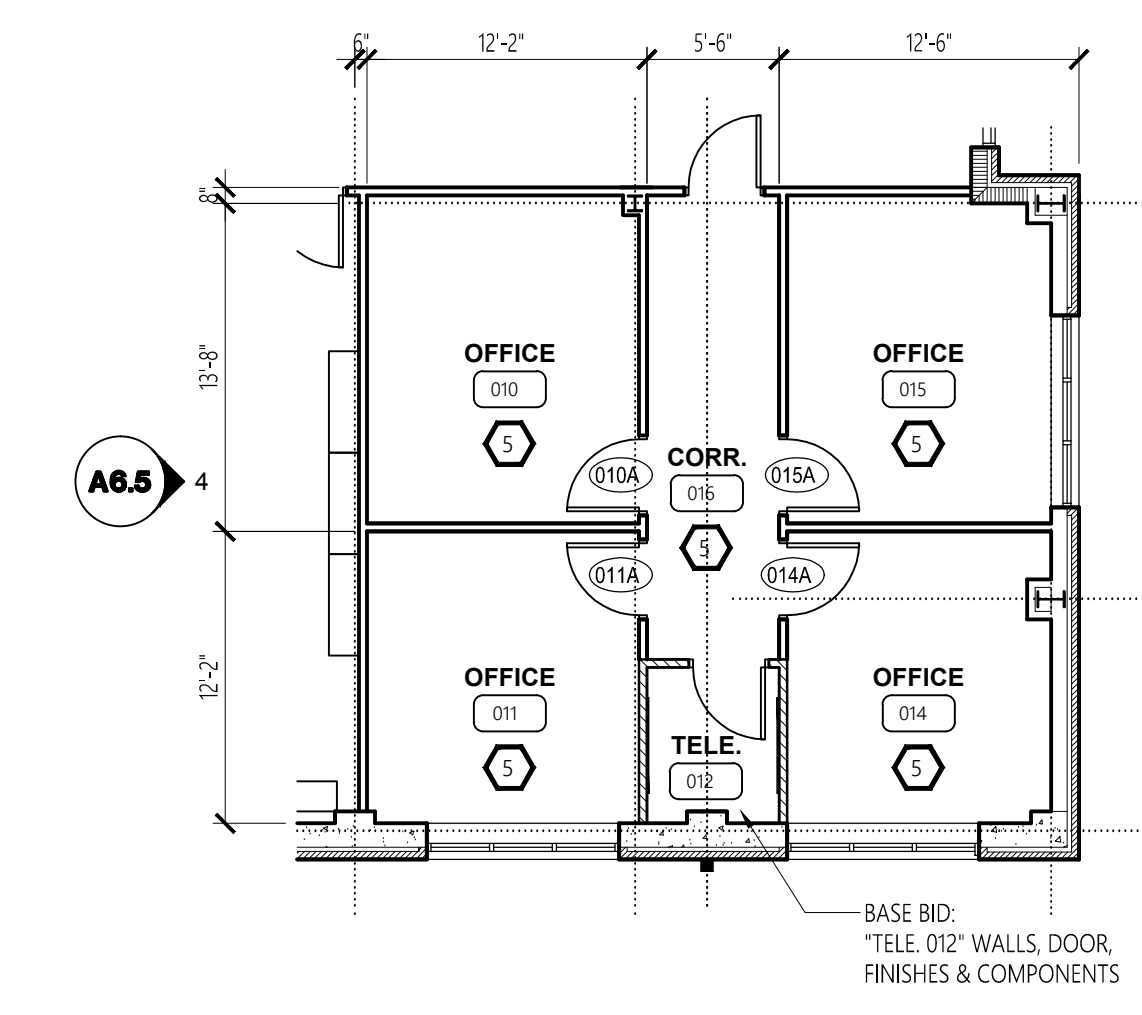
FINISH NOTES

- HAND-RUBBED CONCRETE FINISH NOT REQUIRED BEHIND CABINETS/CASEWORK.
- FURNISH & INSTALL MARBLE THRESHOLD TRANSITION BETWEEN VCT & PCT FLOOR FINISHES.
- "PAINTED EXPOSED STRUCTURE" APPLIES TO STRUCTURAL MEMBERS, MECHANICAL DUCTWORK, CONDUIT AND ALL OTHER COMPONENTS AT THE CEILING. PAINT THE CEILING IN ITS ENTIRETY.



FLOOR PLAN LEGEND

- KEY NOTE SYMBOL - SEE LIST OF KEY NOTES THIS SHEET
- DOOR SYMBOL - SEE DOOR SCHEDULE
- FINISH SYMBOL - SEE FINISH SCHEDULE THIS SHEET
- WINDOW SYMBOL - SEE WINDOW SCHEDULE
- LT LOUVER SYMBOL - SEE SHEET A8.1
- EXISTING WALL - FIELD VERIFY
- 8" REINFORCED CMU WALL
- METAL STUD WALL W/ GYPSUM BD.
- POURED IN PLACE CONCRETE WALL
- NEW WALL CONSTRUCTION - NEW TO MATCH EXISTING MATERIALS FIELD VERIFY
- D.S. PRE-FINISHED METAL DOWNSPOUT INTO BOOT
- MT 2" MARBLE THRESHOLD WITH 18" WIDE LEVELING COMPOUND STRIP ON VCT SIDE OF MARBLE THRESHOLD - SEE 3/A1.0



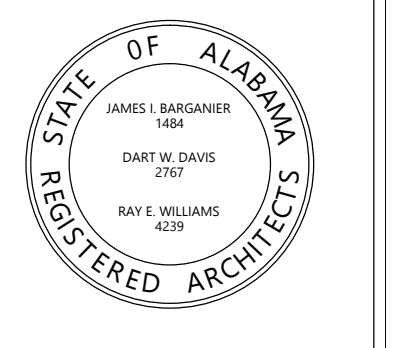
2 PARTIAL FLOOR PLAN (ALTERNATE)
A1.0 SCALE: 1/8" = 1'-0"

FINISH SCHEDULE

FINISH TYPE 1 FLOOR: SEALED CONCRETE BASE: NONE WALLS: PAINTED CONCRETE / CMU CEILING: PAINTED EXPOSED STRUCTURE	FINISH TYPE 6 FLOOR: LUXURY VINYL TILE BASE: WOOD WALLS: WOOD AND ACOUSTICAL PANELS. SEE SHEET A6.2 CEILING: PRE-FINISHED SUSPENDED CEILING CLOUDS BELOW PRE-FINISHED BLACK ACOUSTICAL SOUND BOARDS. SEE FINISH NOTE 1, BELOW.
FINISH TYPE 2 FLOOR: PORCELAIN CERAMIC TILE WALLS: PAINTED CMU WITH PCT WAINSCOT ON PLUMBING WALL CEILING: 2 X 2 LAY-IN CEILING VINYL CLAD GYPSUM BOARD	FINISH TYPE 7 FLOOR: SEALED CONCRETE BASE: RUBBER WALLS: PAINTED GYPSUM BOARD CEILING: 2 X 2 LAY-IN CEILING
FINISH TYPE 3 FLOOR: SEALED CONCRETE BASE: RUBBER WALLS: PAINTED CONCRETE / GYP. BD. CEILING: PAINTED GYPSUM BOARD	FINISH TYPE 8 FLOOR: SEALED CONCRETE BASE: RUBBER WALLS: SEALED BRICK CEILING: 2 X 2 LAY-IN CEILING
FINISH TYPE 4 FLOOR: VINYL COMPOSITE TILE BASE: RUBBER WALLS: PAINTED CMU CEILING: 2X2 LAY-IN CEILING	FINISH TYPE 9 FLOOR: SEALED CONCRETE/BASE BID CARPET TILE (ALTERNATE) BASE: RUBBER WALLS: PAINTED CONCRETE / CMU CEILING: PAINTED EXPOSED STRUCTURE
FINISH TYPE 5 (ALT.) FLOOR: CARPET BASE: RUBBER WALLS: PAINTED CMU / GYP. BD. CEILING: 2 X 2 LAY-IN CEILING	FINISH TYPE 10 FLOOR: SEALED CONCRETE BASE: NONE WALLS: PAINTED GYPSUM BOARD CEILING: 3/4" TH. PLYWOOD AT EAST WALL / PAINTED GYPSUM BOARD

FINISH NOTE 1:
PAINT FLAT BLACK ALL EXPOSED DUCTWORK, CONDUIT, FRAMING AND ANY OTHER EXPOSED MISC. MATERIALS.

No.	Revision	Date
1	Adm. #2	7-13-17
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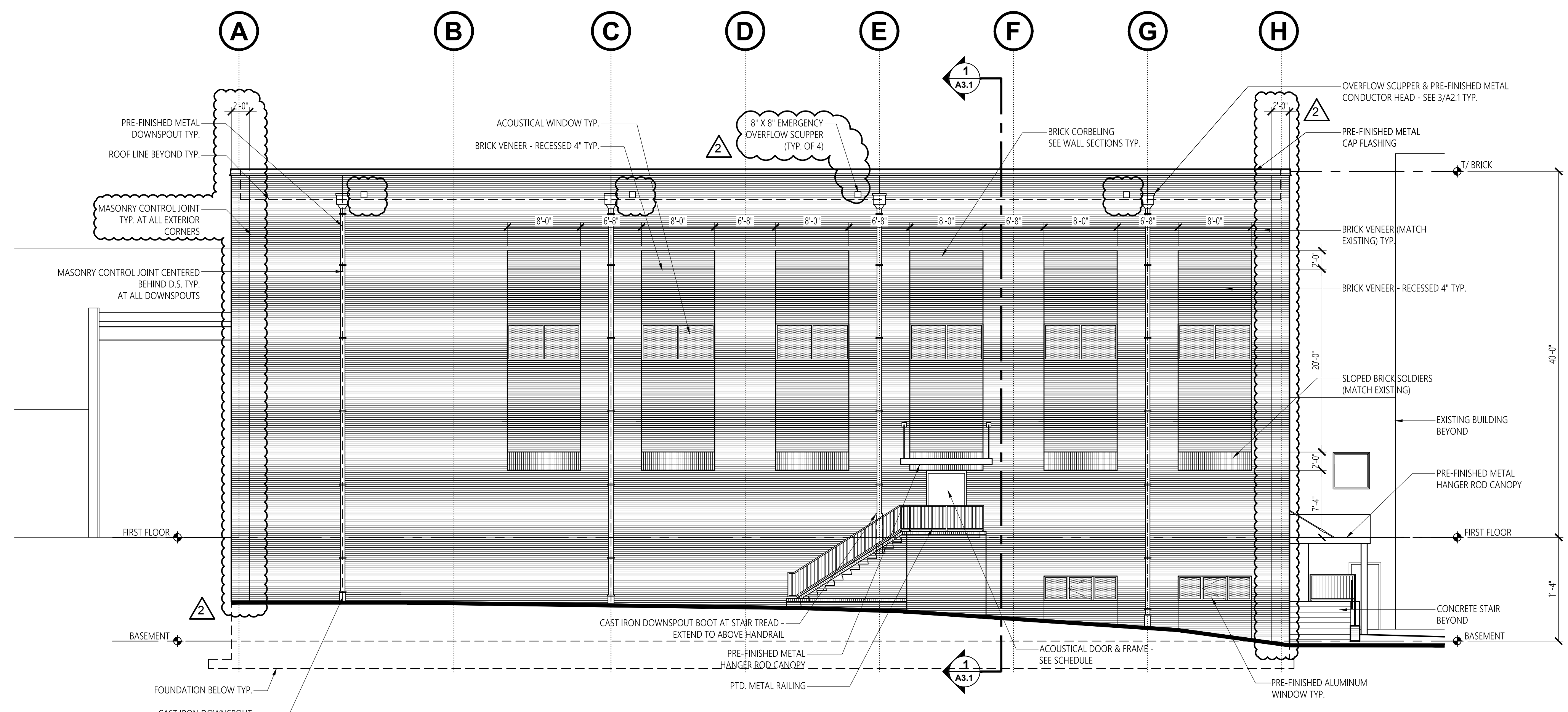
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
**WEST & SOUTH
ELEVATIONS**

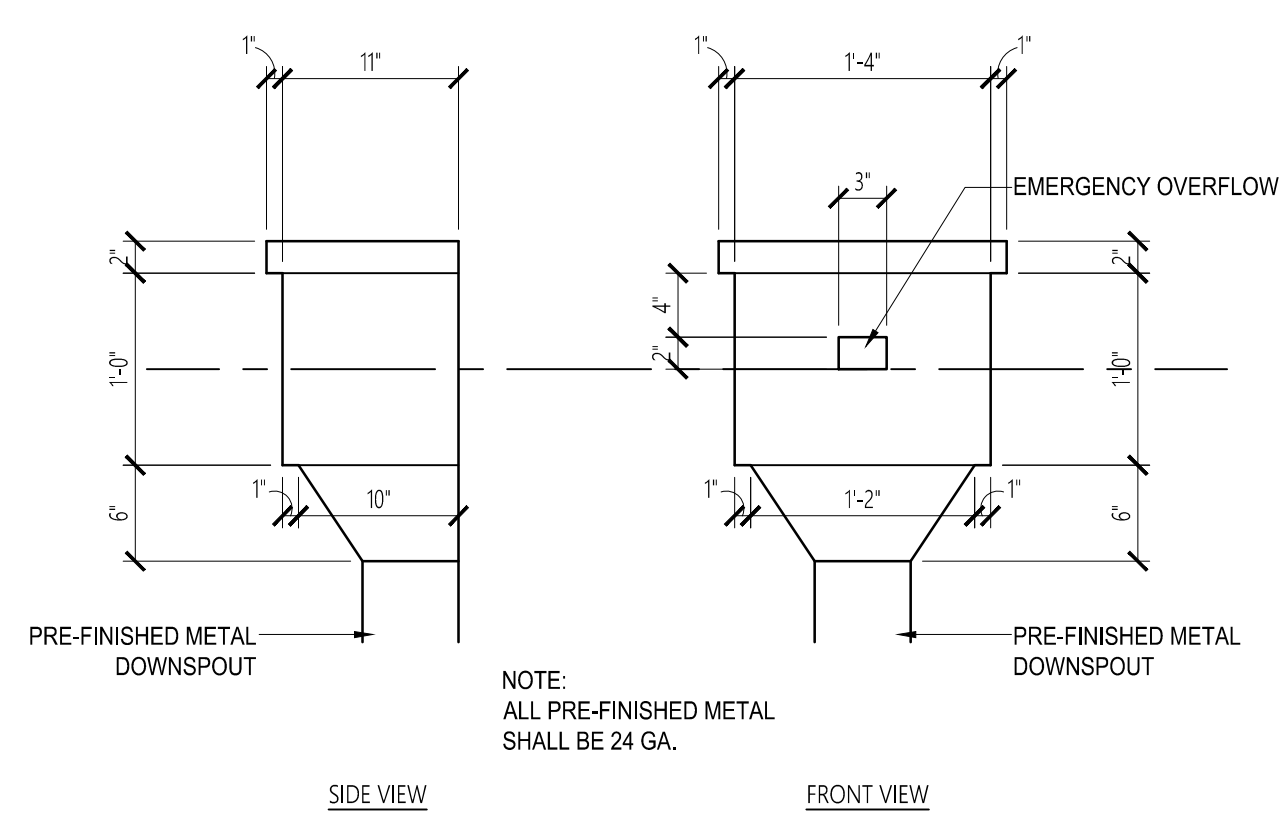
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-
CHECKED BY:
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DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A2.1

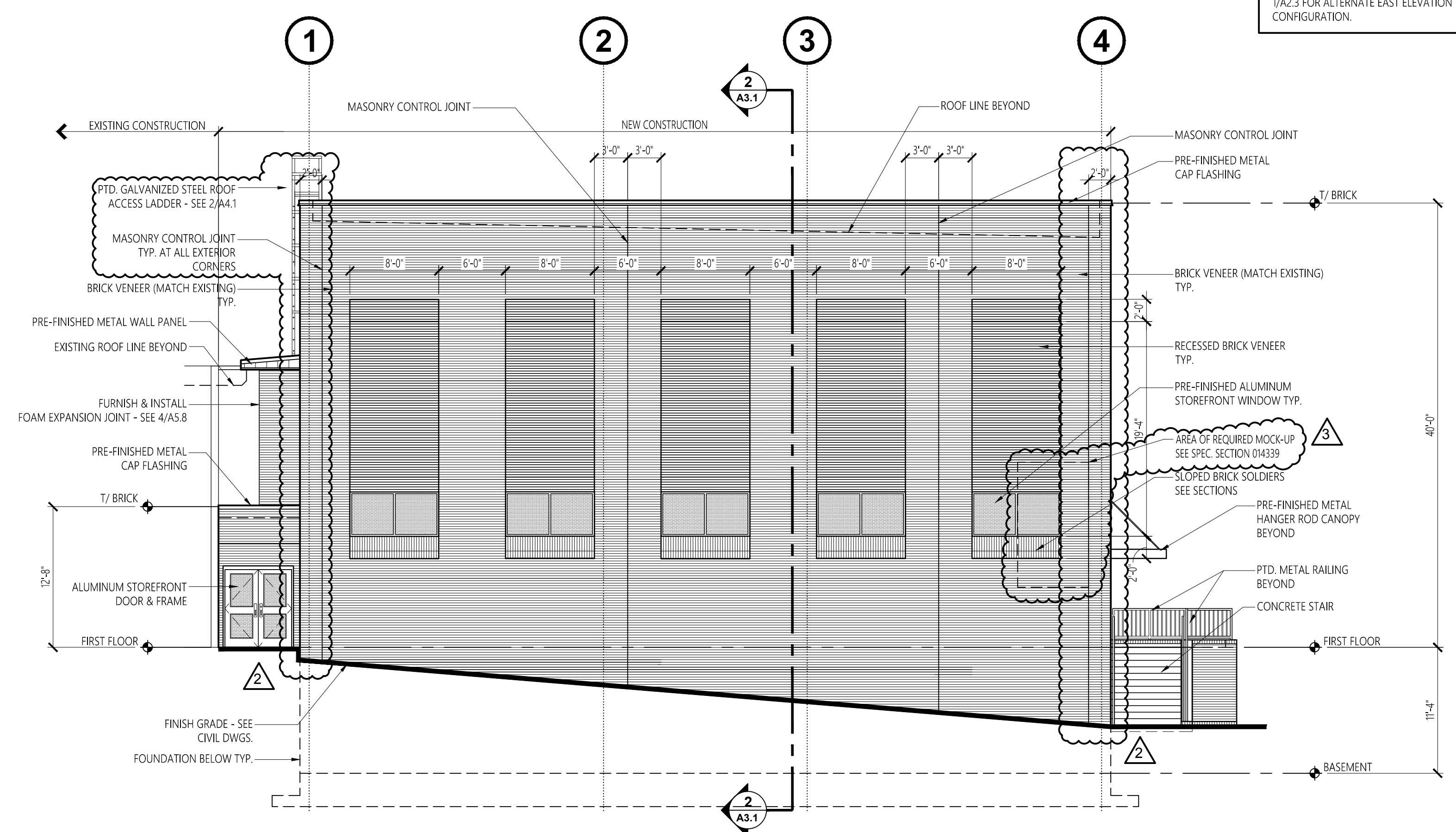


1 EAST ELEVATION (BASE BID)
A2.1 SCALE: 1/8" = 1'-0"

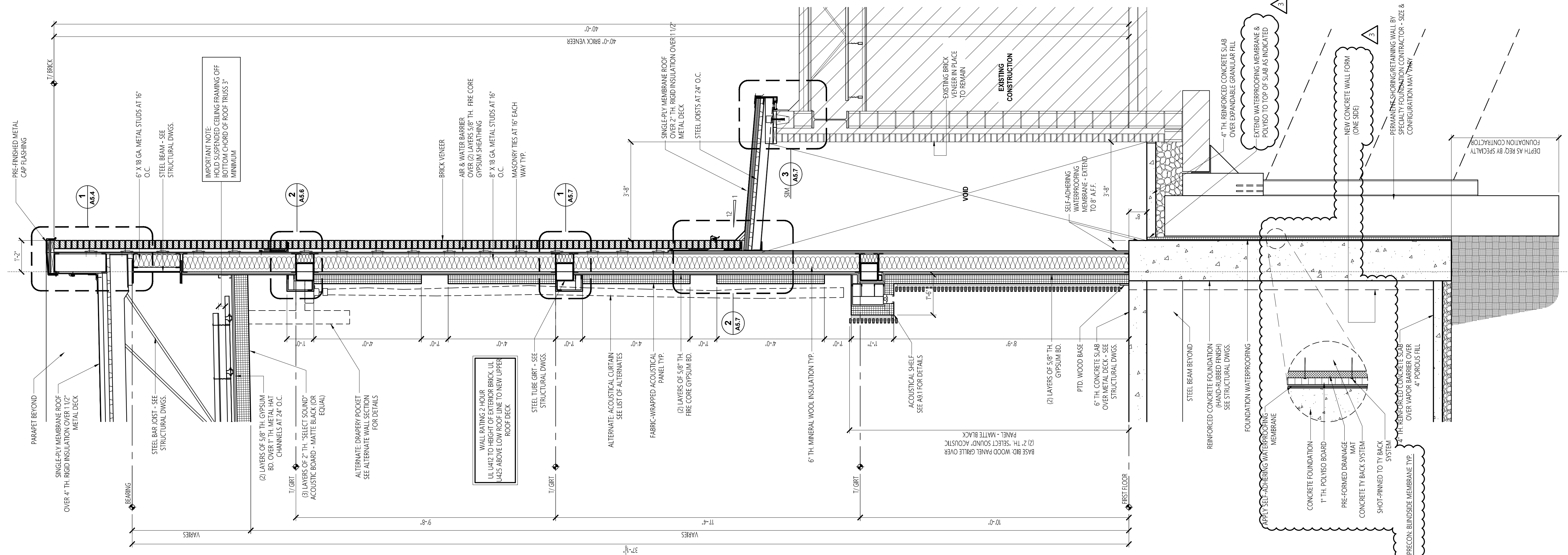
NOTE:
BASE BID CONFIGURATION SHOWN. SEE
1/A2.3 FOR ALTERNATE EAST ELEVATION
CONFIGURATION.



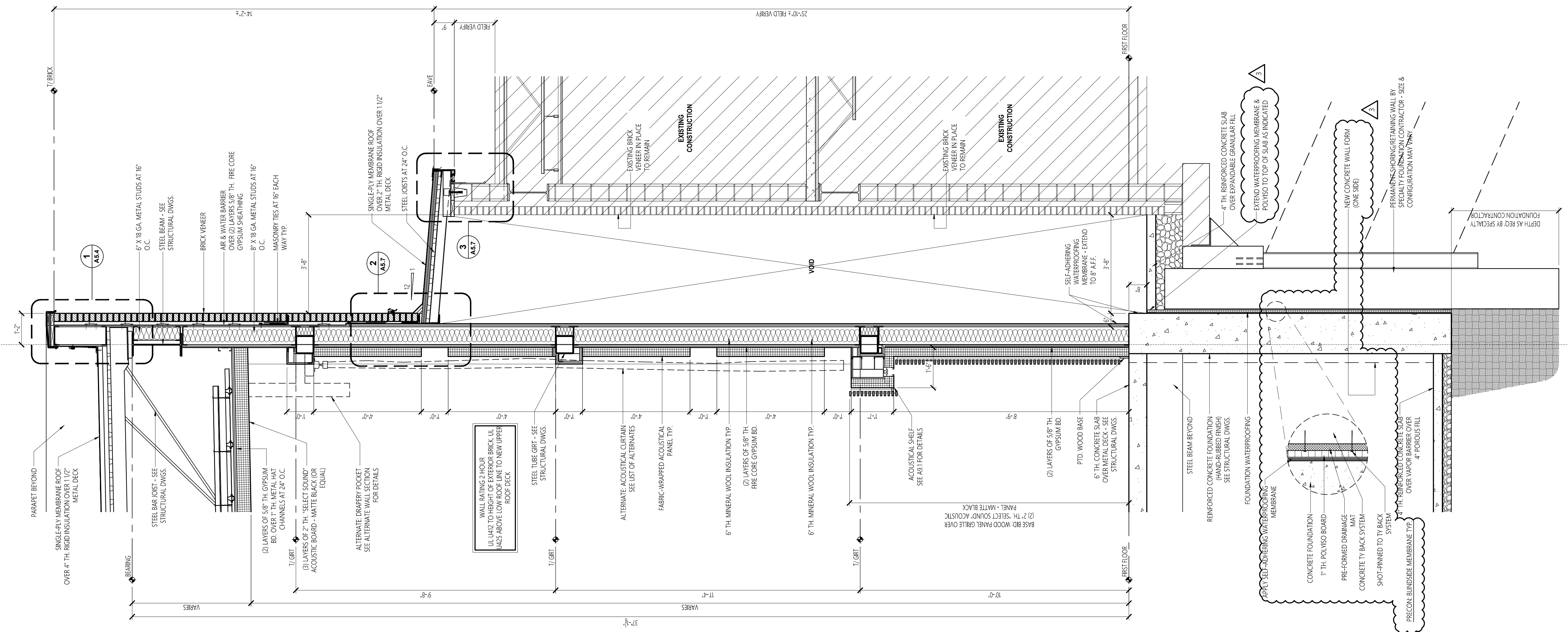
3 CONDUCTOR HEAD DETAIL
A2.1 SCALE: 1" = 1'-0"



2 SOUTH ELEVATION
A2.1 SCALE: 1/8" = 1'-0"



1 WALL SECTION - BASE BID
 A3.4 SCALE: 1/2" = 1'-0"




2 WALL SECTION - BASE BID
 A3.4 SCALE: 1/2" = 1'-0"

IMPORTANT NOTE:
 HOLD SUSPENDED CEILING FRAMING OFF
 BOTTOM CHORD OF ROOF TRUSS 3"
 MINIMUM

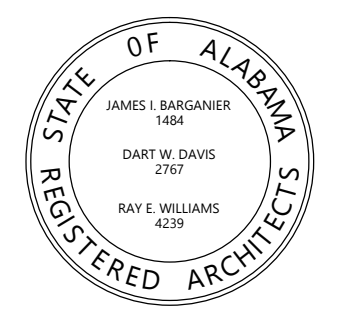
WALL RATING 2-HOUR
 UL U412 TO HEIGHT OF EXTERIOR BRICK, UL
 U425 ABOVE LOW ROOF LINE TO NEW UPPER
 ROOF DECK

BASE BID: WOOD PANEL GRILLE OVER
 (2) 2" SELECT SOUND[®] ACOUSTIC
 PANEL - MATTIE BLACK



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No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
 Drawn By:

**GOODWIN HALL - RENOVATION
 AND
 BAND REHEARSAL HALL ADDITION**
 Project Number 15-255

SHEET TITLE:
WALL SECTIONS

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 -

CHECKED BY:
 -

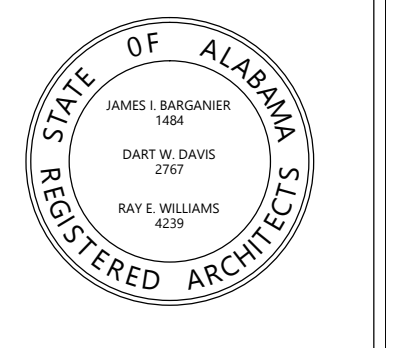
DATE:
 6-14-2017

FILE NUMBER:
 -

PROJECT NUMBER:
 16-111

SHEET NUMBER:
A3.4

No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



Project Number: 2015-255
Drawn By:
BARGANIER DAVIS SIMS

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
ROOF PLAN

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-

CHECKED BY:
-

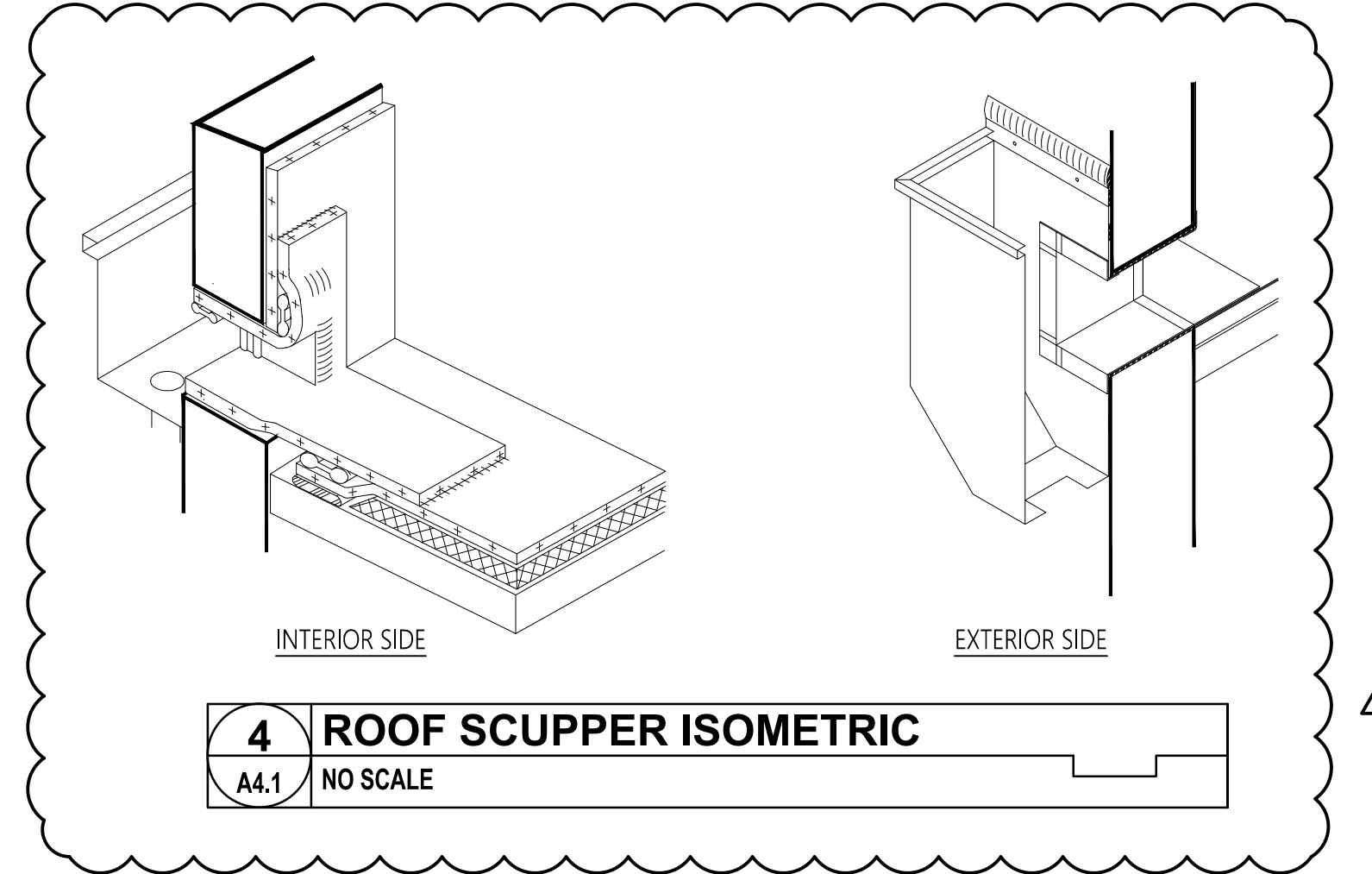
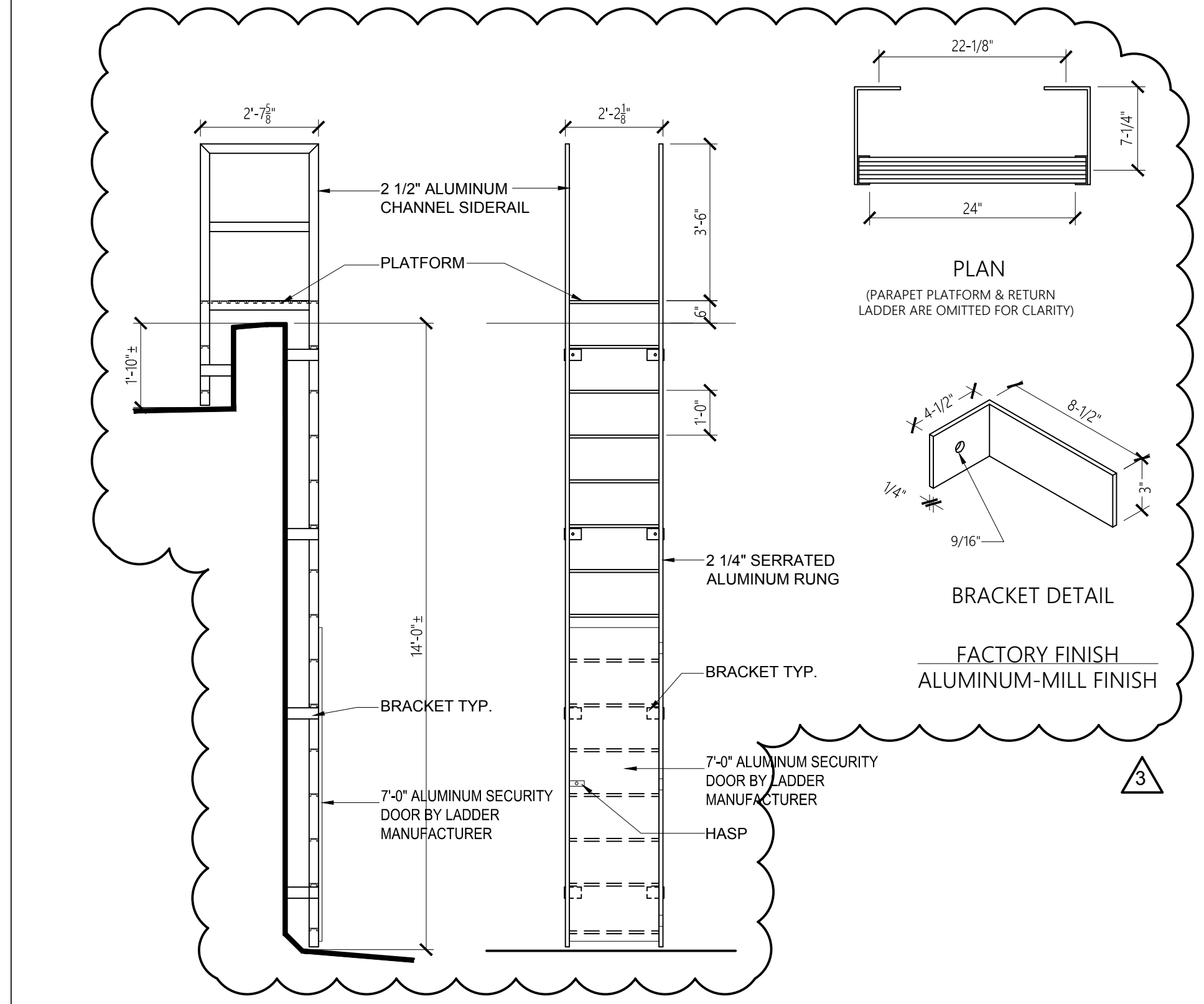
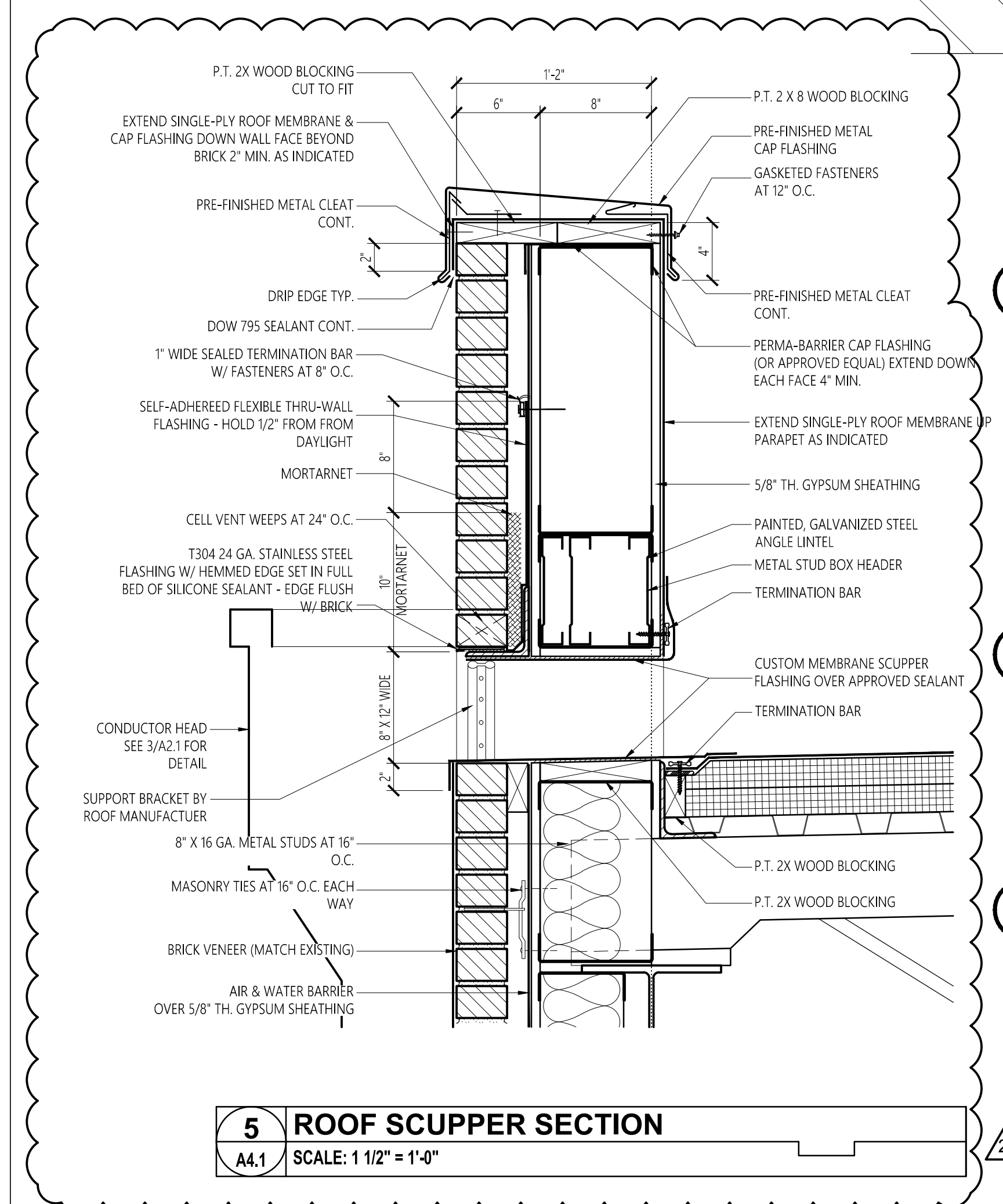
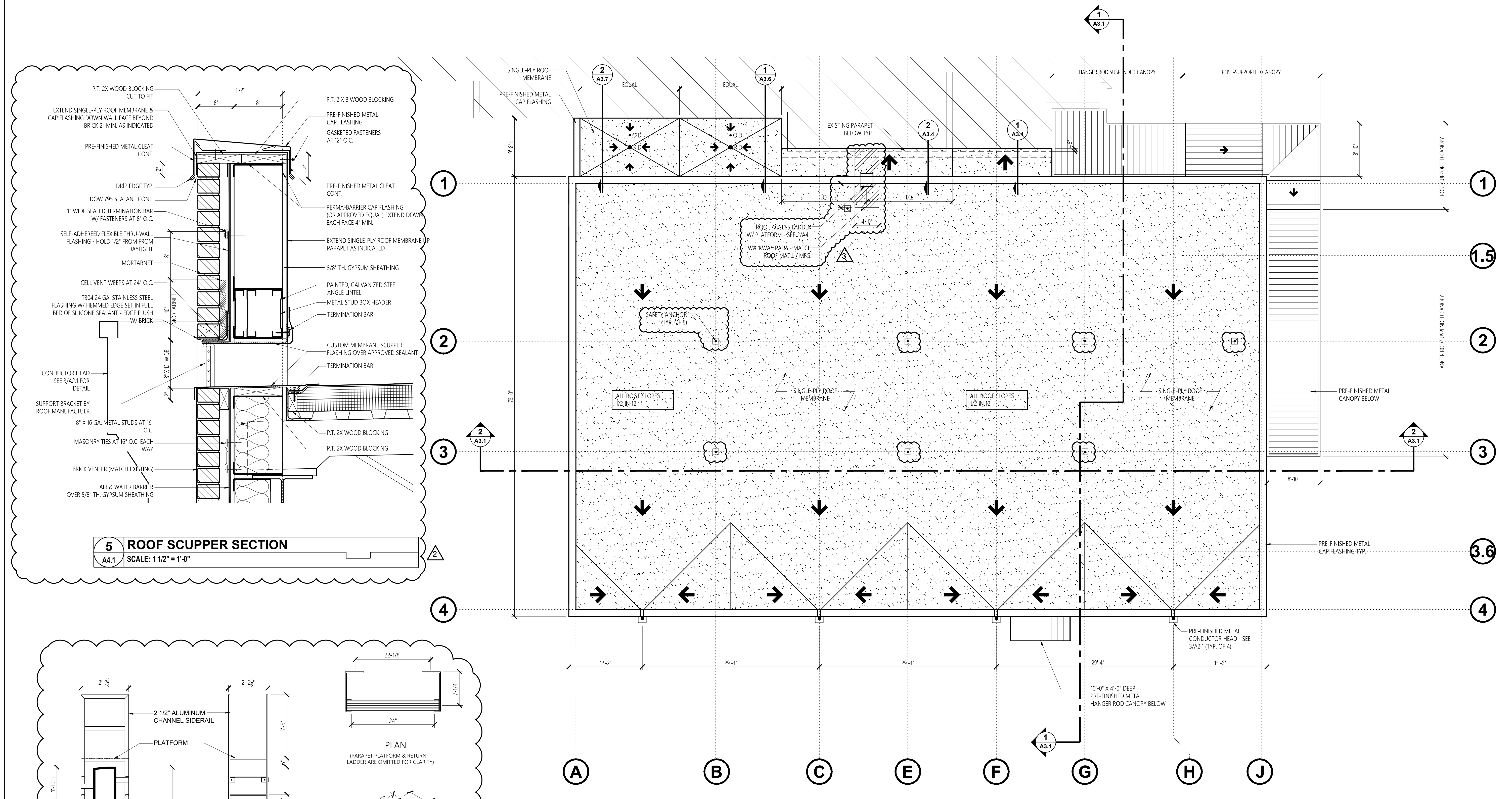
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6-14-2017

FILE NUMBER:
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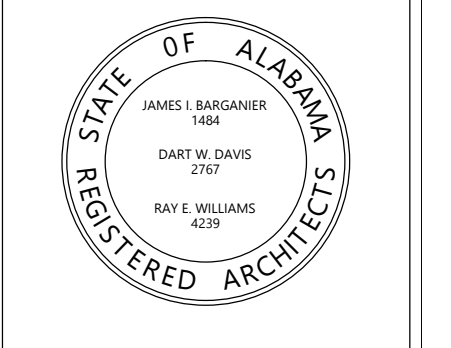
PROJECT NUMBER:
16-111

SHEET NUMBER:

A4.1



No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



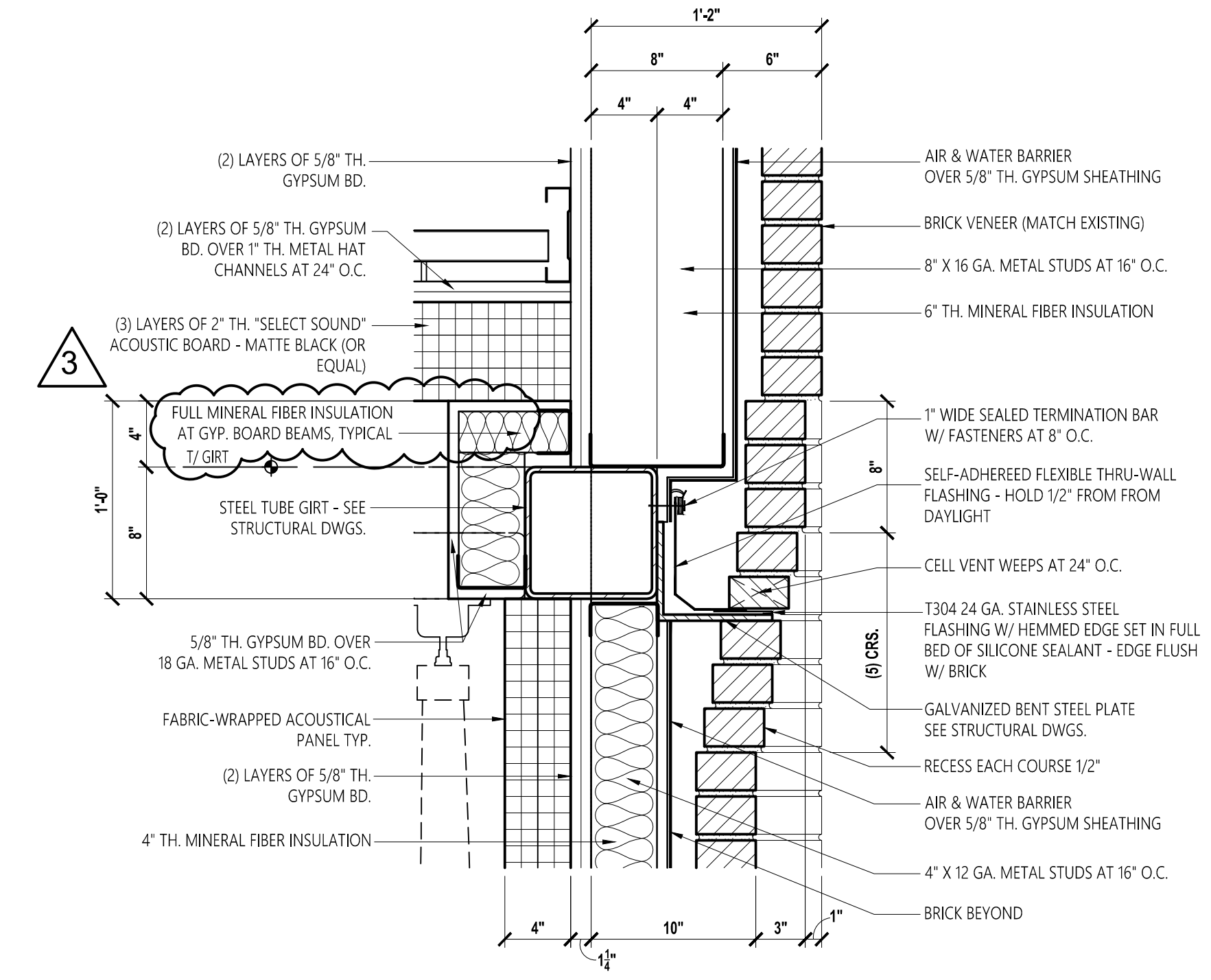
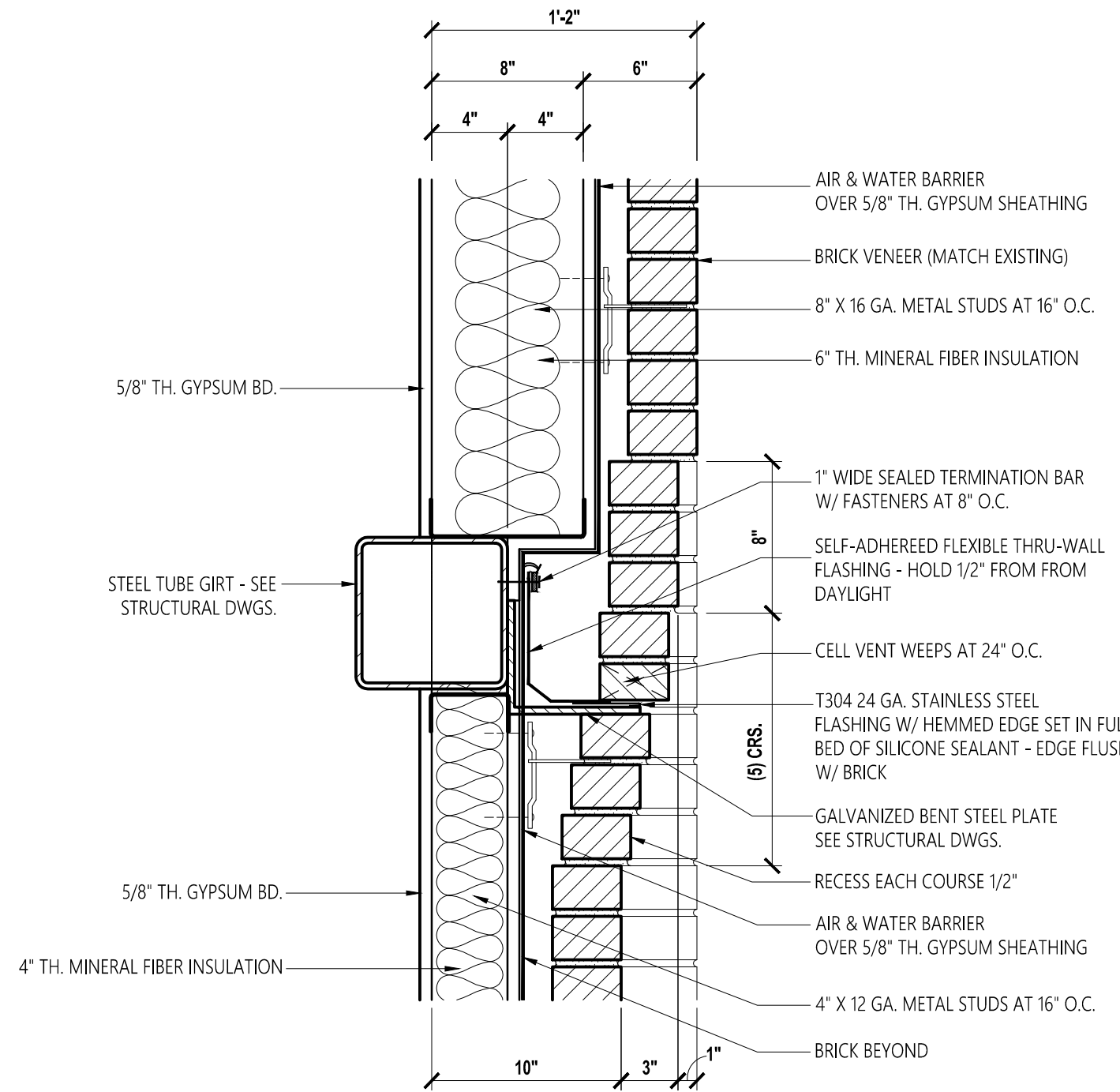
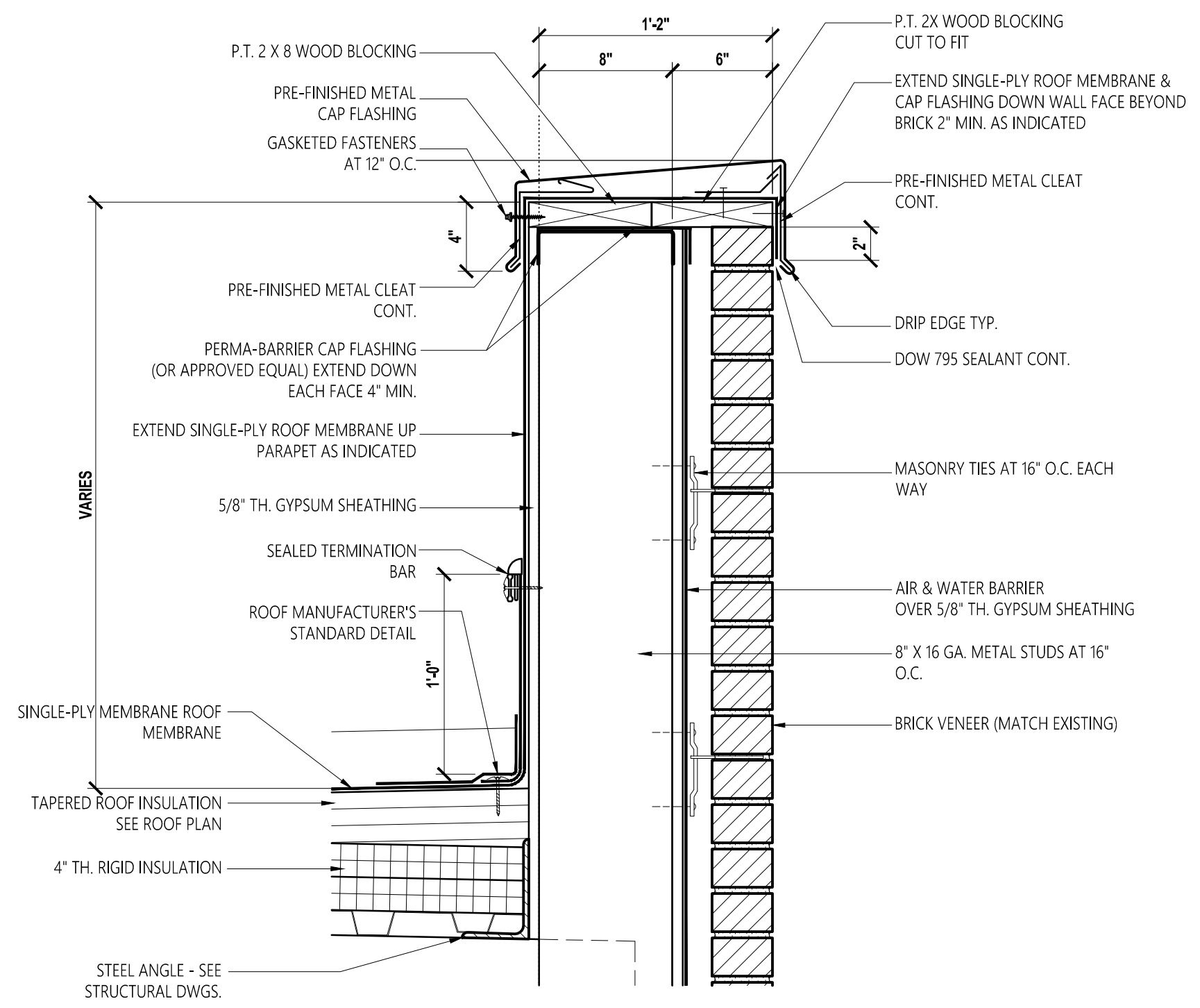
Project Number: 2015-255
BARGANIER DAVIS SIMS
 Drawn By:

**GOODWIN HALL - RENOVATION
 AND
 BAND REHEARSAL HALL ADDITION**
 Project Number 15-255

SHEET TITLE:
SECTION DETAILS

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 -
 CHECKED BY:
 -
 DATE:
 6-14-2017
 FILE NUMBER:
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 PROJECT NUMBER:
 16-111
 SHEET NUMBER:

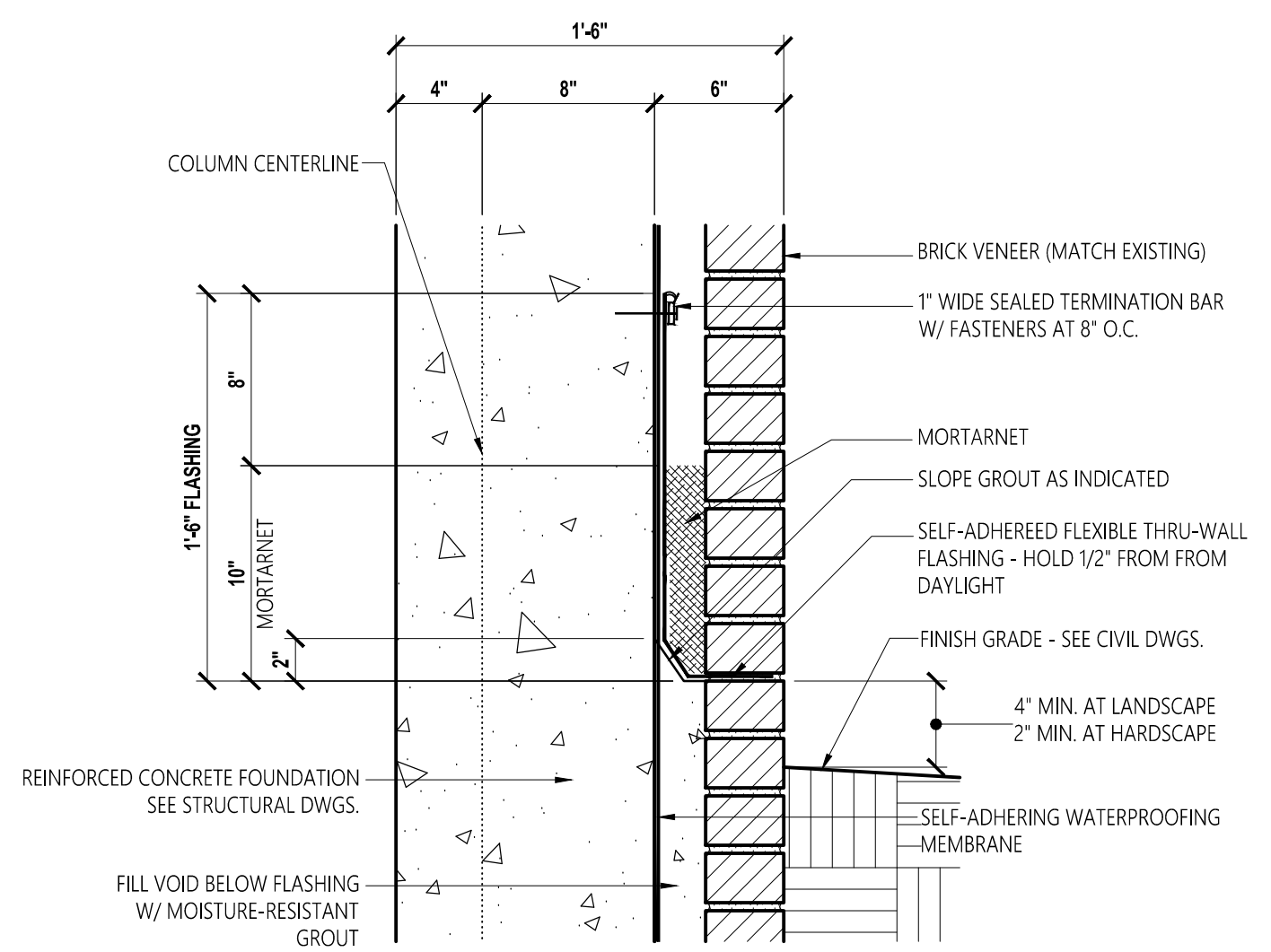
A5.4



1 SECTION DETAIL
 SCALE: 1 1/2" = 1'-0"

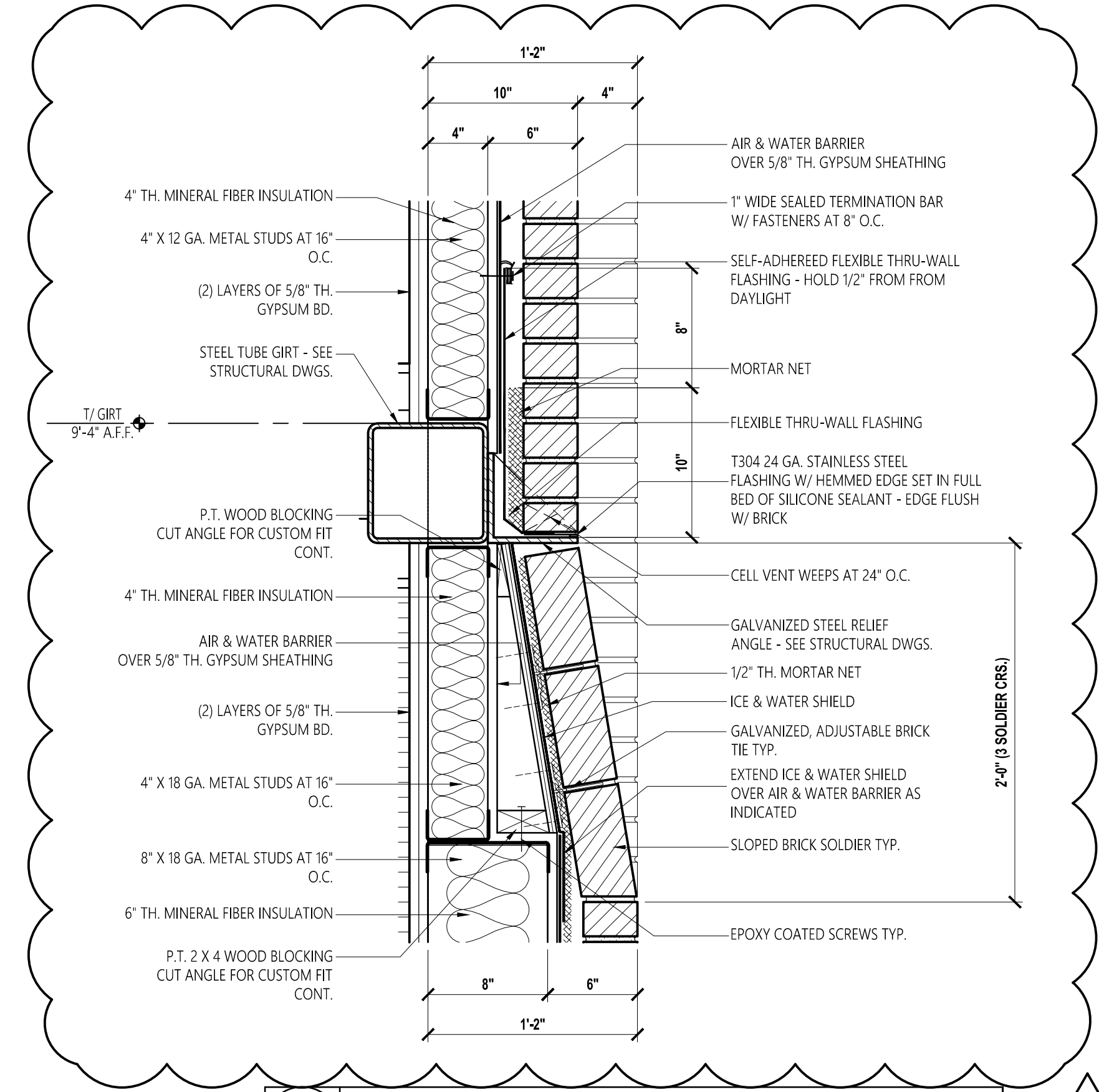
2 SECTION DETAIL
 SCALE: 1 1/2" = 1'-0"

3 SECTION DETAIL
 SCALE: 1 1/2" = 1'-0"



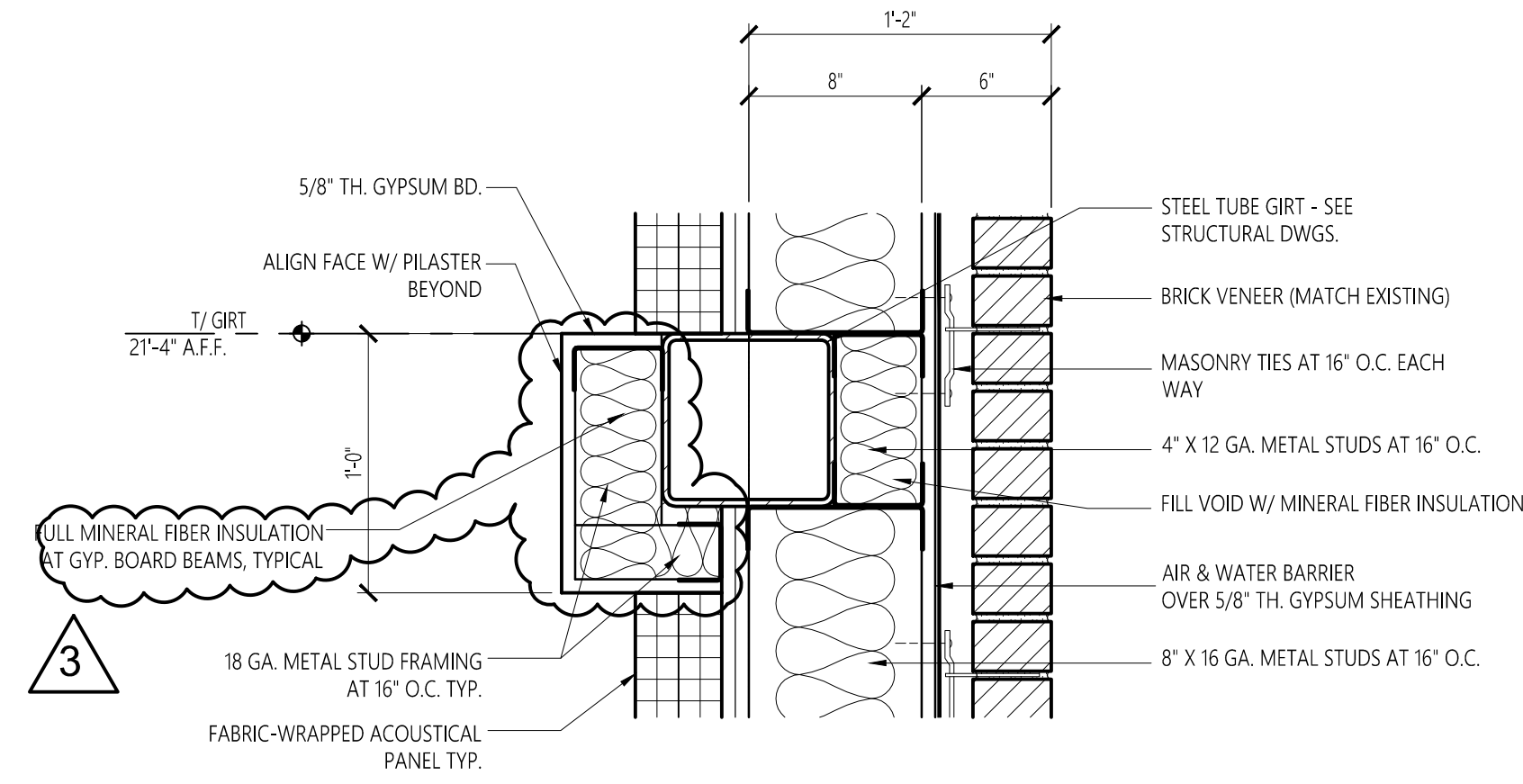
4 -NOT USED-
 SCALE: 1 1/2" = 1'-0"

5 SECTION DETAIL
 SCALE: 1 1/2" = 1'-0"

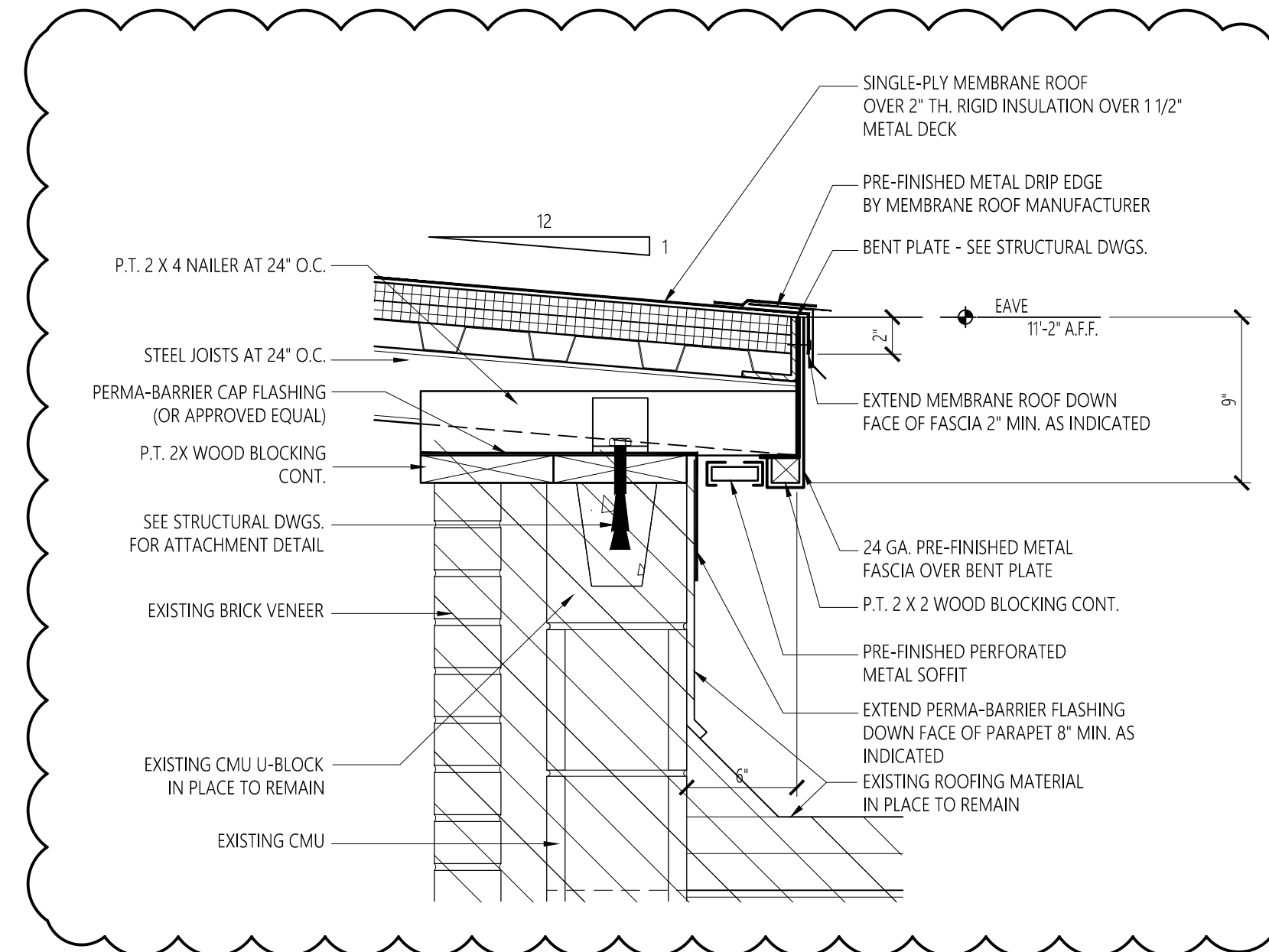


6 SECTION DETAIL
 SCALE: 1 1/2" = 1'-0"

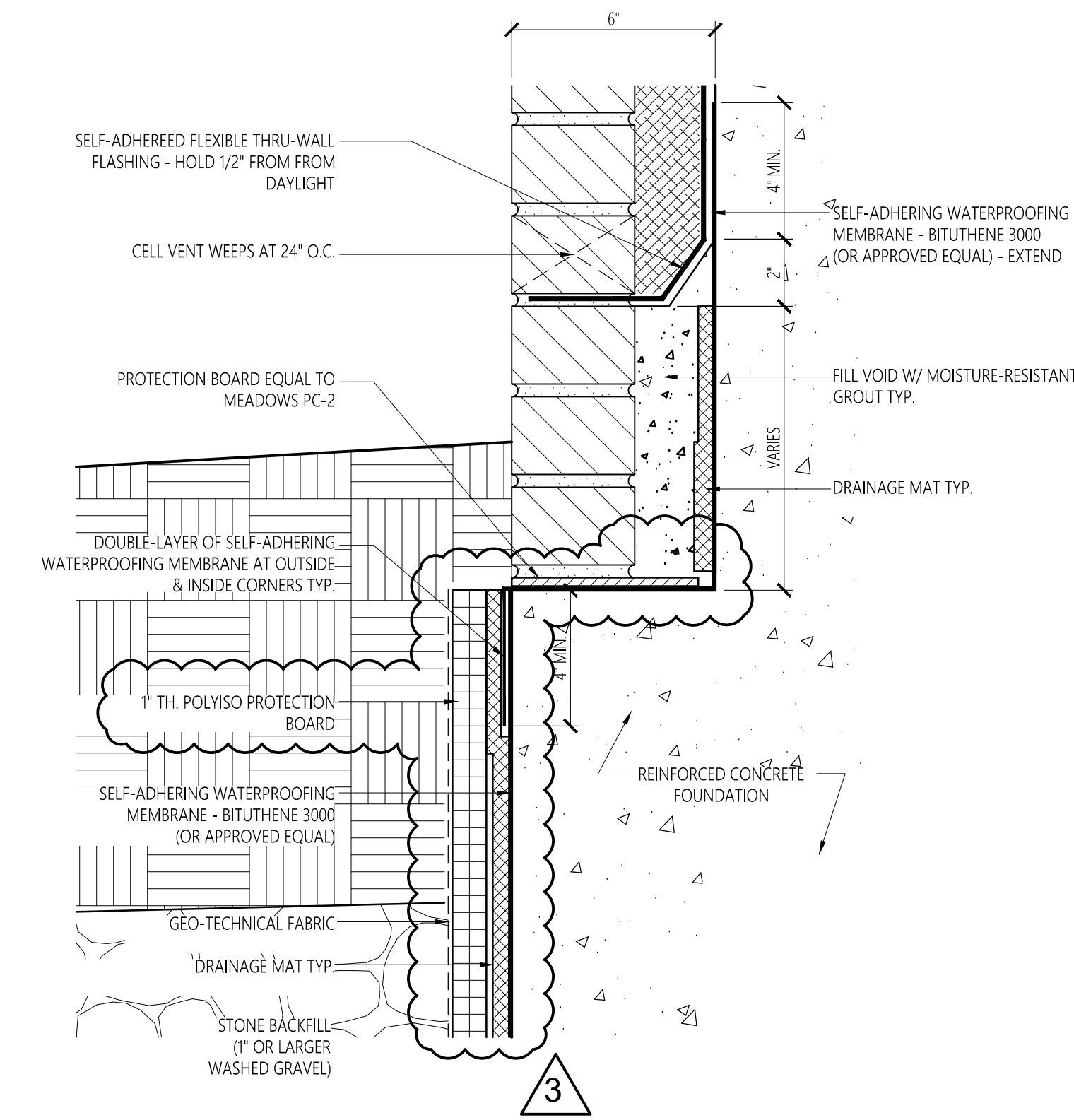
- GENERAL NOTES**
- ALL MORTARNET SHALL BE 10" TALL MINIMUM.
 - HOLD ALL THRU-WALL FLASHING FROM FACE OF BRICK/DAYLIGHT.
 - ALL THRU-WALL FLASHING SHALL EXTEND 8" MINIMUM ABOVE TOP OF MORTARNET.
 - PROVIDE ALL METAL THRU-WALL FLASHING W/ 2" MIN. EDGE DAMS



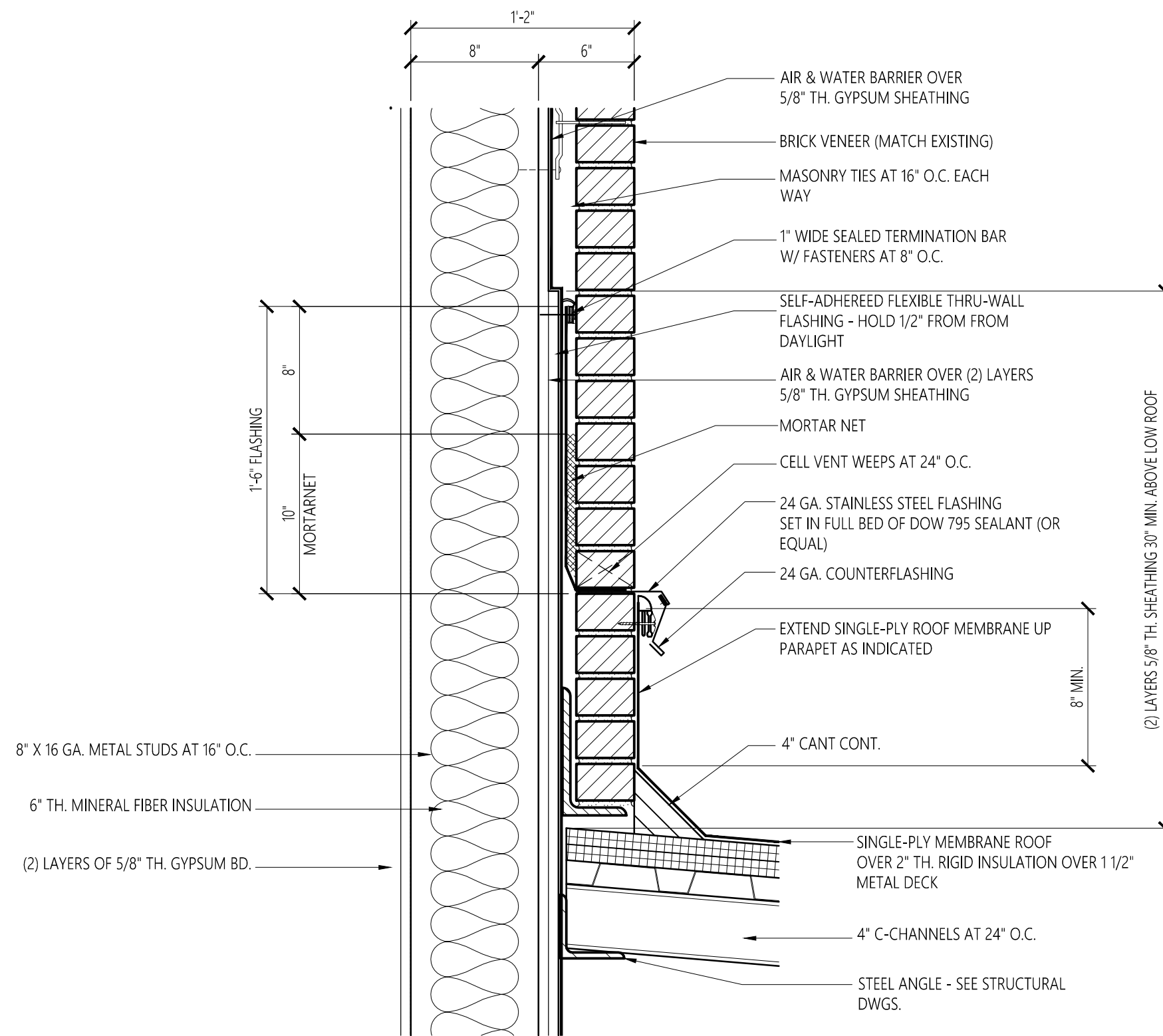
1 SECTION DETAIL
A5.7 SCALE: 1 1/2" = 1'-0"



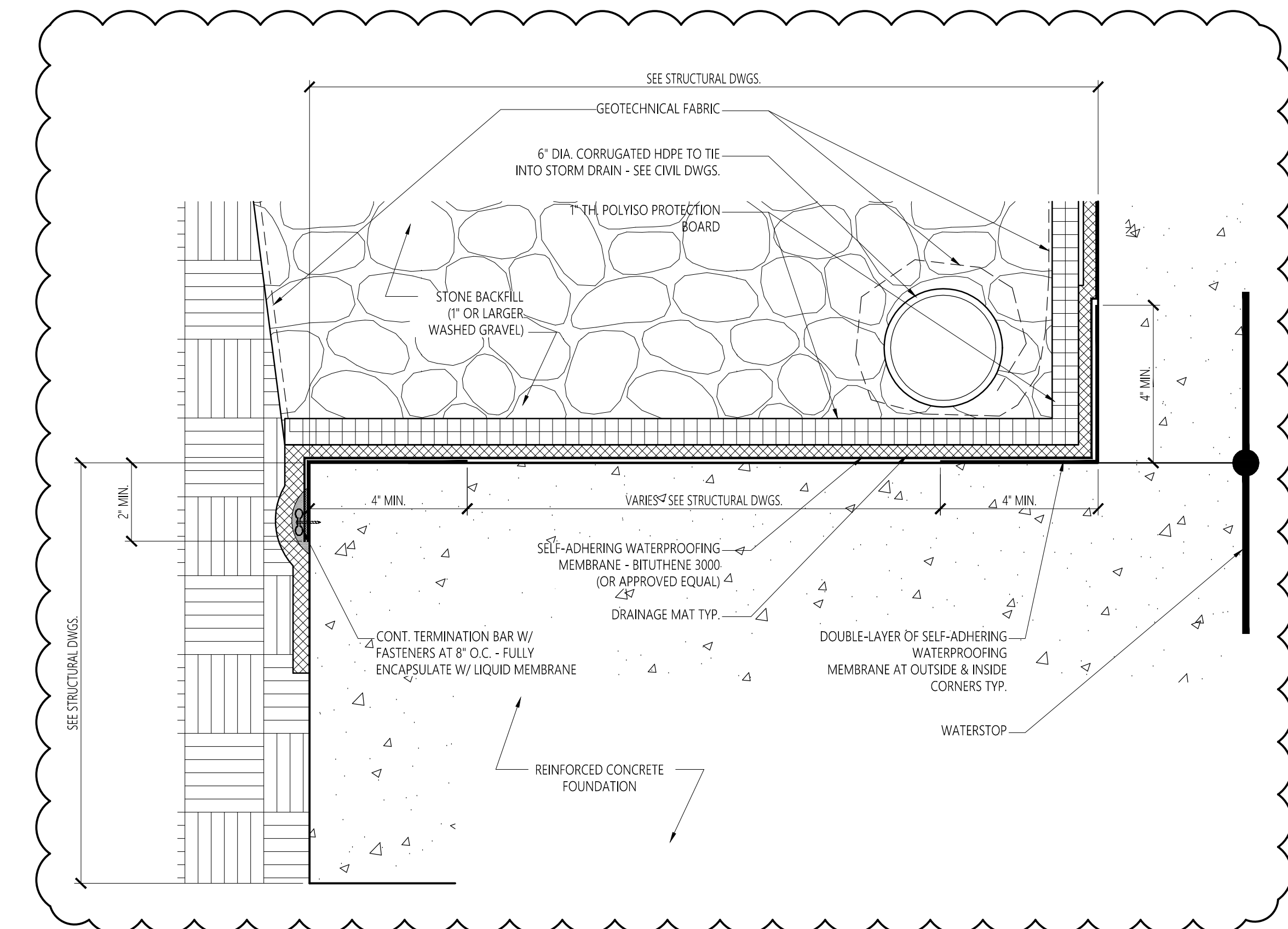
3 SECTION DETAIL
A5.7 SCALE: 1 1/2" = 1'-0"



4 TYPICAL BRICK LEDGE DETAIL
A5.7 SCALE: 3" = 1'-0"

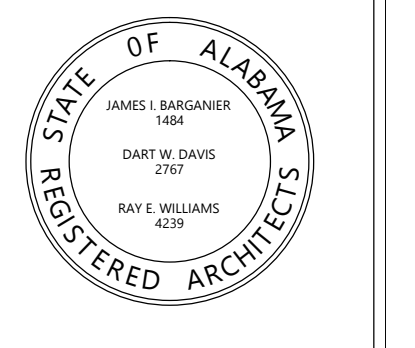


2 SECTION DETAIL
A5.7 SCALE: 1 1/2" = 1'-0"



5 TYPICAL FOUNDATION DETAIL
A5.7 SCALE: 3" = 1'-0"

No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
SECTION DETAILS

DRAWN BY:
-

CHECKED BY:
-

DATE:
6-14-2017

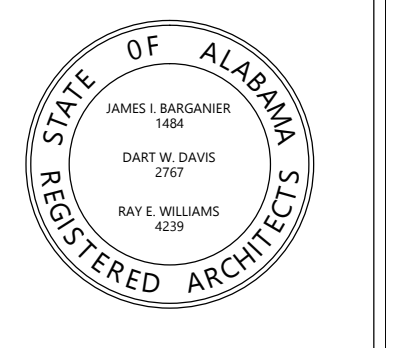
FILE NUMBER:
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PROJECT NUMBER:
16-111

SHEET NUMBER:

A5.7

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



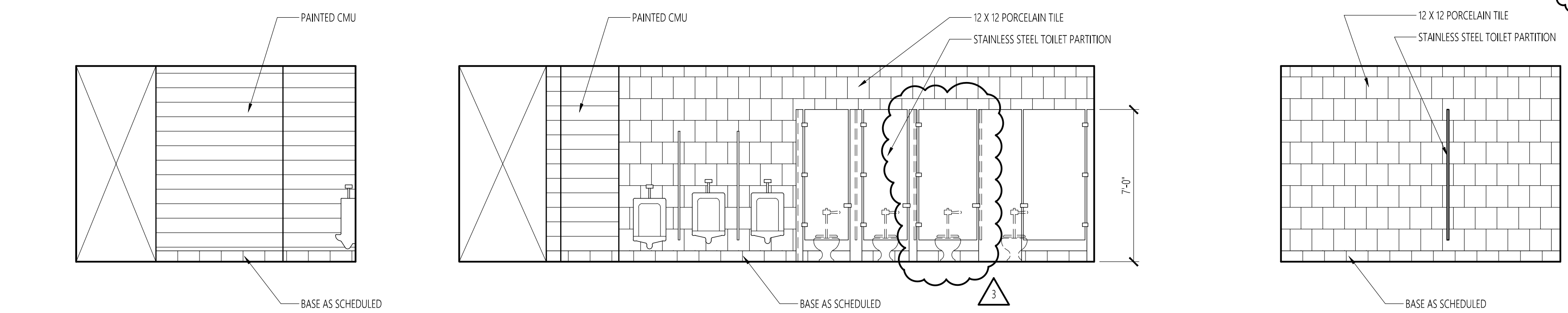
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

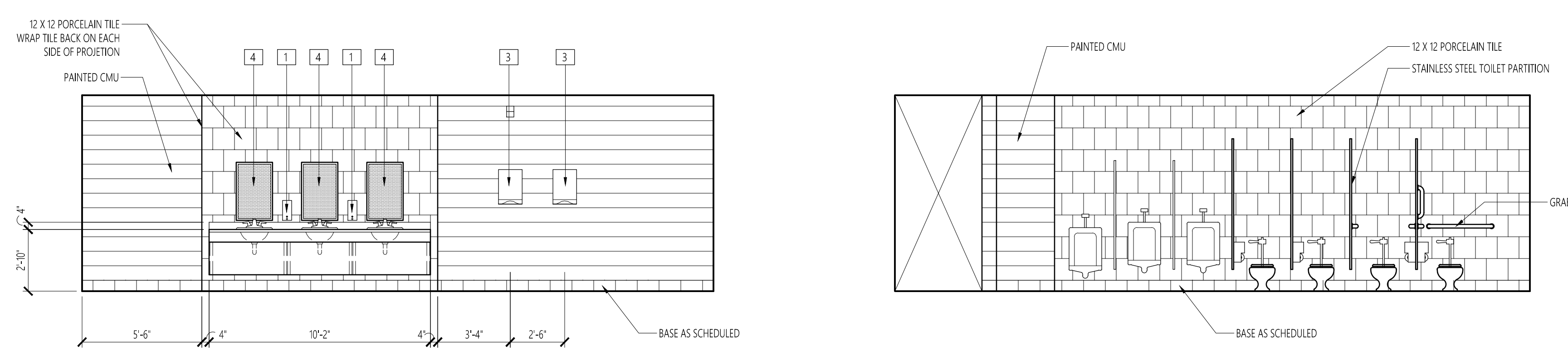
SHEET TITLE:
**ENLARGED TOILET
PLAN AND INTERIOR
ELEVATIONS**

DRAWN BY:
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CHECKED BY:
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DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

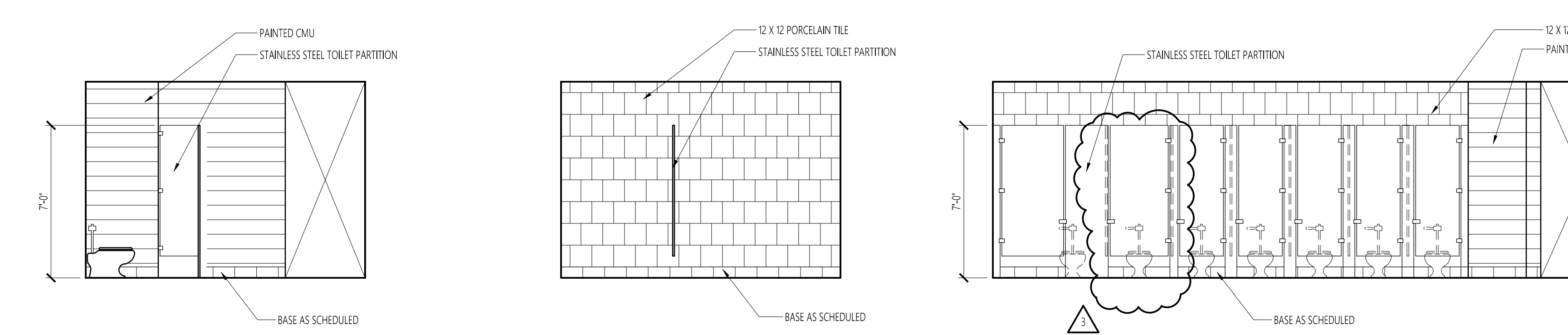
A6.1



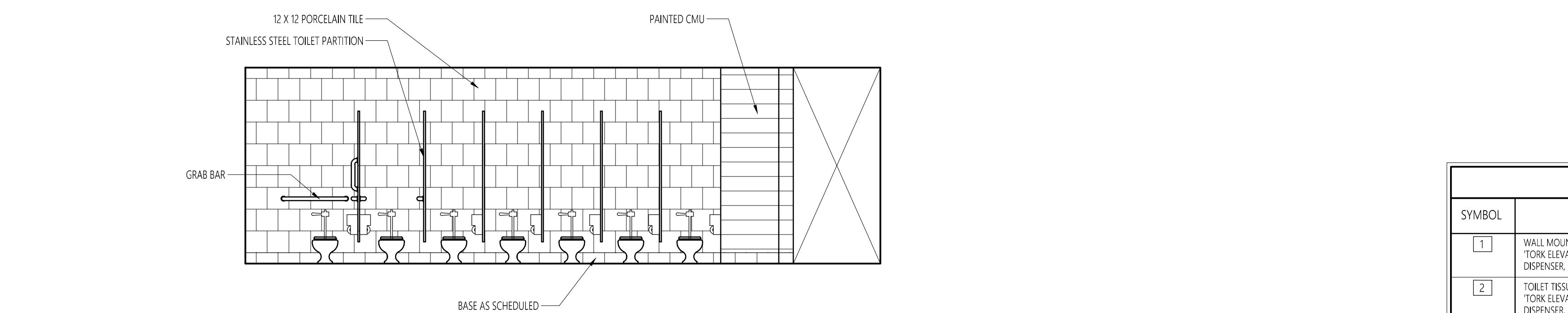
2 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"
3 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"
4 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"



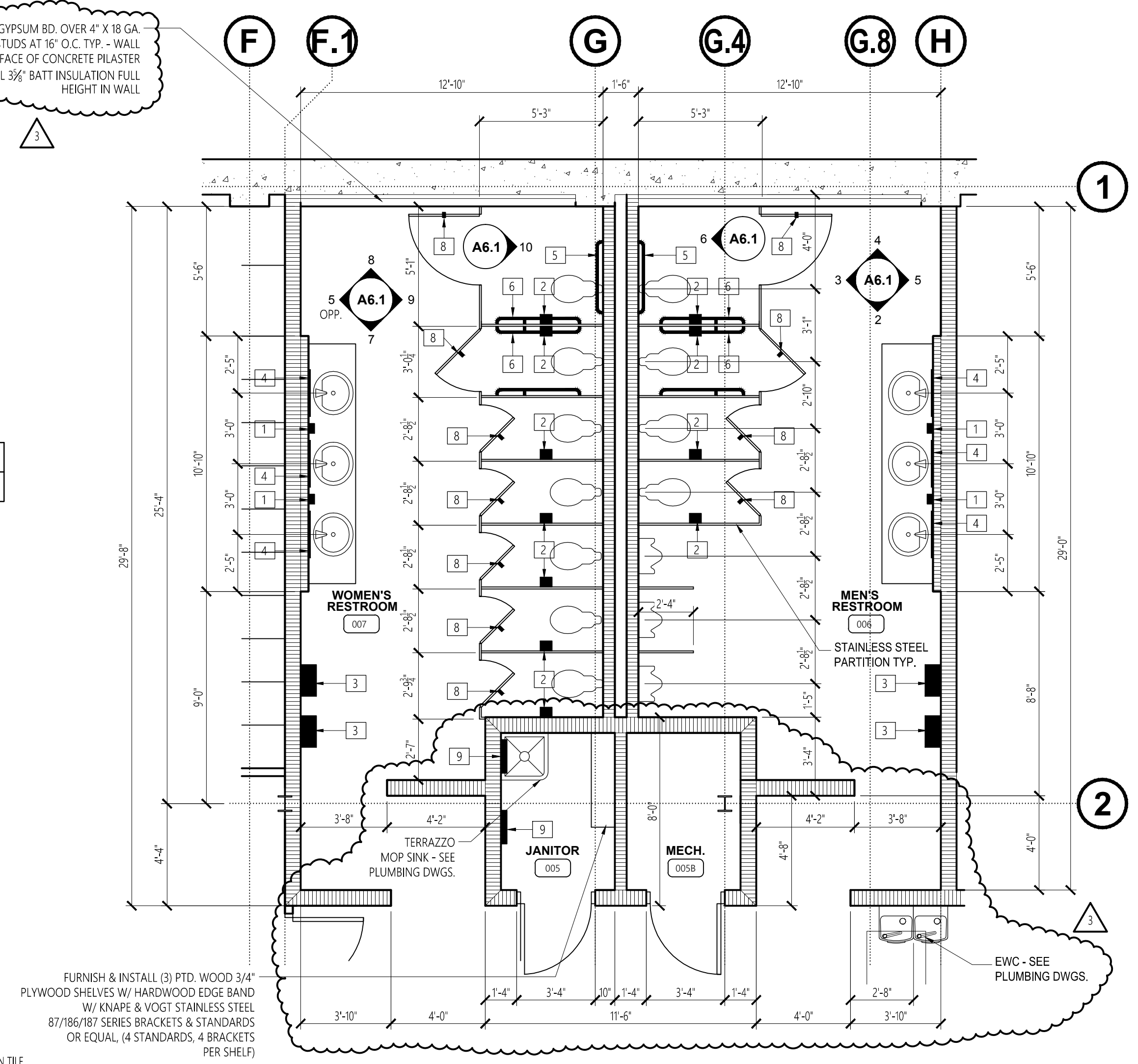
5 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"
6 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"



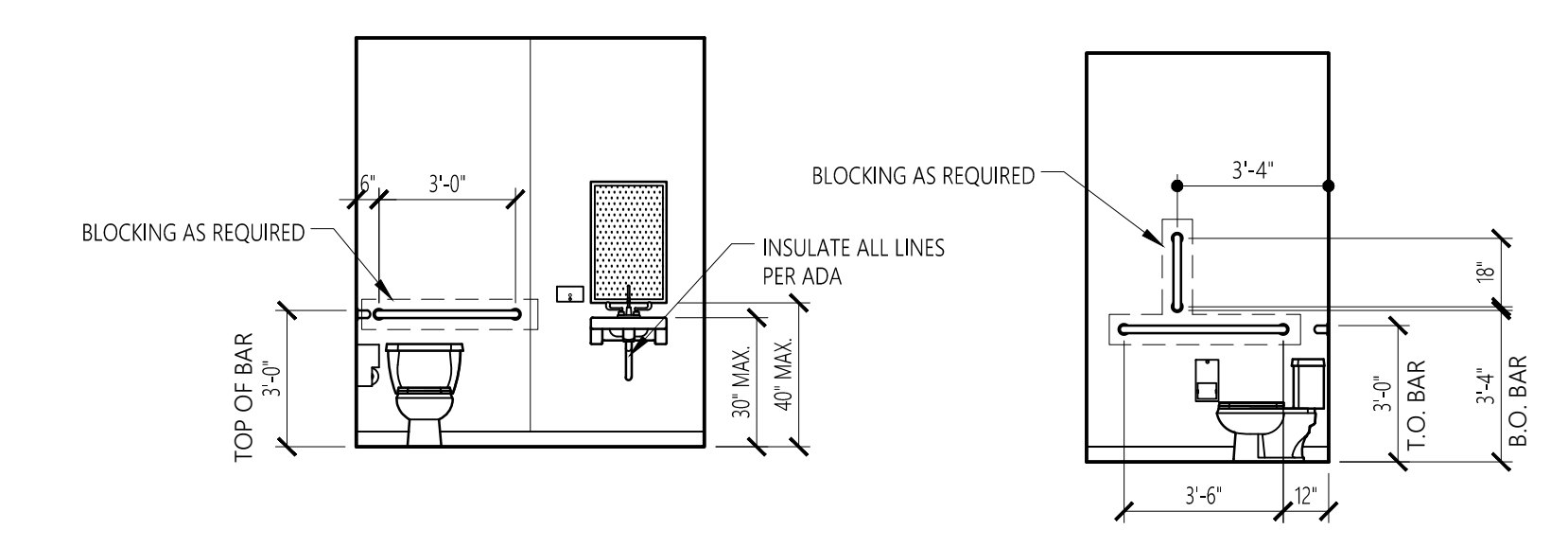
7 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"
8 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"
9 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"



10 INTERIOR ELEVATION SCALE: 1/4" = 1'-0"



1 ENLARGED TOILET PLAN SCALE: 1/4" = 1'-0"



11 TYPICAL GRAB BAR DETAIL SCALE: 1/4" = 1'-0"

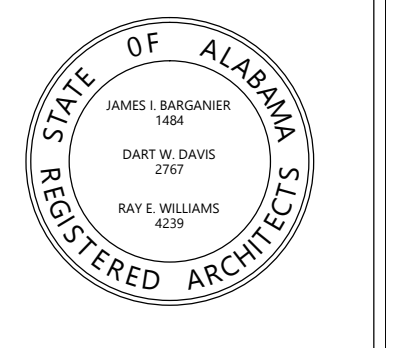
FURNISH & INSTALL (3) PTD. WOOD 3/4" PLYWOOD SHELVES W/ HARDWOOD EDGE BAND W/ KINAPE & VOGT STAINLESS STEEL 87/186/187 SERIES BRACKETS & STANDARDS OR EQUAL, (4 STANDARDS, 4 BRACKETS PER SHELF)

5/8" TH. GYPSUM BD. OVER 4" X 16 GA. METAL STUDS AT 16" O.C. TYP. - WALL FLUSH W/ FACE OF CONCRETE PILASTER. INSTALL 3/8" BATT INSULATION FULL HEIGHT IN WALL

SYMBOL	ACCESSORY	MOUNTING HEIGHT
1	WALL MOUNTED SOAP DISPENSER TORK ELEVATION 571608 AUTOMATIC FOAM DISPENSER, BLACK	40" TO DISPENSING MECHANISM
2	TOILET TISSUE DISPENSER TORK ELEVATION 5555290 TWIN TISSUE DISPENSER, BLACK	24" AFF TO SPINDLE - 36" MAX. FROM REAR WALL TO FURTHEST FACE
3	HAND TOWEL DISPENSER TORK ELEVATION 5510282 AUTOMATIC TOWEL DISPENSER, BLACK	40" TO DISPENSING MECHANISM
4	FRAMED PLATE GLASS MIRROR	40" TO BOTTOM OF REFLECTIVE SURFACE
5	GRAB BAR 36"	34" AFF TO CEN. OF BAR - SEE S/A6.0
6	GRAB BAR 42"	34" AFF TO CEN. OF BAR - SEE S/A6.0
7	18" VERTICAL GRAB BAR	40" AFF TO BOTTOM OF BAR - SEE S/A6.0
8	ROBE HOOK	66" AFF (48" H.C.) TO HOOK
9	MOP/BROOM HOLDER	72" AFF TO TOP OF HOLDER

- TOILET ACCESSORY NOTES**
- INDICATES TOILET ACCESSORY NUMBER - SEE THIS SHEET FOR TOILET ACCESSORY INDEX.
 - AS A GUIDELINE, MOUNT THE OPERATING FEATURE AND/OR RECEPTACLE OF THE ACCESSORY 40" A.F.F. ARCHITECT RETAINS FINAL APPROVAL.
 - OPERATING FEATURE SHALL NOT EXCEED 48" A.F.F.
 - MOUNT BOTTOM EDGE OF REFLECTIVE SURFACE ON ALL MIRRORS 40" A.F.F. MAX.
 - IN THE EVENT OF CONFLICT BETWEEN ADA REQUIREMENTS FOR ACCOMMODATION OF THE HANDICAPPED AND DIMENSIONS STATED HEREIN, ADA REQUIREMENTS SHALL GOVERN.
 - FURNISH & INSTALL ADEQUATE WOOD BLOCKING IN CMU WALLS AT ALL GRAB BAR LOCATIONS PER CODE, (250 LB.).
 - ALL TOILET ACCESSORIES TO BE BRUSHED STAINLESS STEEL FINISH UNLESS NOTED OTHERWISE.
 - FURNISH & INSTALL WOOD BLOCKING BEHIND ACCESSORIES.

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1	Addm. #2	7-13-17
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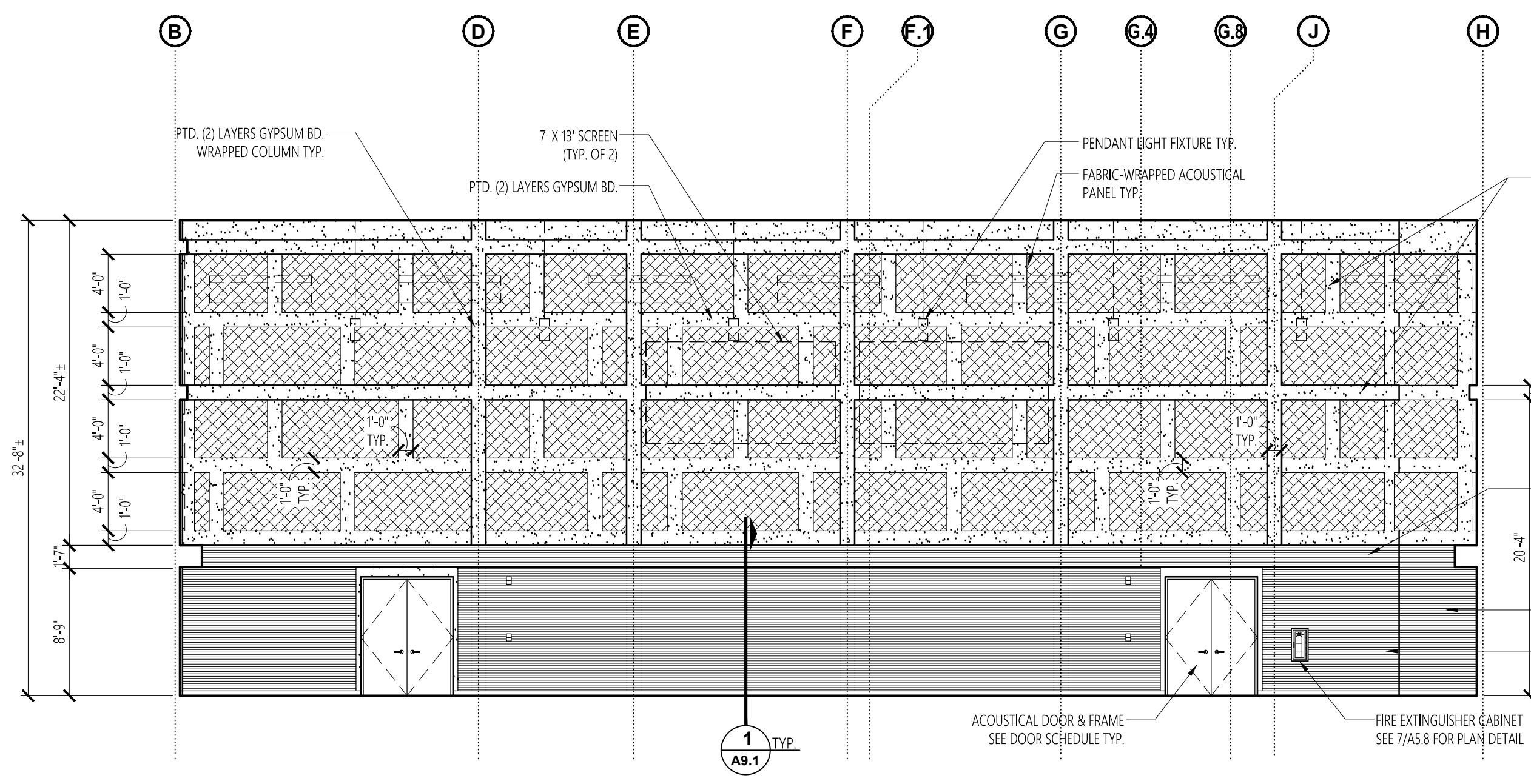
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

**SHEET TITLE:
REHEARSAL HALL
INTERIOR ELEVATIONS
(BASE BID)**

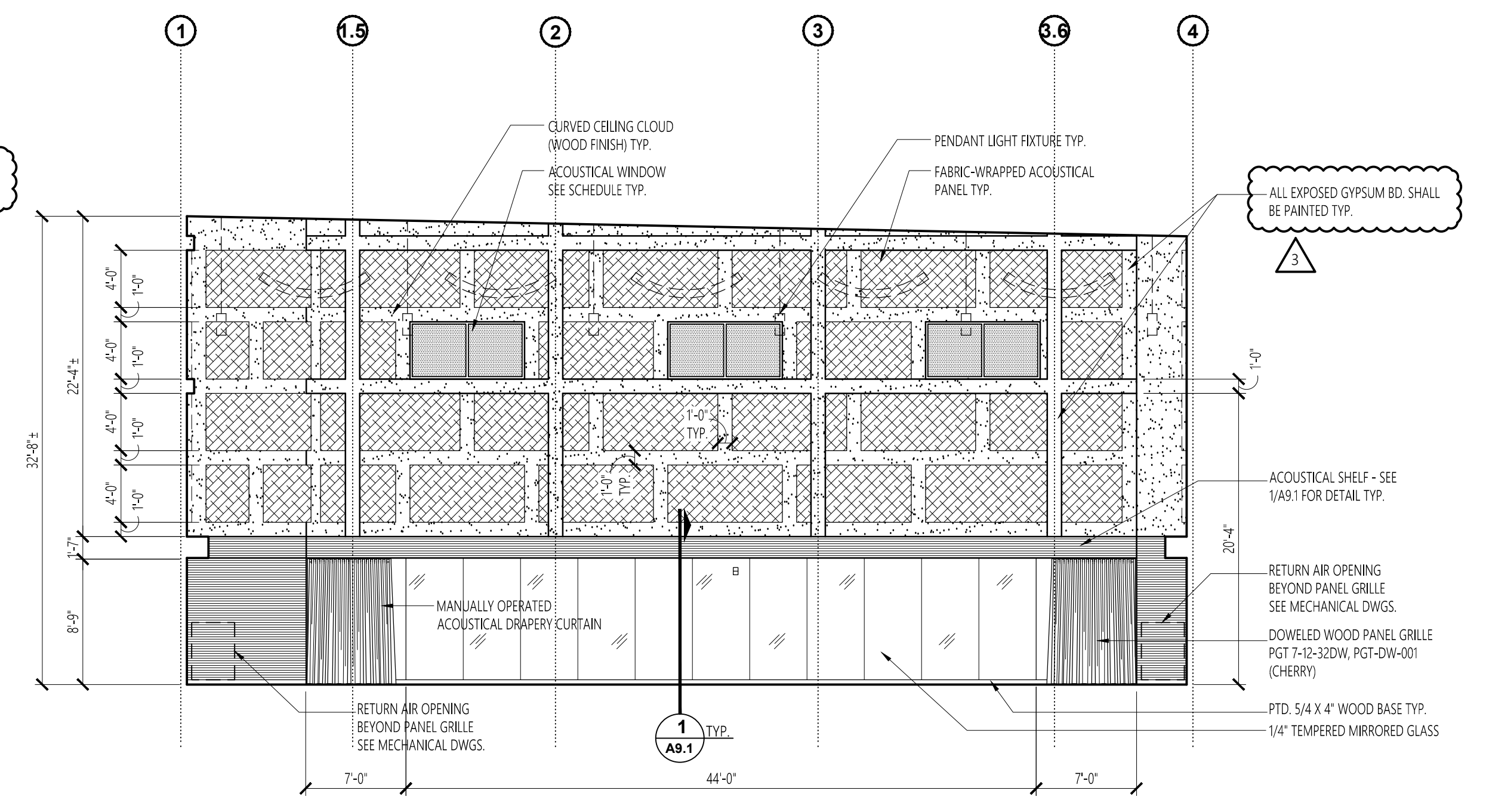
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DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A6.2



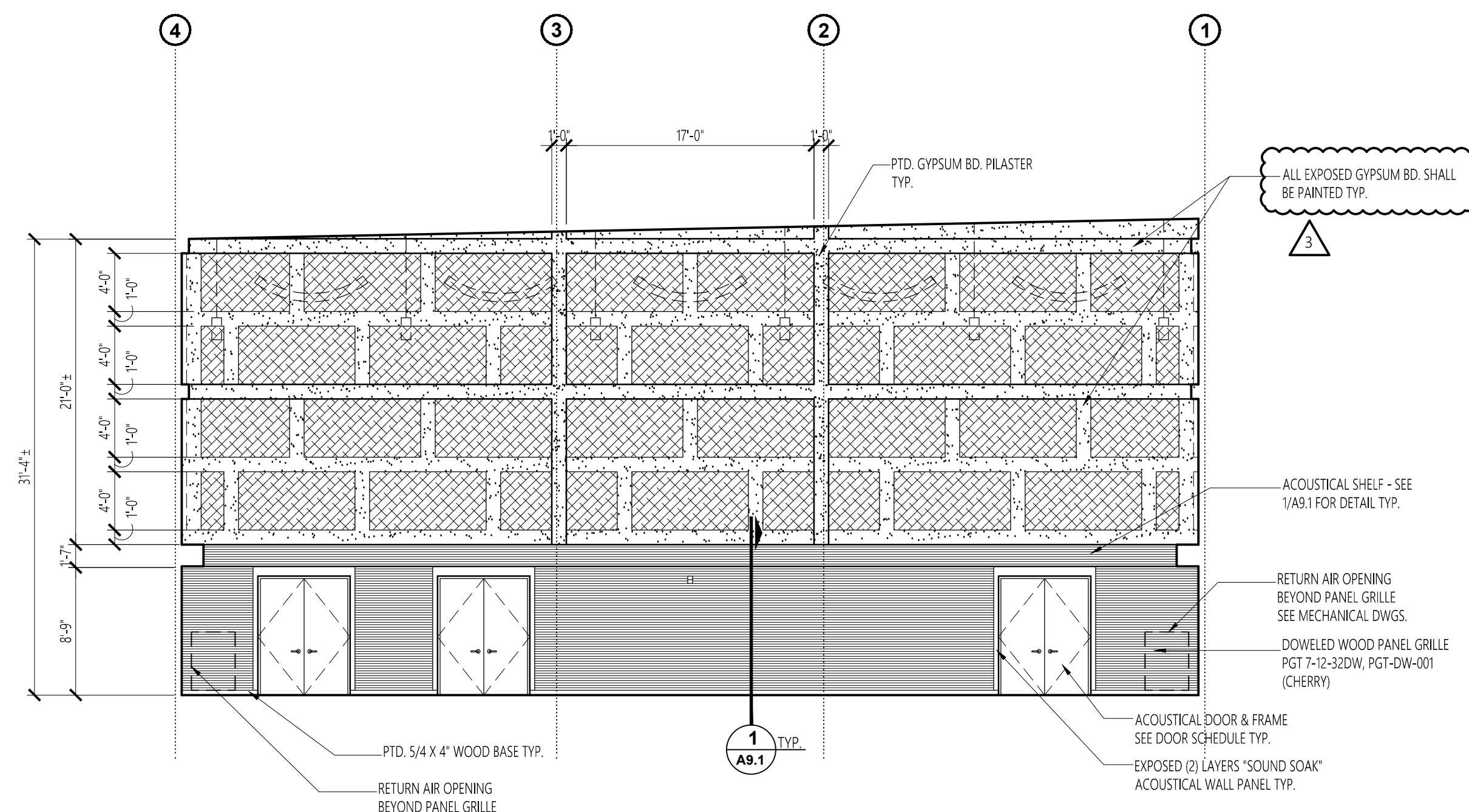
NOTE:
FURNISH & INSTALL (2) LAYERS "SOUND SOAK" ACOUSTICAL WALL PANEL (BLACK) BEHIND WOOD PANEL GRILLE LOCATIONS - SEE SECTION

1 WEST ELEVATION - REHEARSAL HALL (BASE BID)
A6.2 SCALE: 1/8" = 1'-0"



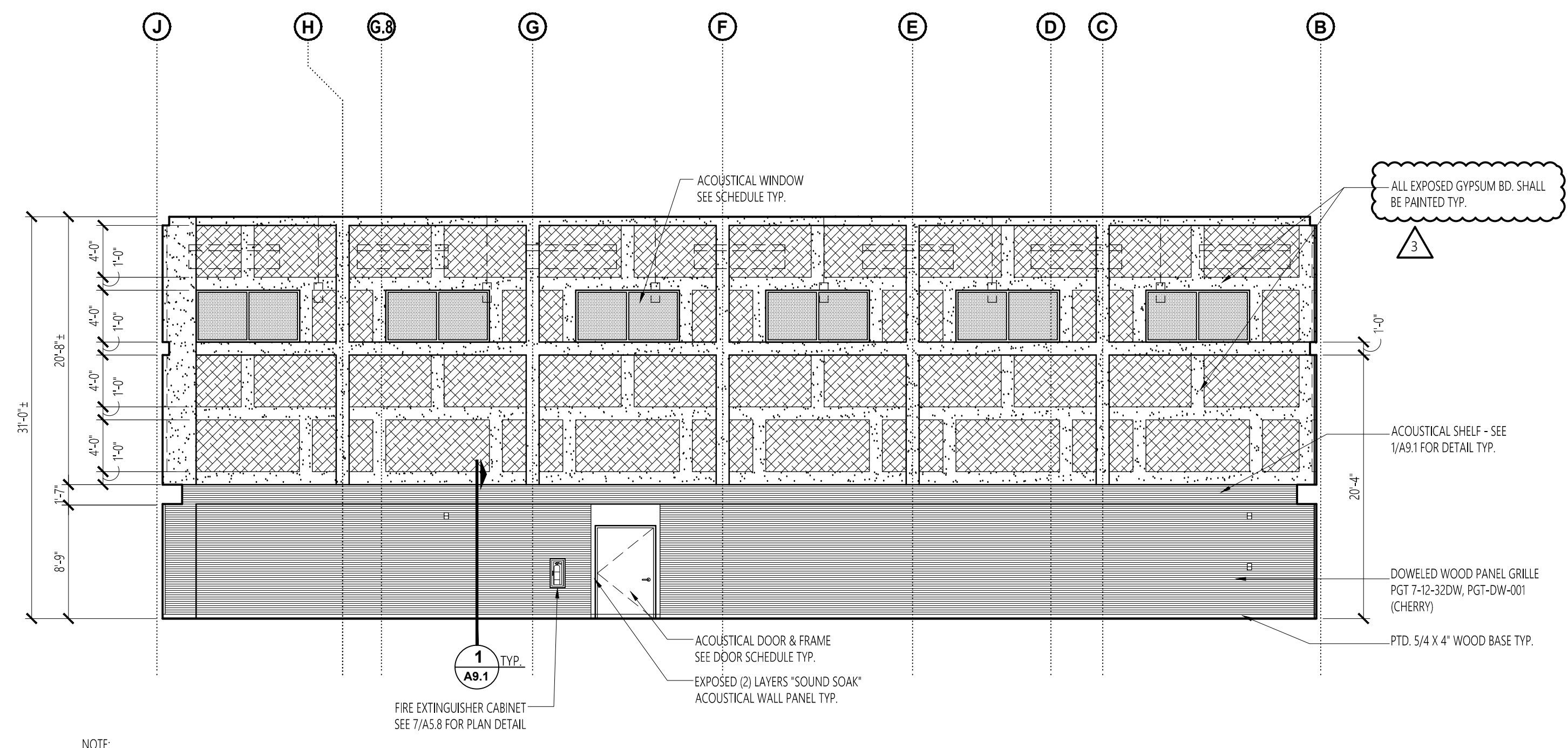
NOTE:
FURNISH & INSTALL (2) LAYERS "SOUND SOAK" ACOUSTICAL WALL PANEL (BLACK) BEHIND WOOD PANEL GRILLE LOCATIONS - SEE SECTION

2 NORTH ELEVATION - REHEARSAL HALL (BASE BID)
A6.2 SCALE: 1/8" = 1'-0"



NOTE:
FURNISH & INSTALL (2) LAYERS "SOUND SOAK" ACOUSTICAL WALL PANEL (BLACK) BEHIND WOOD PANEL GRILLE LOCATIONS - SEE SECTION

3 SOUTH ELEVATION - REHEARSAL HALL (BASE BID)
A6.2 SCALE: 1/8" = 1'-0"



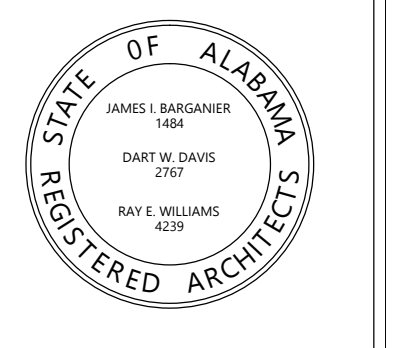
NOTE:
FURNISH & INSTALL (2) LAYERS "SOUND SOAK" ACOUSTICAL WALL PANEL (BLACK) BEHIND WOOD PANEL GRILLE LOCATIONS - SEE SECTION

4 EAST ELEVATION - REHEARSAL HALL (BASE BID)
A6.2 SCALE: 1/8" = 1'-0"

GENERAL NOTES

1. PROVIDE BLOCKOUTS IN WOOD PANEL GRILLE AT ALL RECEPTACLES. COORDINATE LOCATIONS W/ ELECTRICAL DRAWINGS.

No.	Revision	Date
1	△ Addm. #2	7-13-17
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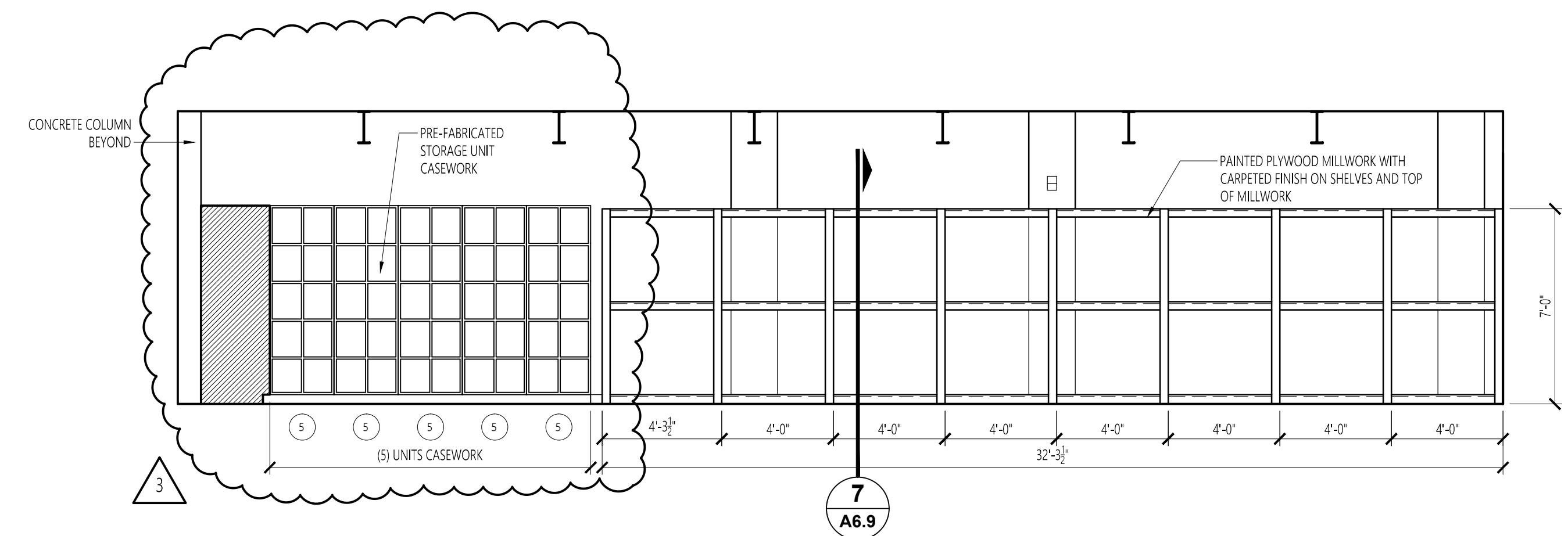
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
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Project Number 15-255

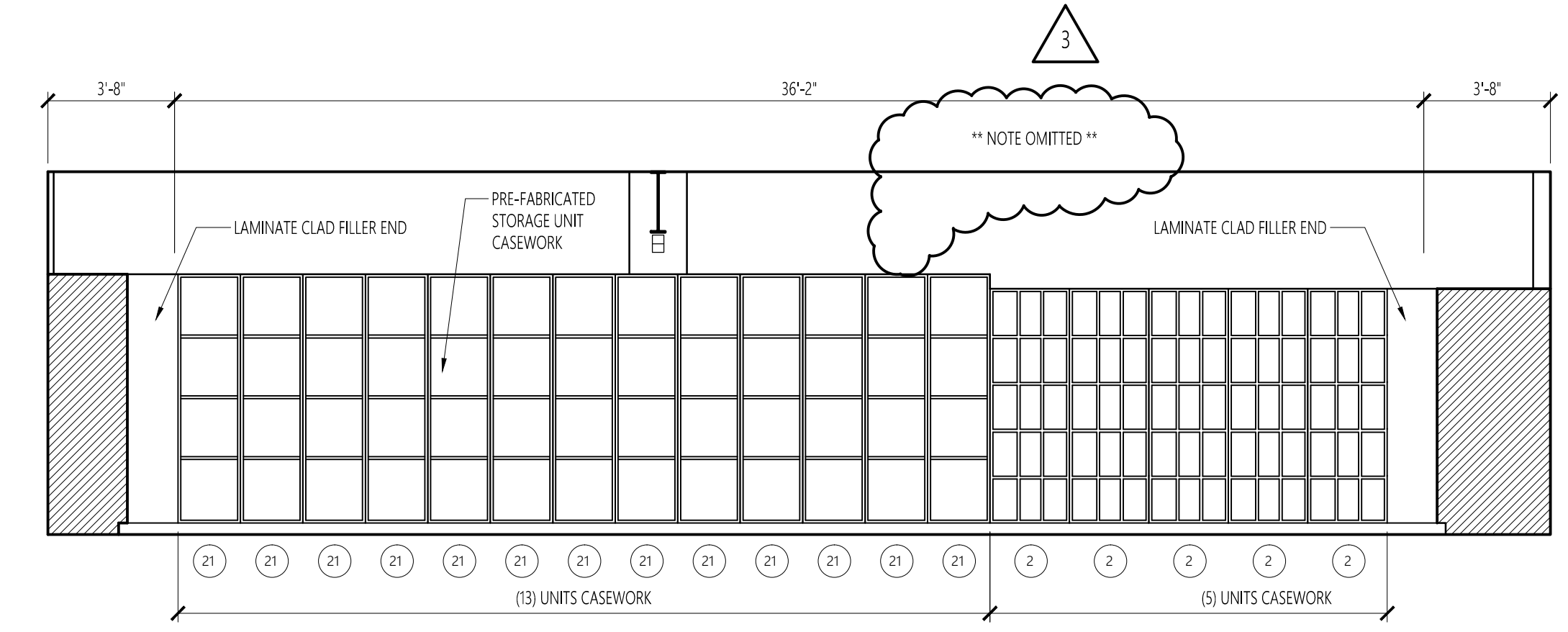
SHEET TITLE:
**INSTRUMENT STORAGE
INTERIOR ELEVATIONS**

DRAWN BY:
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CHECKED BY:
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DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

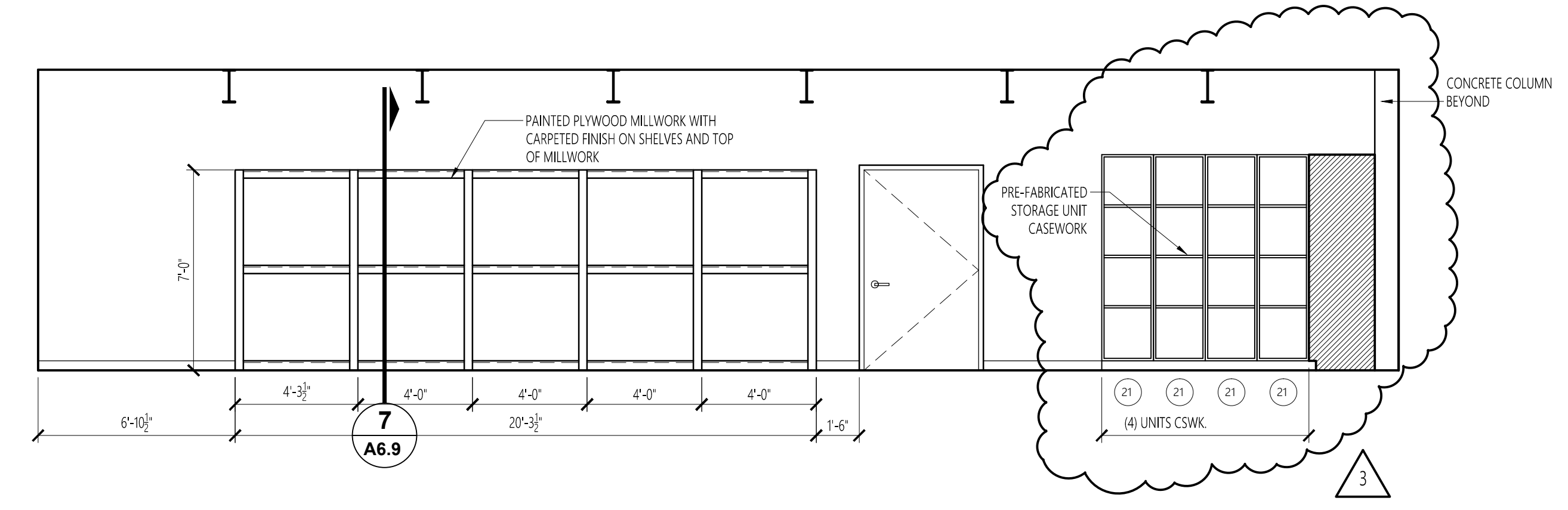
A6.4



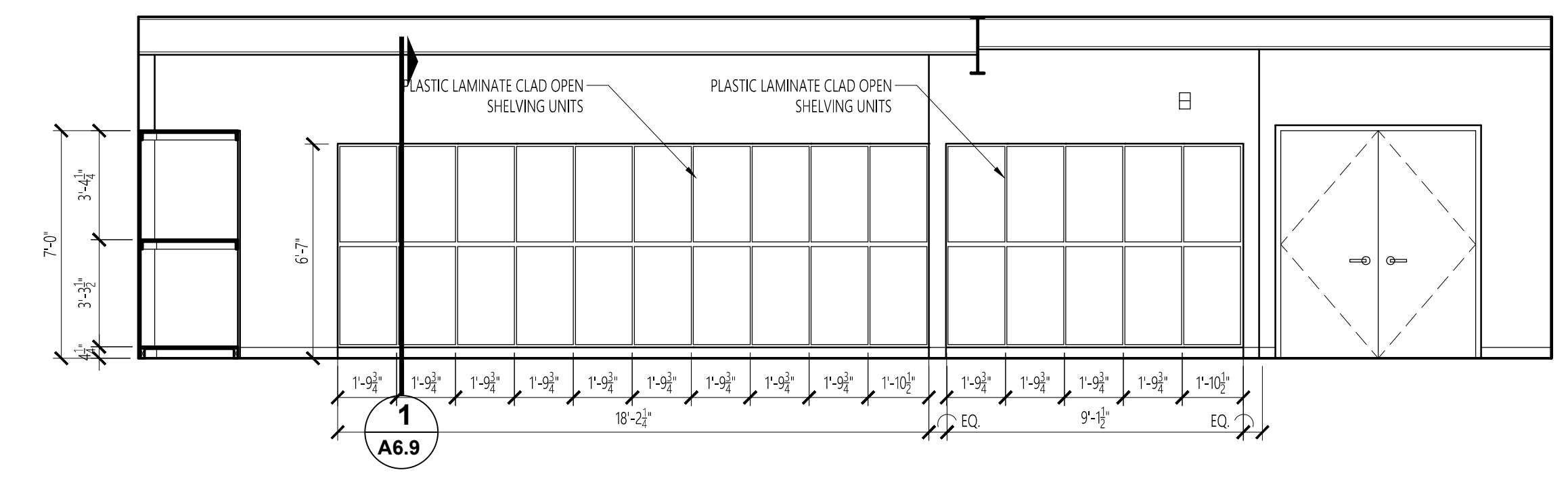
1 WEST ELEVATION - STORAGE 008
A6.4 SCALE: 1/4" = 1'-0"



2 SOUTH ELEVATION - STORAGE 008
A6.4 SCALE: 1/4" = 1'-0"

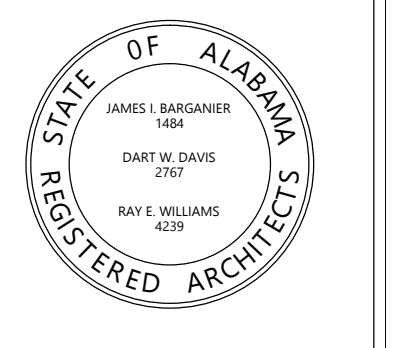


3 EAST ELEVATION - STORAGE 008
A6.4 SCALE: 1/4" = 1'-0"



4 NORTH ELEVATION - STORAGE 008
A6.4 SCALE: 1/4" = 1'-0"

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



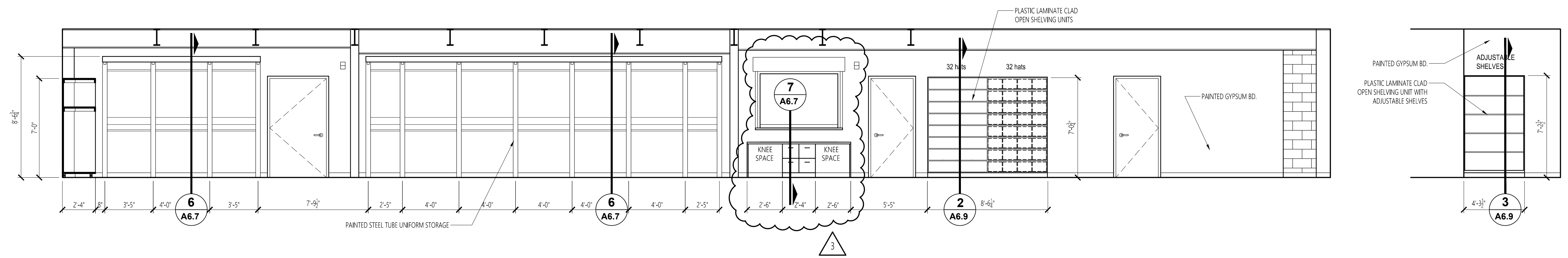
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
**UNIFORM STORAGE
INTERIOR ELEVATIONS**

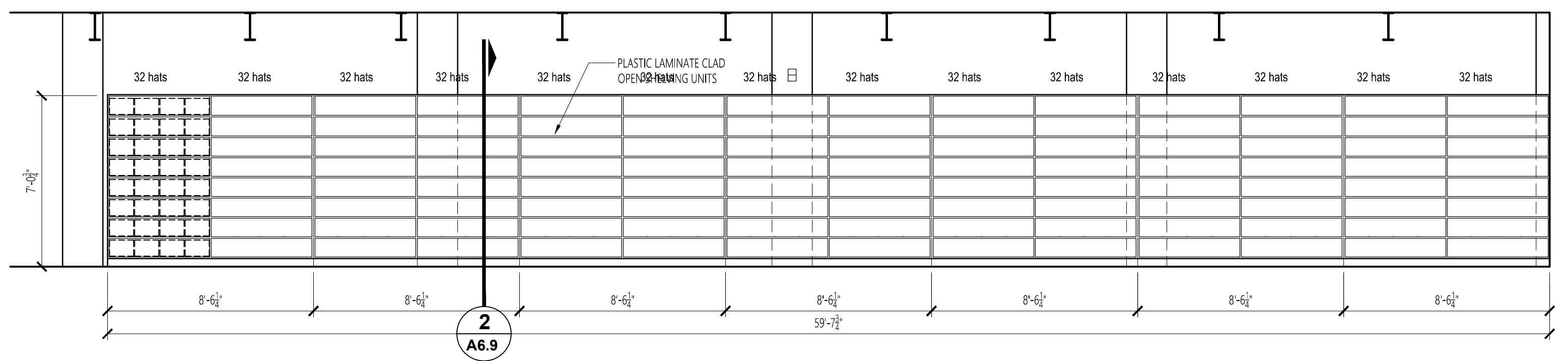
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CHECKED BY:
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DATE:
6-14-2017
FILE NUMBER:
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PROJECT NUMBER:
16-111
SHEET NUMBER:

A6.5

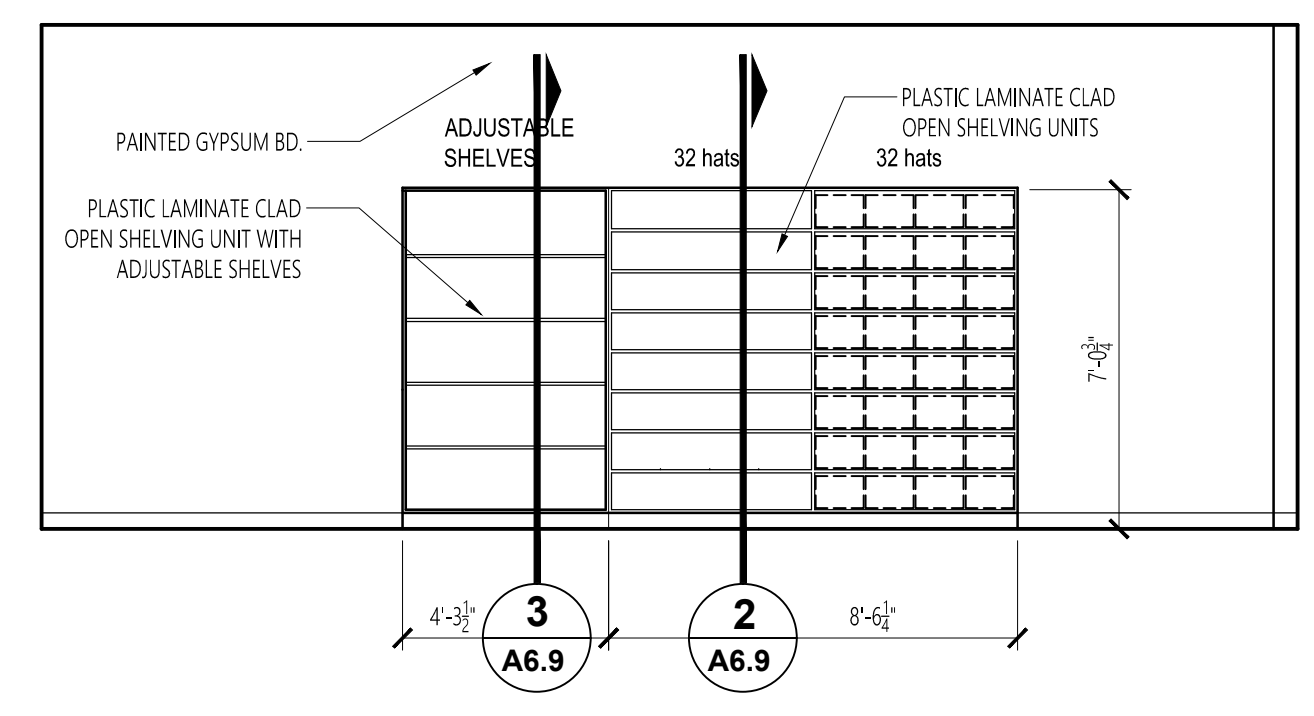


1 WEST ELEVATION - STORAGE 009
A6.5 SCALE: 1/4" = 1'-0"

2 NORTH ELEVATION - STORAGE 009 BASE BID
A6.5 SCALE: 1/4" = 1'-0"

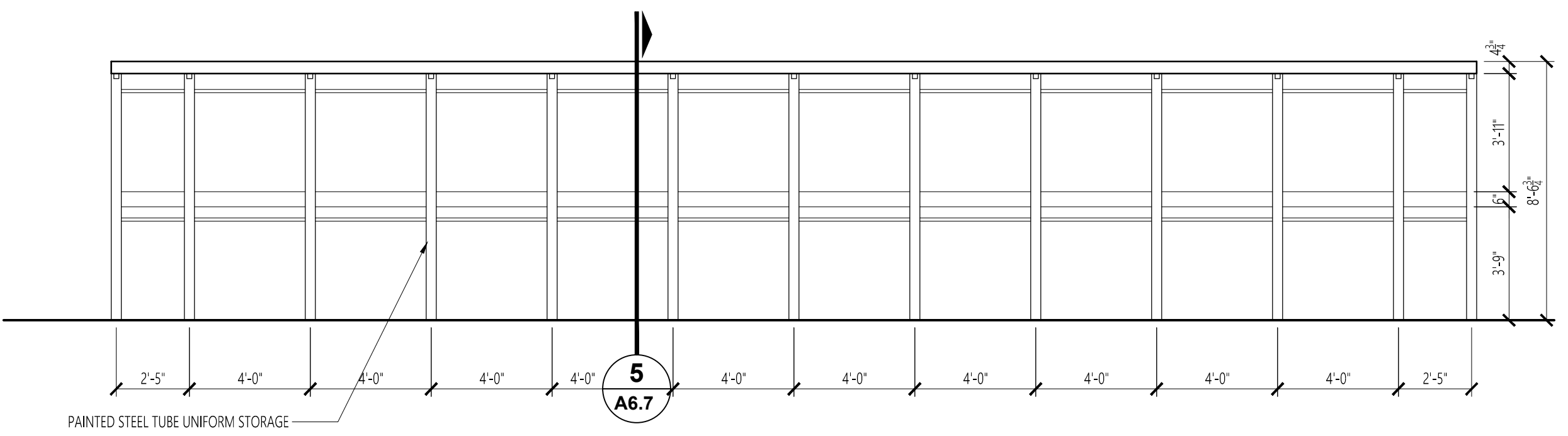


3 EAST ELEVATION - STORAGE 009
A6.5 SCALE: 1/4" = 1'-0"

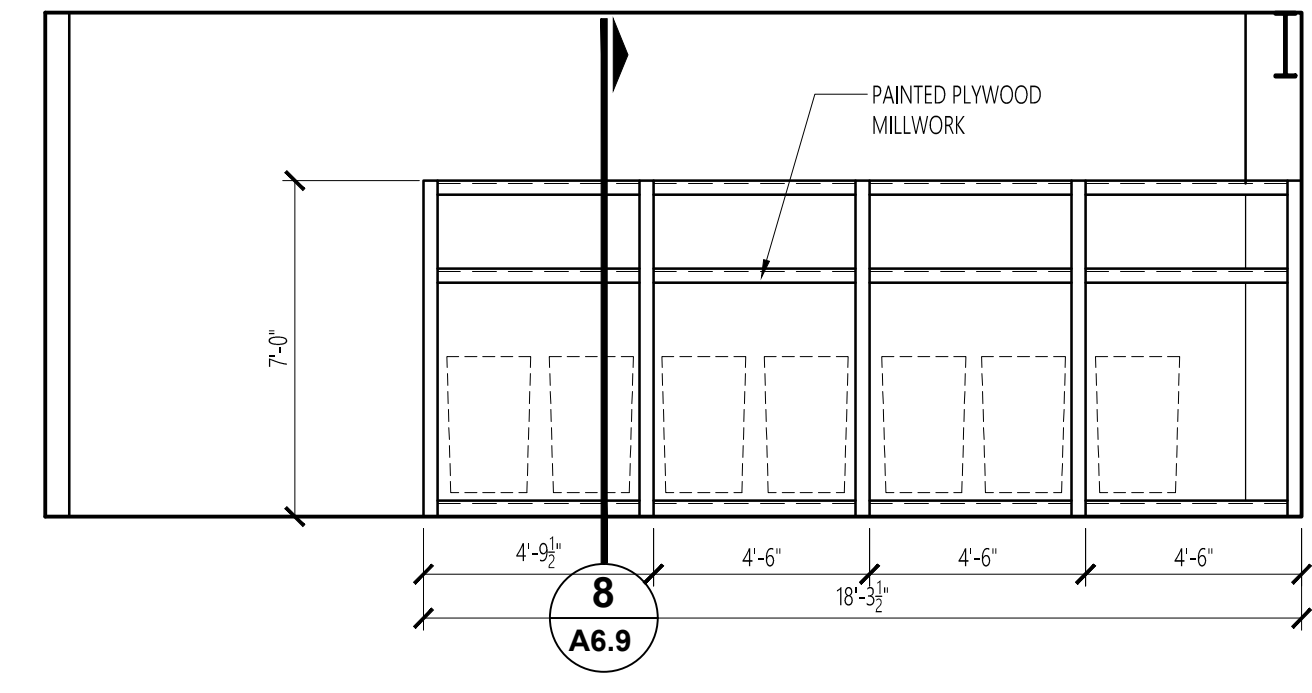


4 NORTH ELEVATION - STORAGE 009 ALTERNATE
A6.5 SCALE: 1/4" = 1'-0"

NOTE:
THIS IS NOT NEW CASEWORK AS PART OF THIS ALTERNATE.
THIS CASEWORK SHIFTED TO THIS WALL IF ALTERNATE IS ACCEPTED.

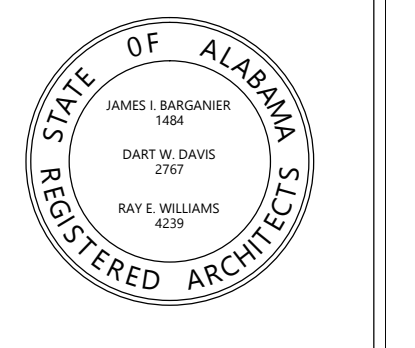


5 CENTER RACK ELEVATION - STORAGE 009
A6.5 SCALE: 1/4" = 1'-0"



6 SOUTH ELEVATION - STORAGE 009
A6.5 SCALE: 1/4" = 1'-0"

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



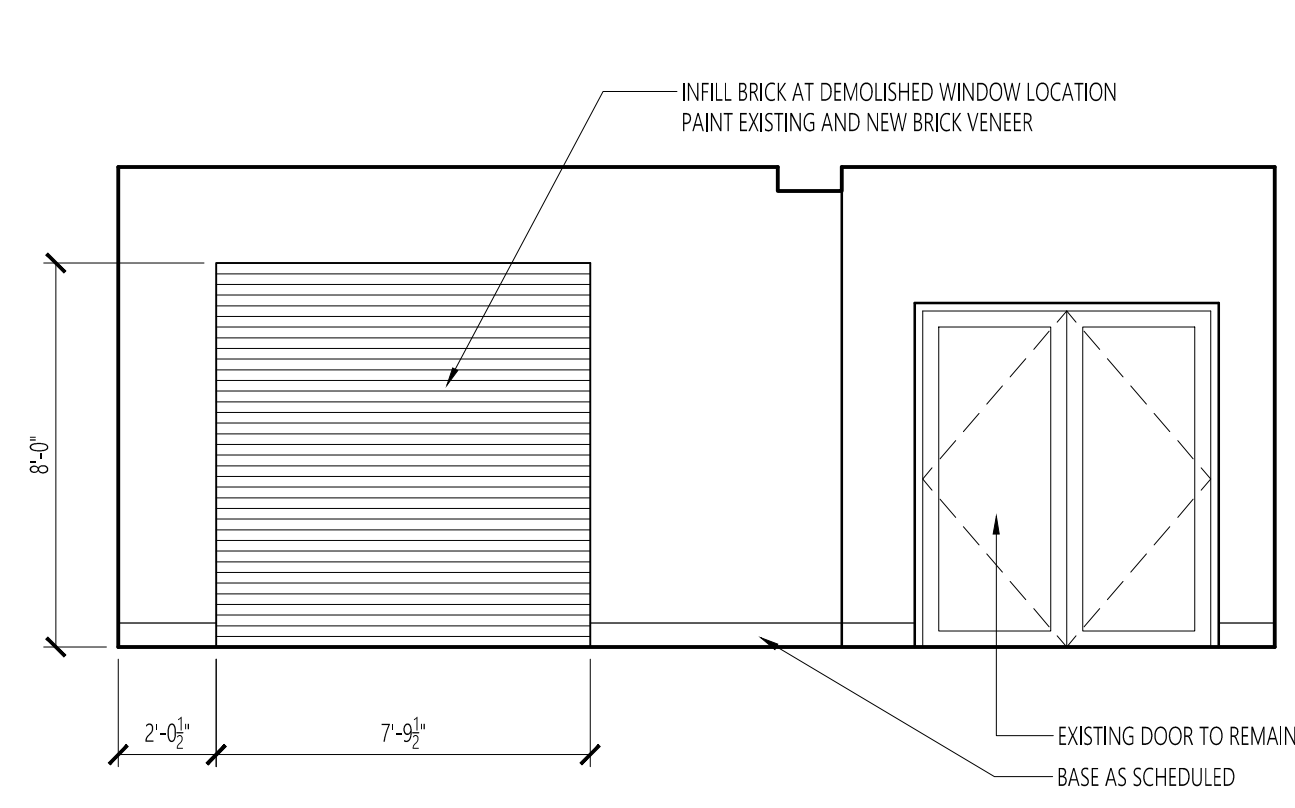
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

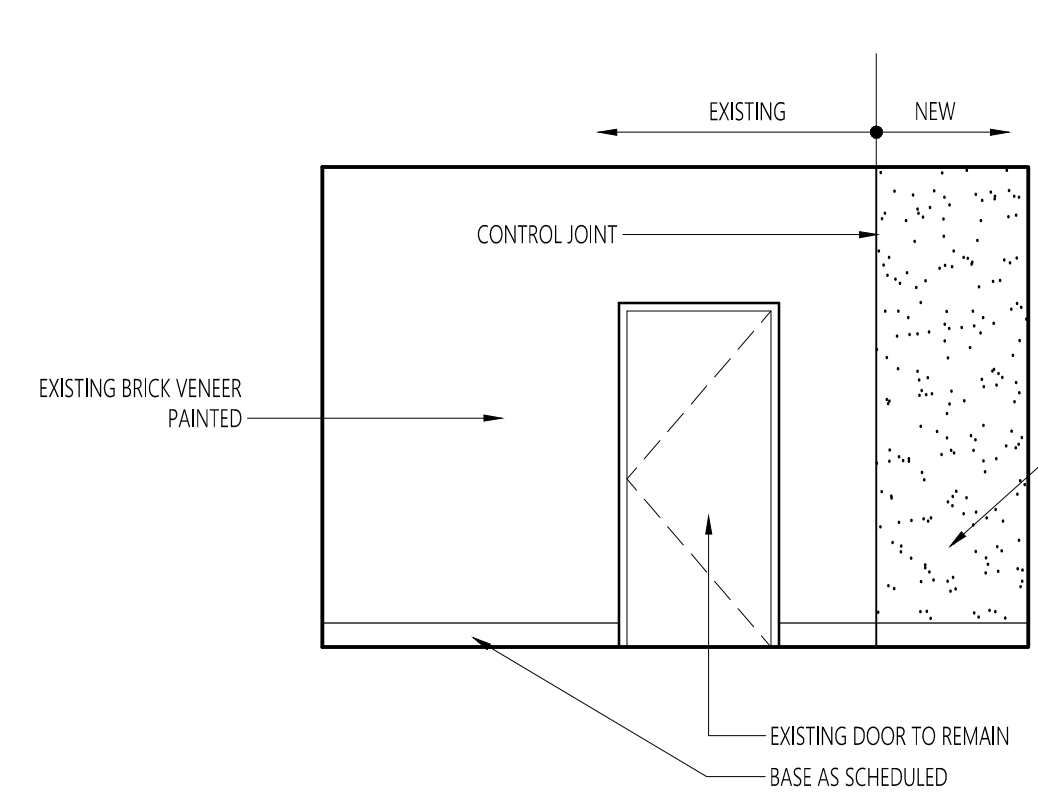
SHEET TITLE:
INTERIOR ELEVATIONS

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

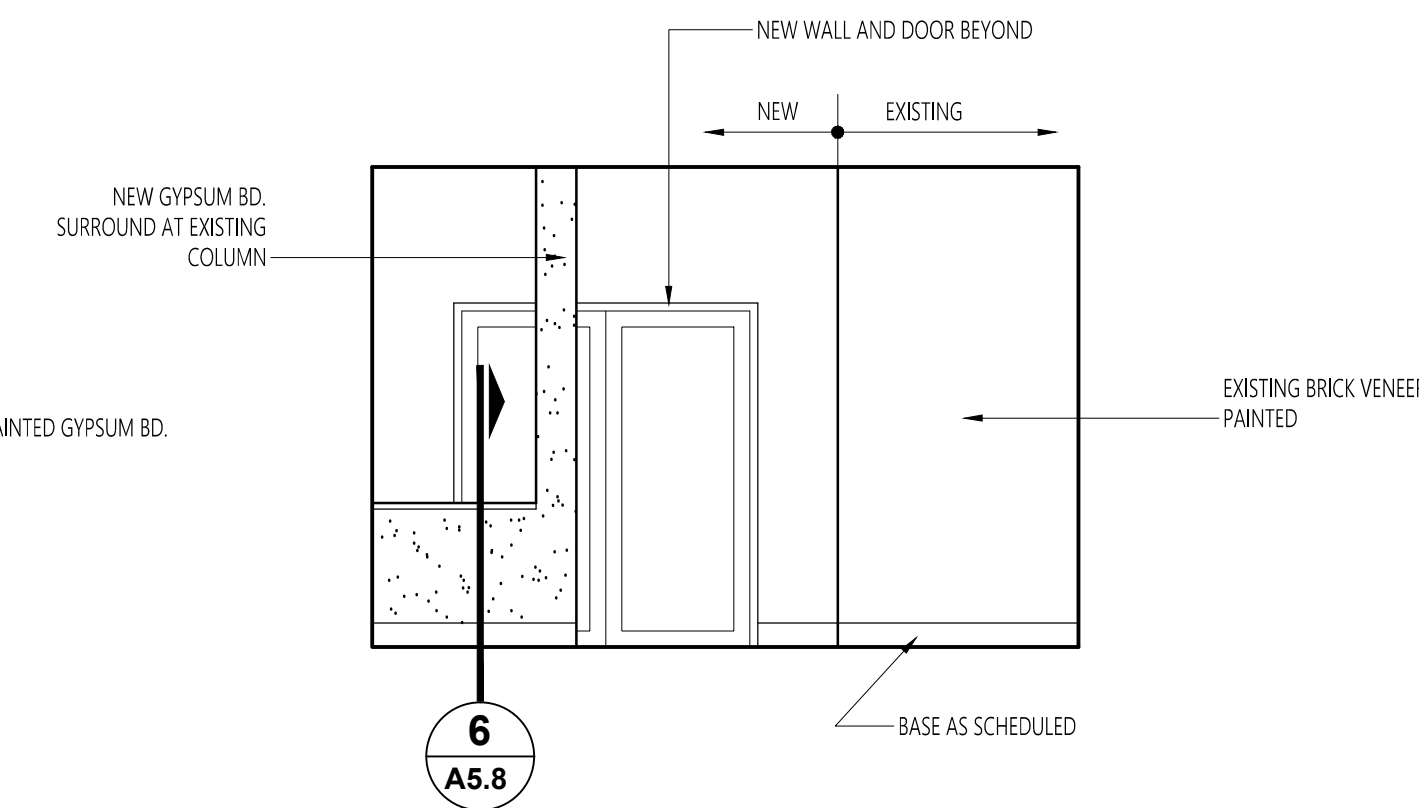
A6.7



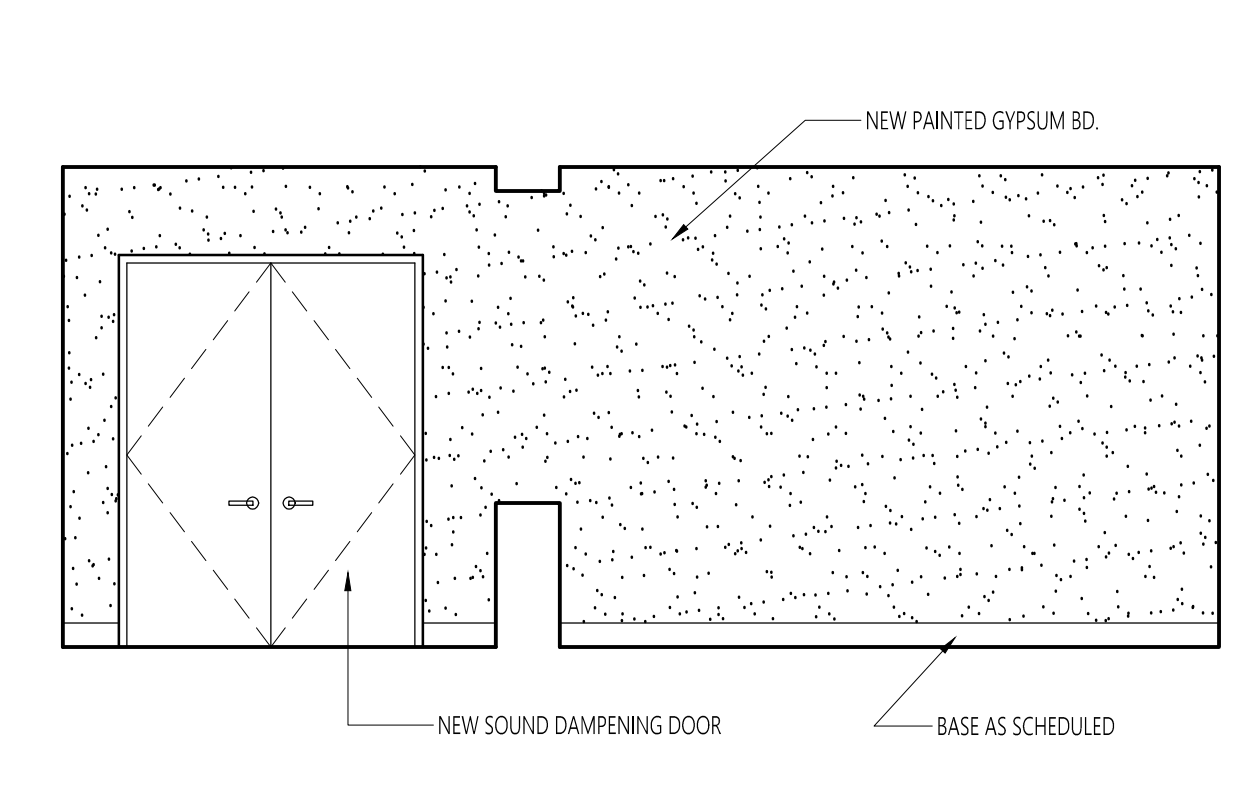
1 WEST ELEVATION - CORRIDOR 103
A6.7 SCALE: 1/4" = 1'-0"



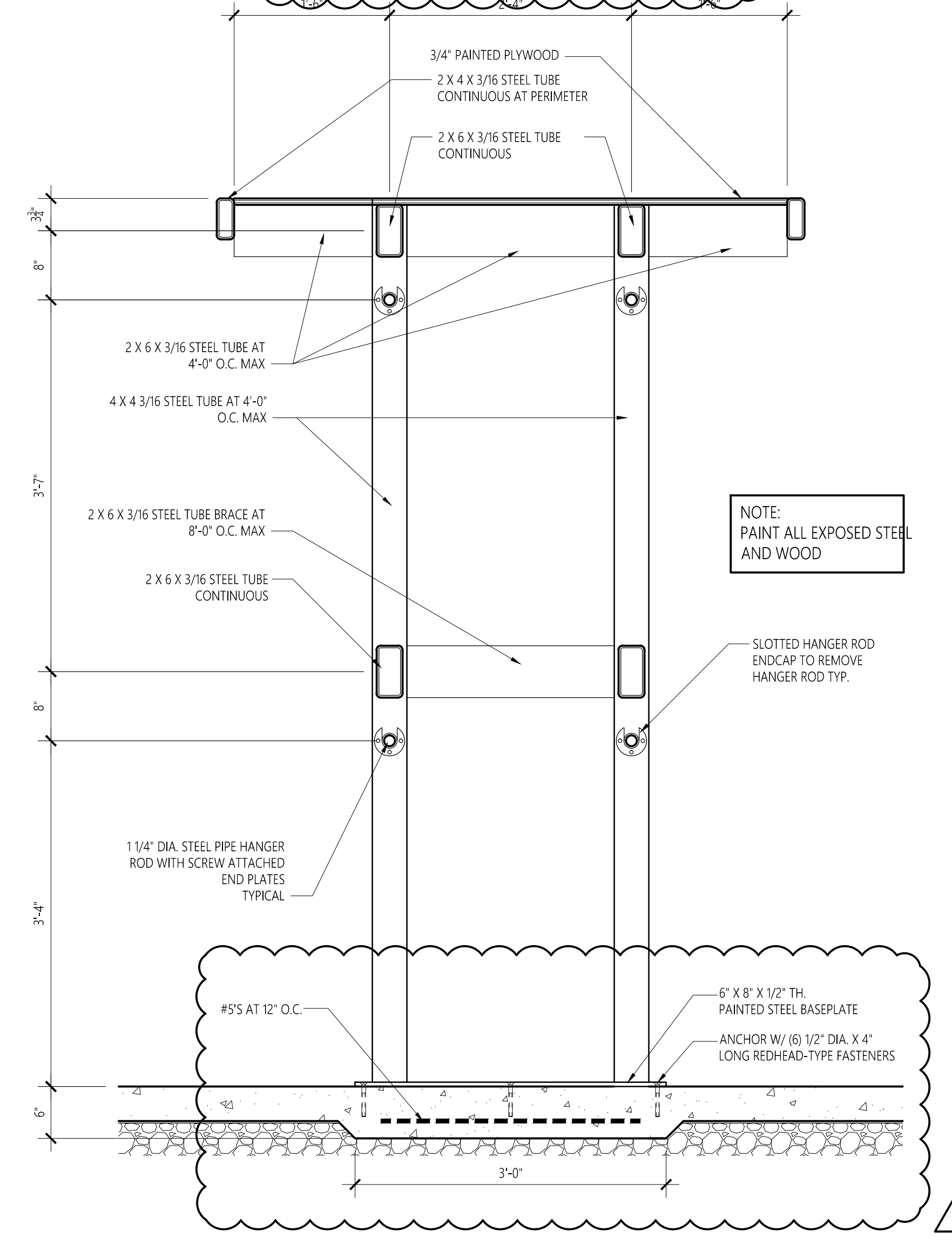
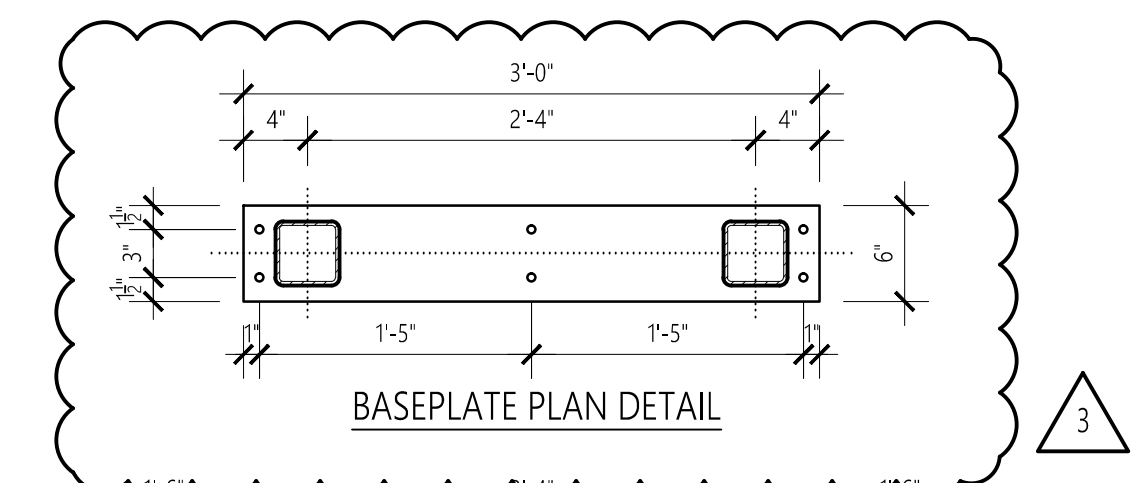
2 NORTH ELEVATION - CORRIDOR 103
A6.7 SCALE: 1/4" = 1'-0"



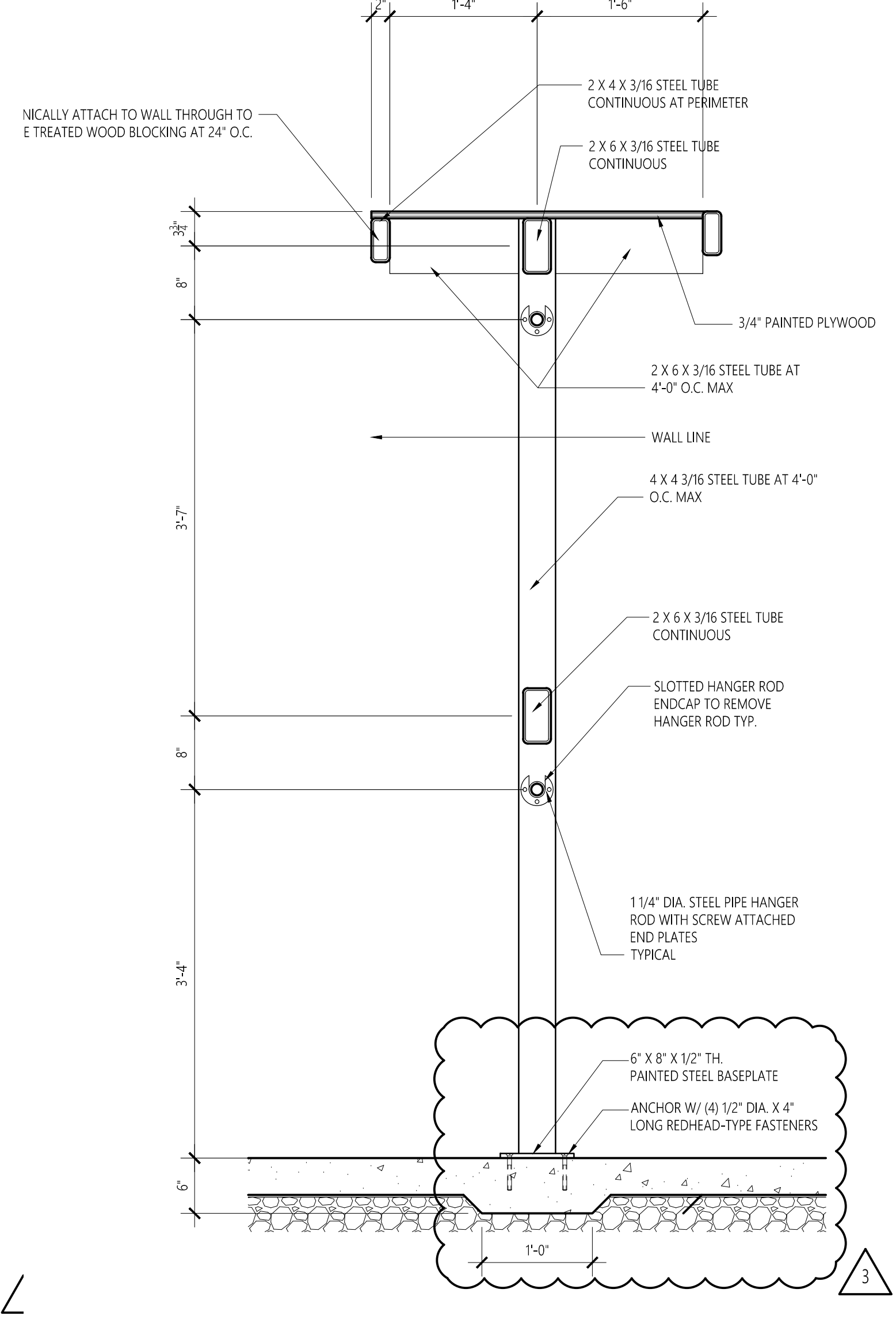
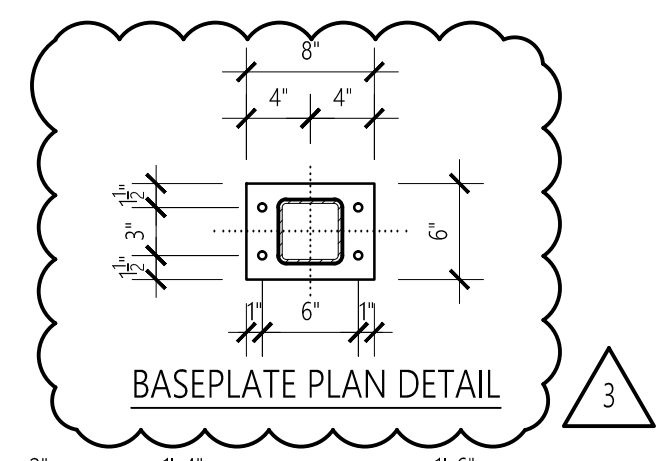
3 SOUTH ELEVATION - CORRIDOR 103
A6.7 SCALE: 1/4" = 1'-0"



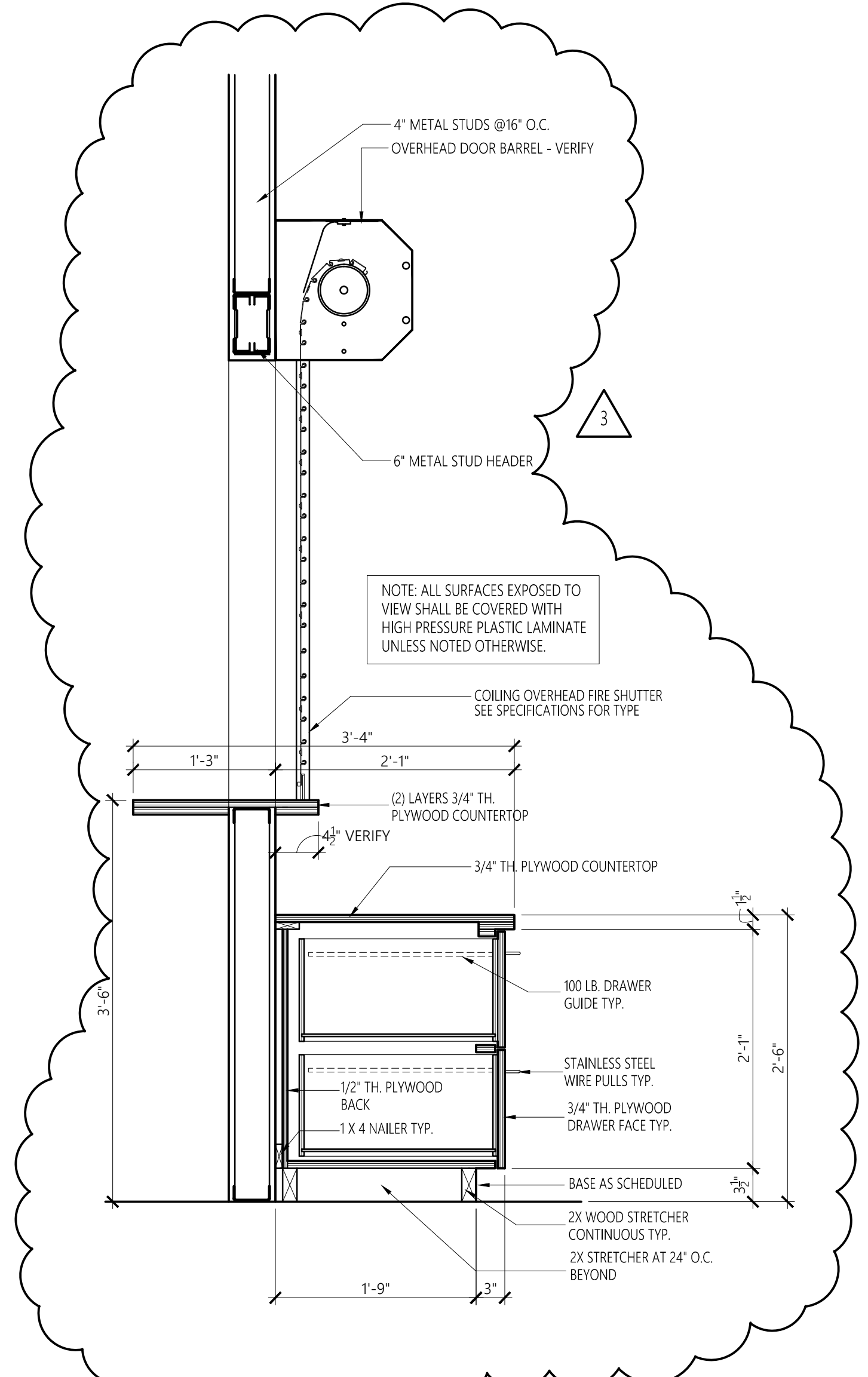
4 EAST ELEVATION - CORRIDOR 103
A6.7 SCALE: 1/4" = 1'-0"



5 SECTION
A6.7 SCALE: 1" = 1'-0"

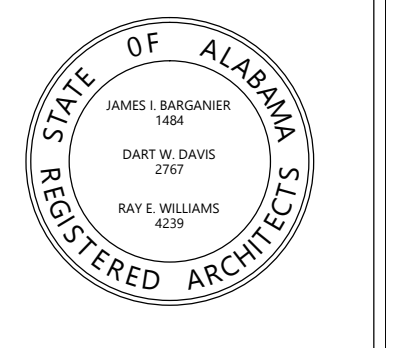


6 SECTION
A6.7 SCALE: 1" = 1'-0"



7 SECTION
A6.7 SCALE: 1" = 1'-0"

No.	Revision	Date
1	Adm. #2	7-13-17
2	Adm. #3	7-20-17



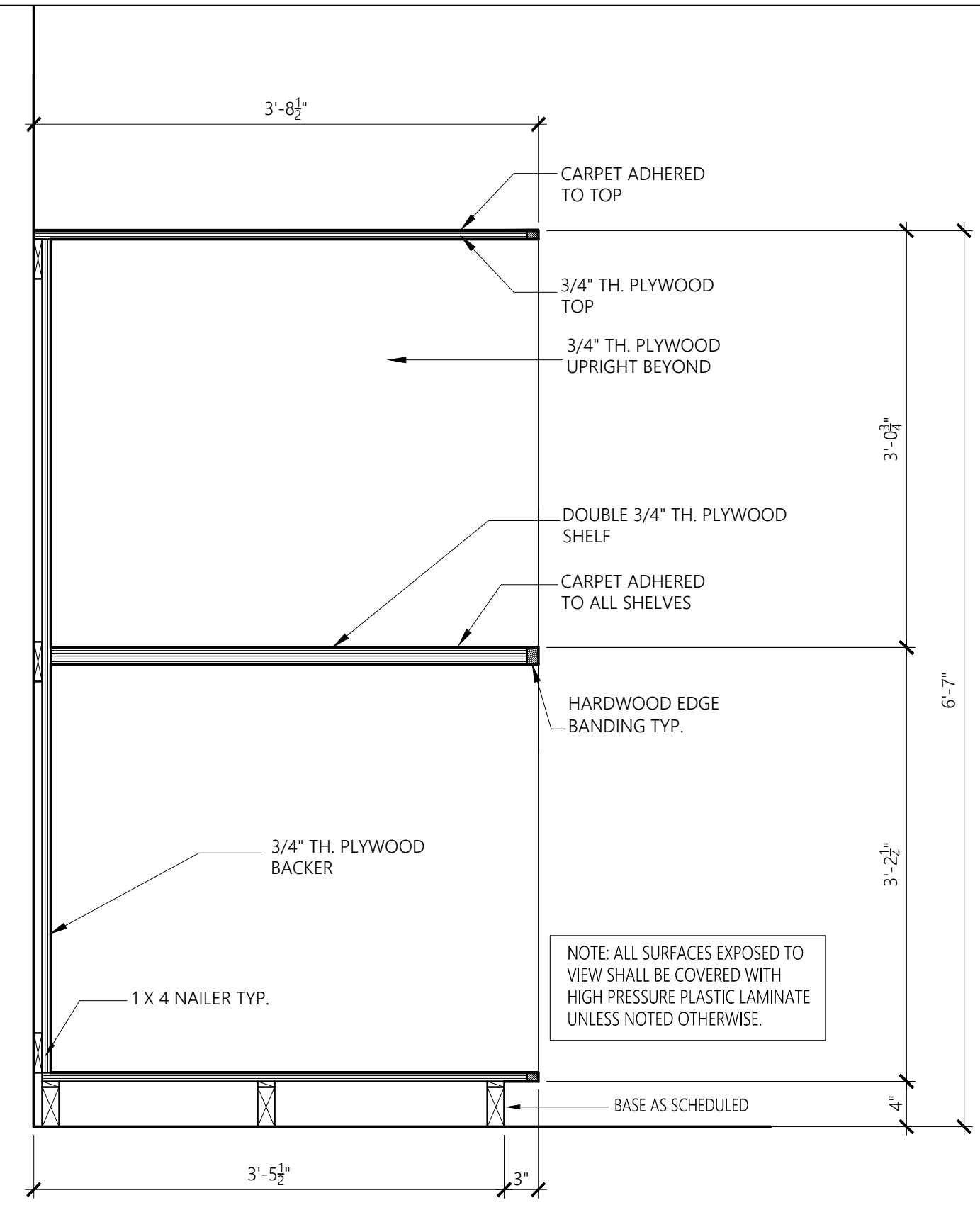
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

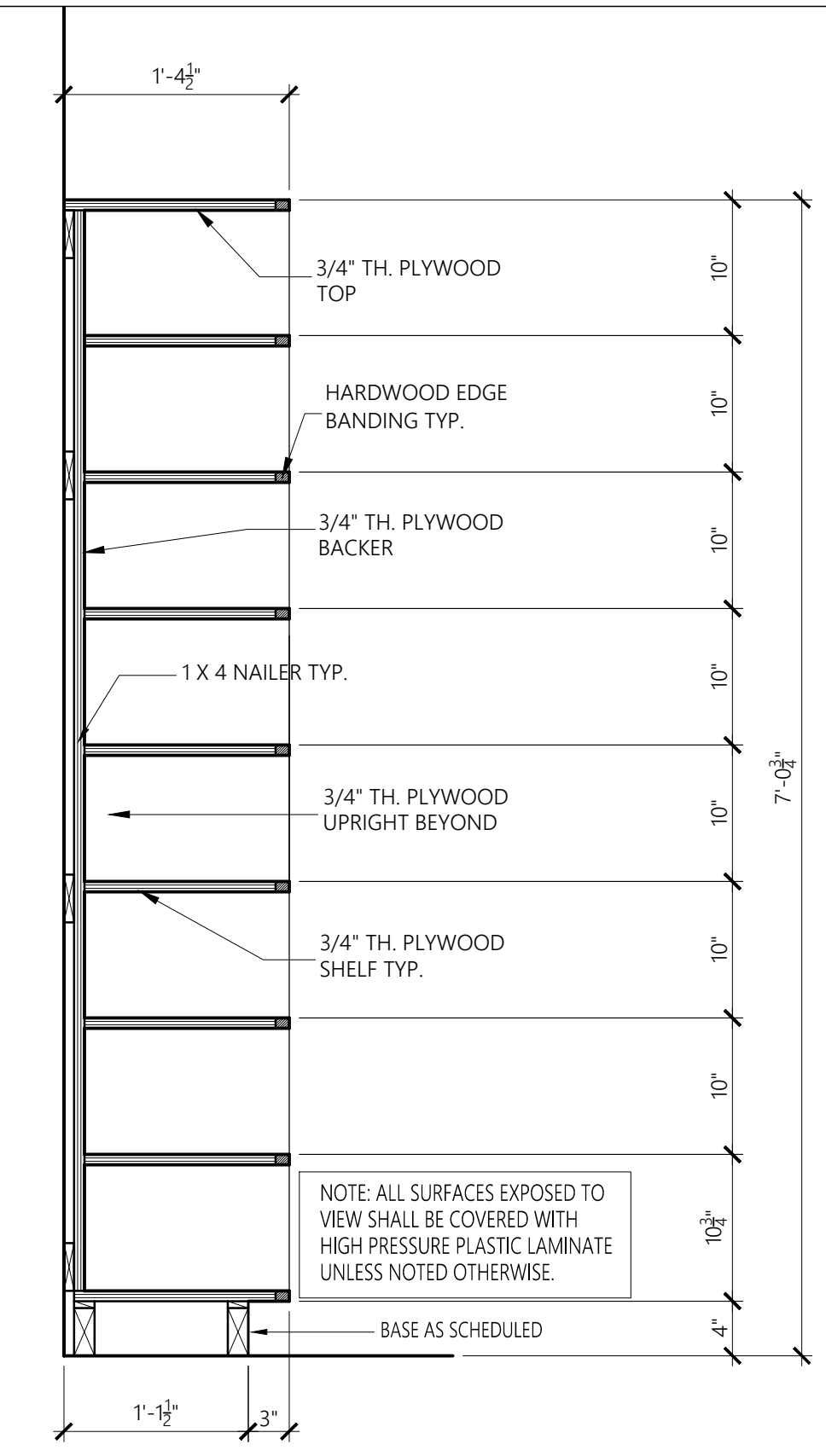
SHEET TITLE:
CASEWORK SECTIONS

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

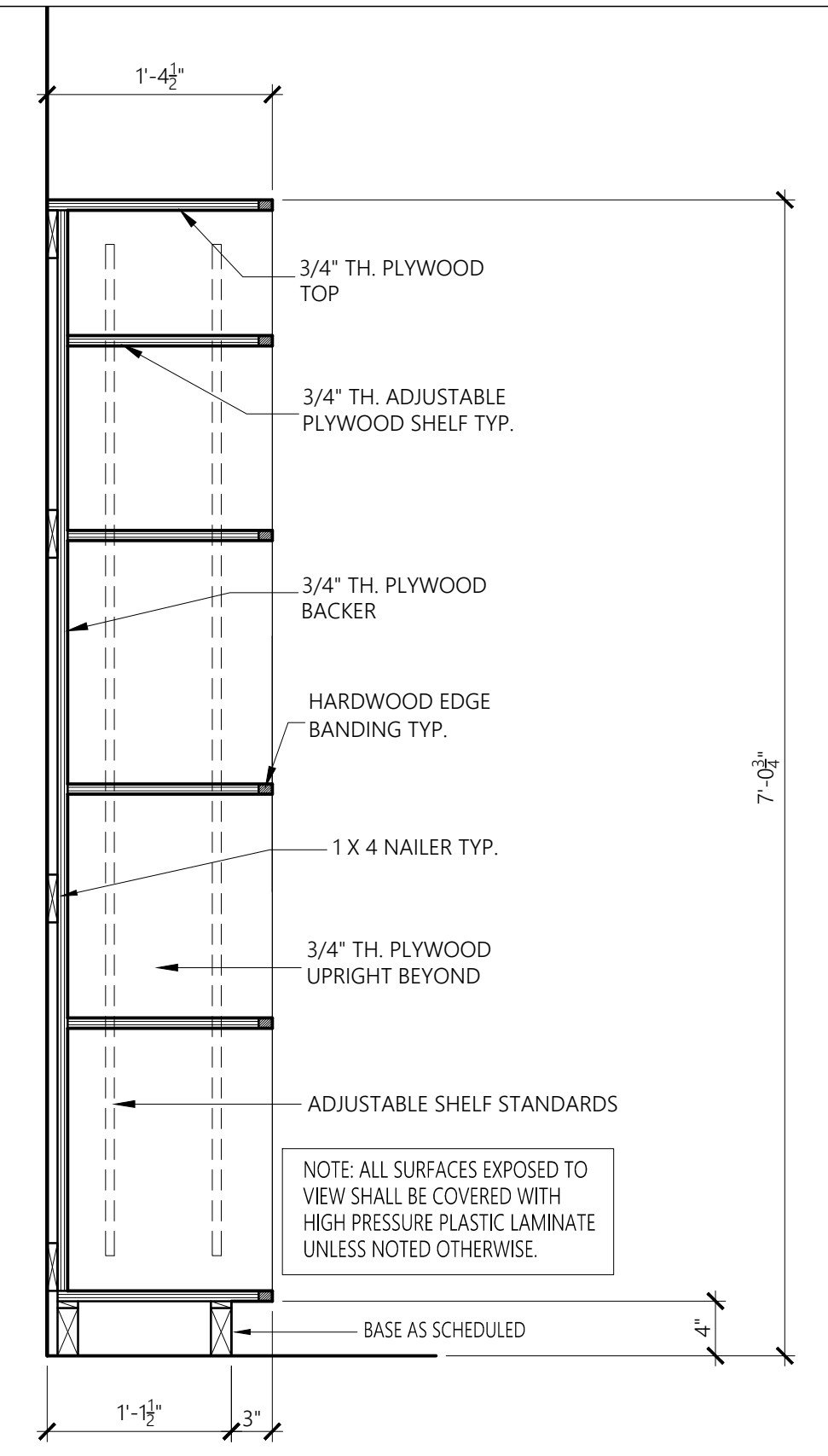
A6.9



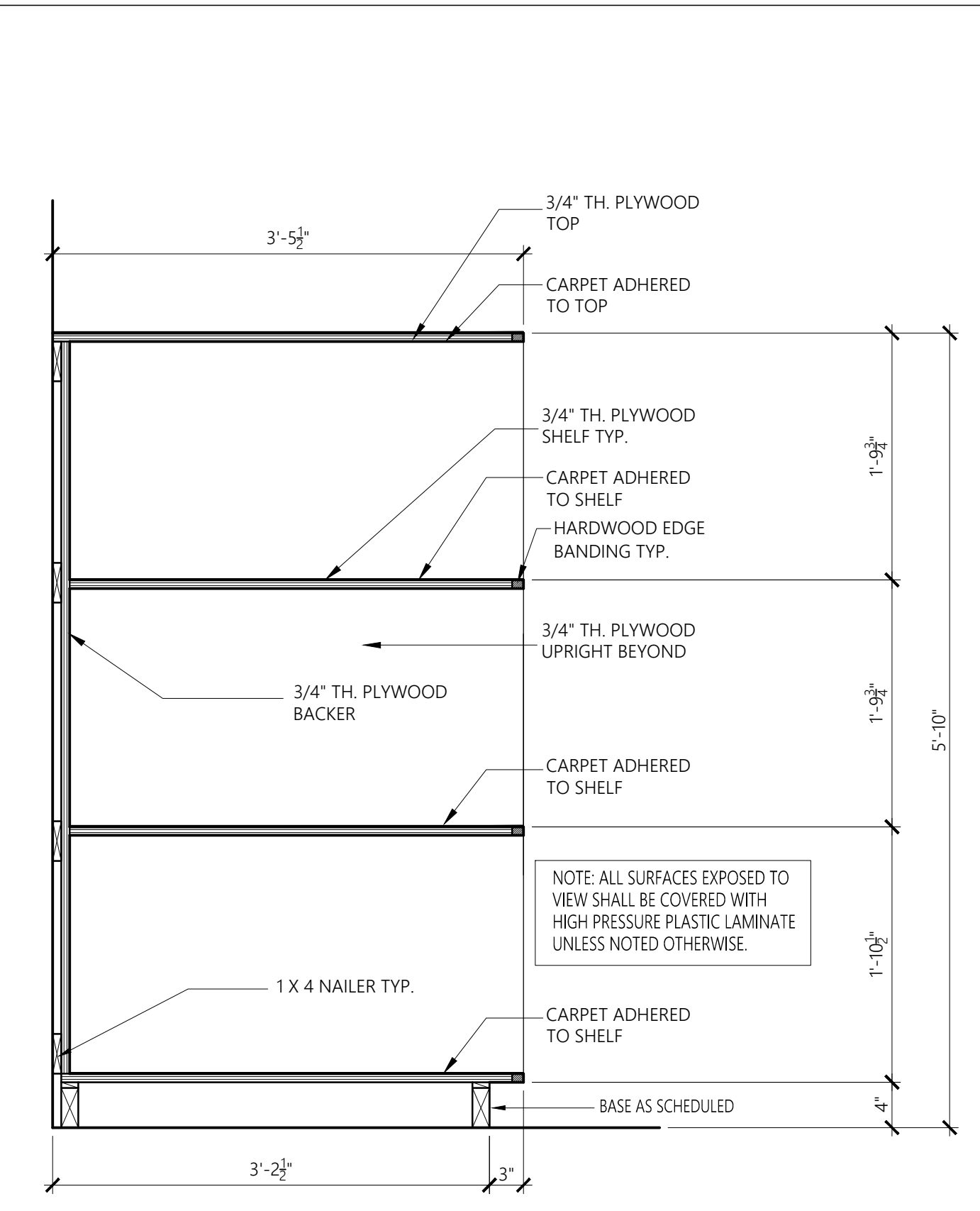
1 SECTION
A6.9 SCALE: 1" = 1'-0"



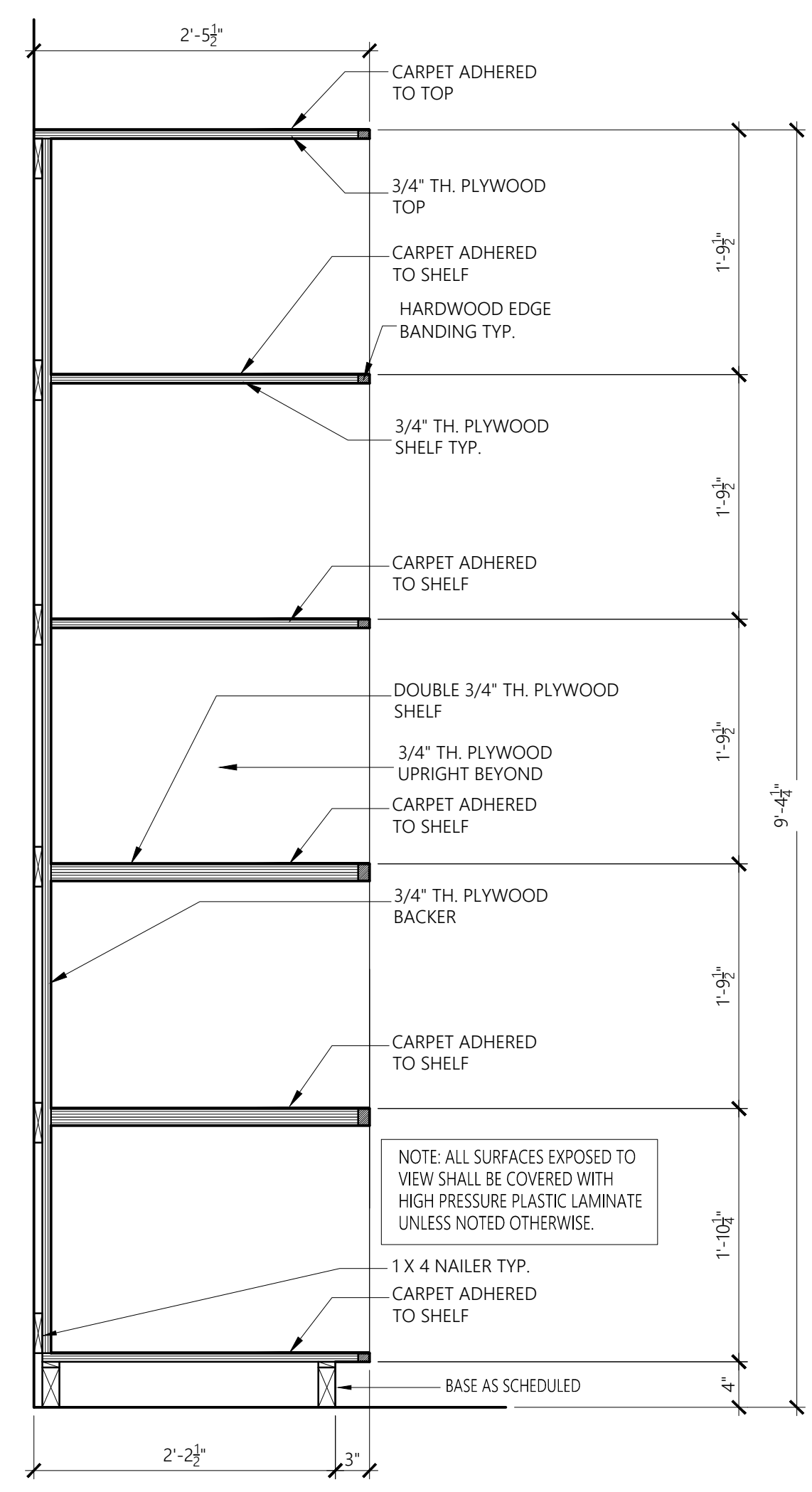
2 SECTION
A6.9 SCALE: 1" = 1'-0"



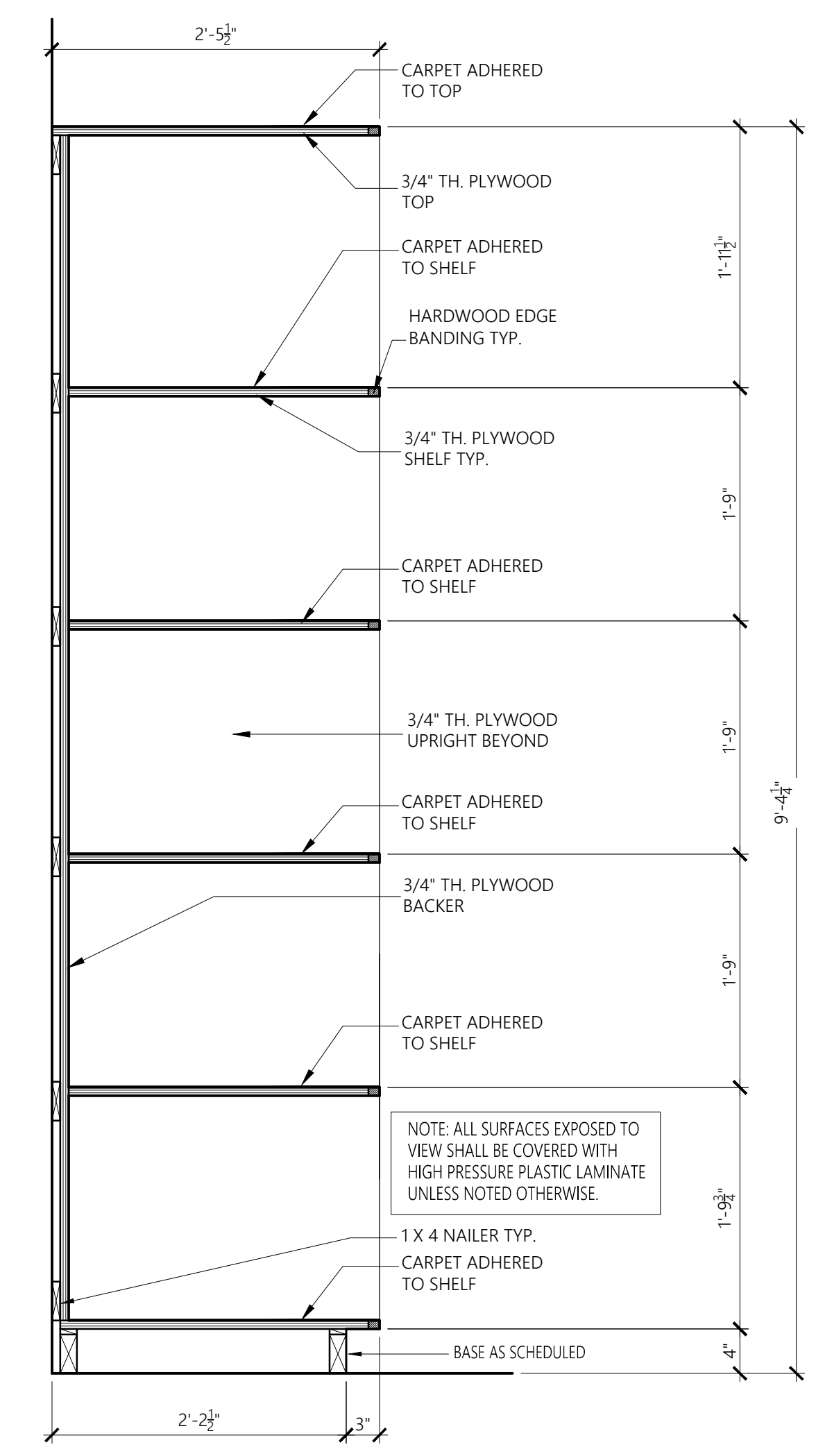
3 SECTION
A6.9 SCALE: 1" = 1'-0"



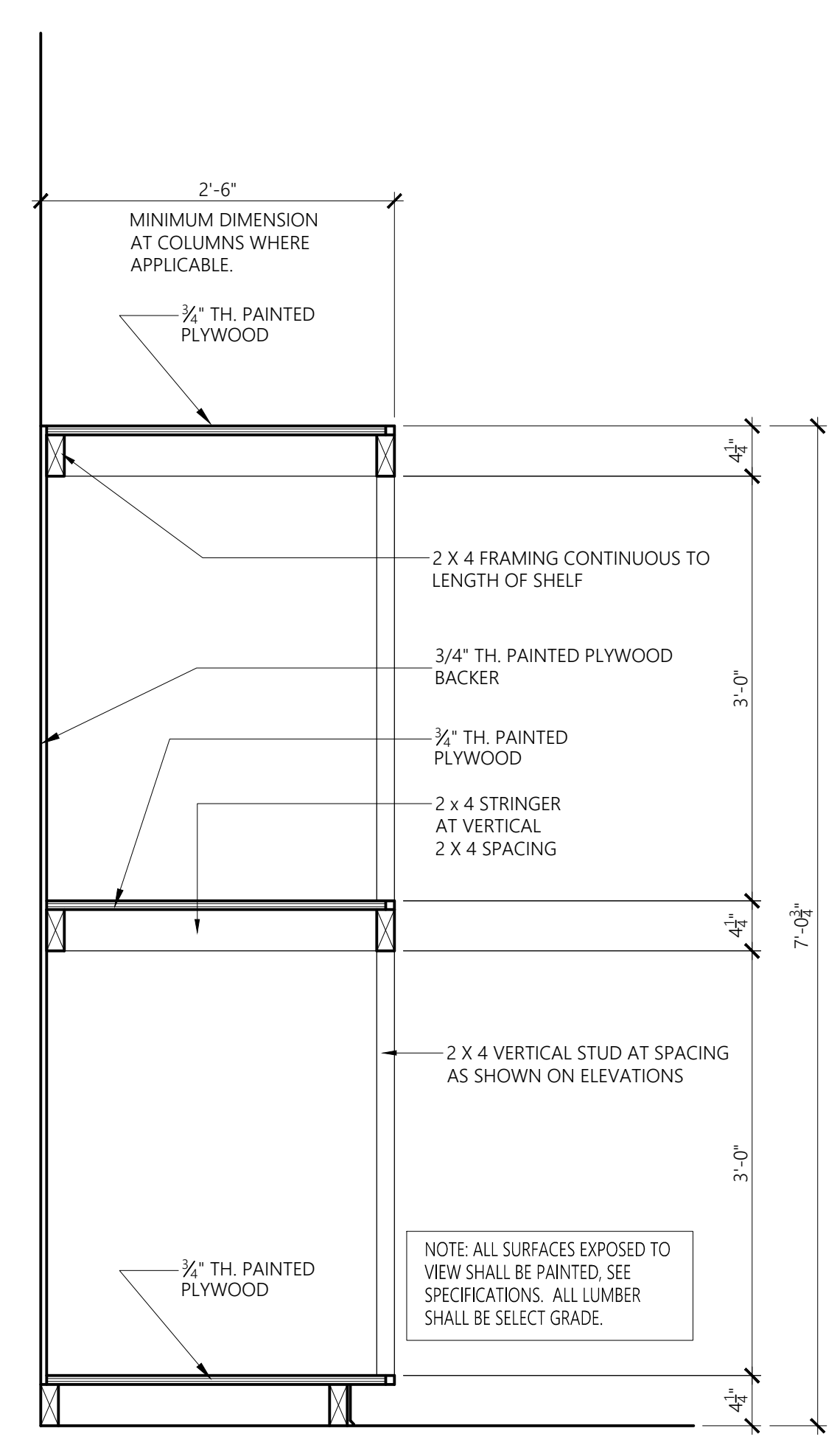
4 SECTION
A6.9 SCALE: 1" = 1'-0"



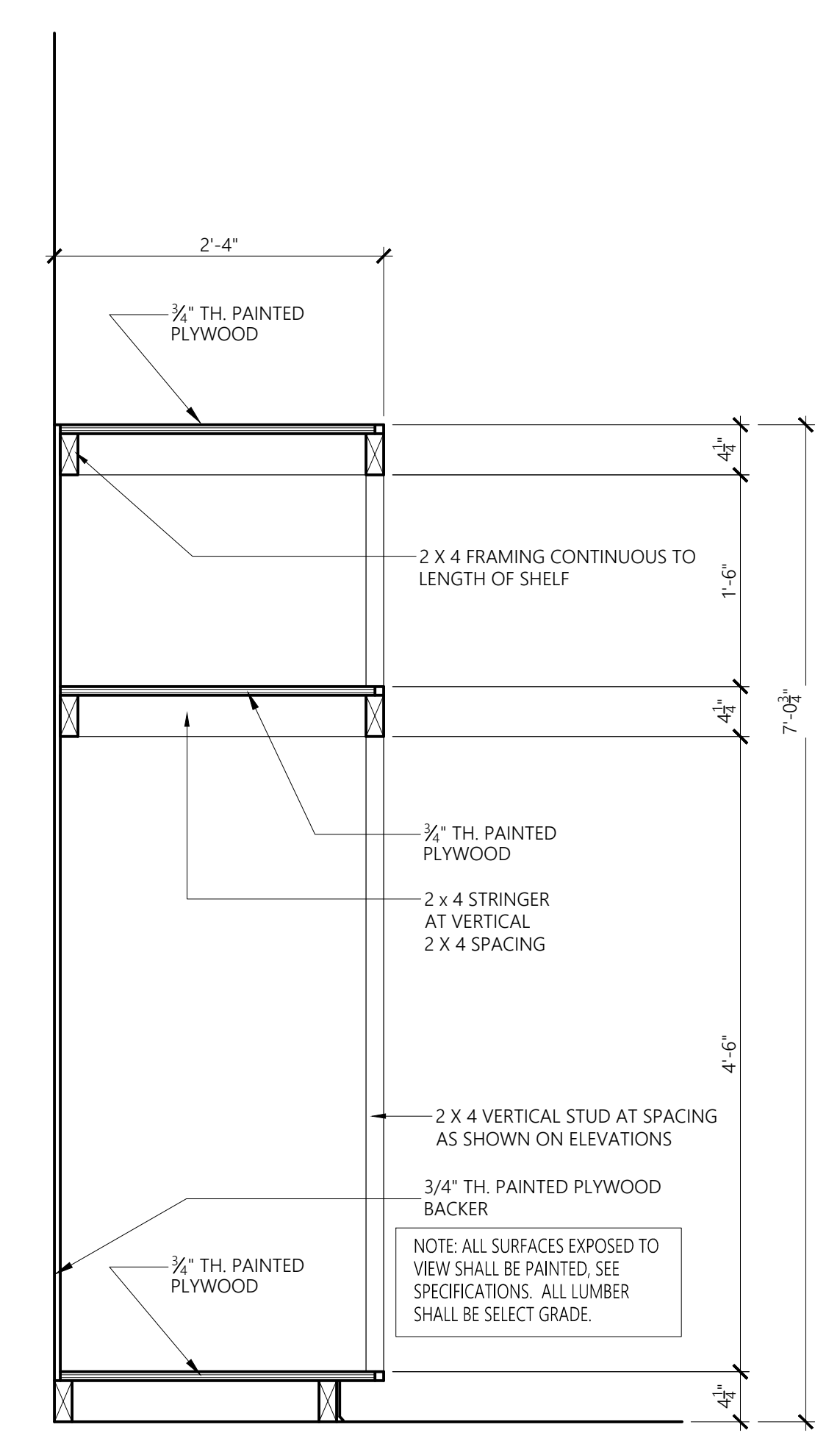
5 SECTION
A6.9 SCALE: 1" = 1'-0"



6 SECTION
A6.9 SCALE: 1" = 1'-0"



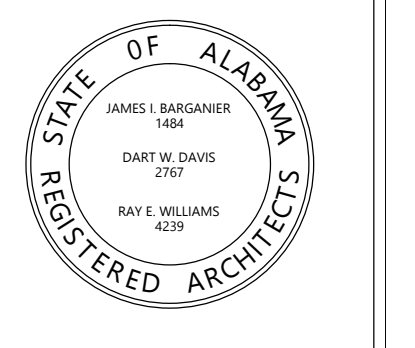
7 SECTION
A6.9 SCALE: 1" = 1'-0"



8 SECTION
A6.9 SCALE: 1" = 1'-0"

3 SHEET REISSUED

No.	Revision	Date
1	△ Addm. #2	7-13-17
2	△ Addm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

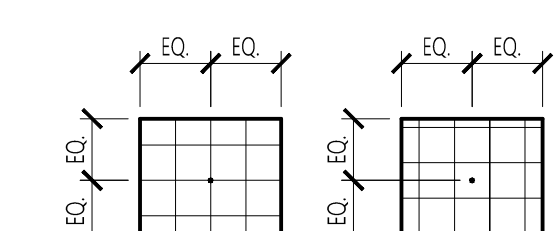
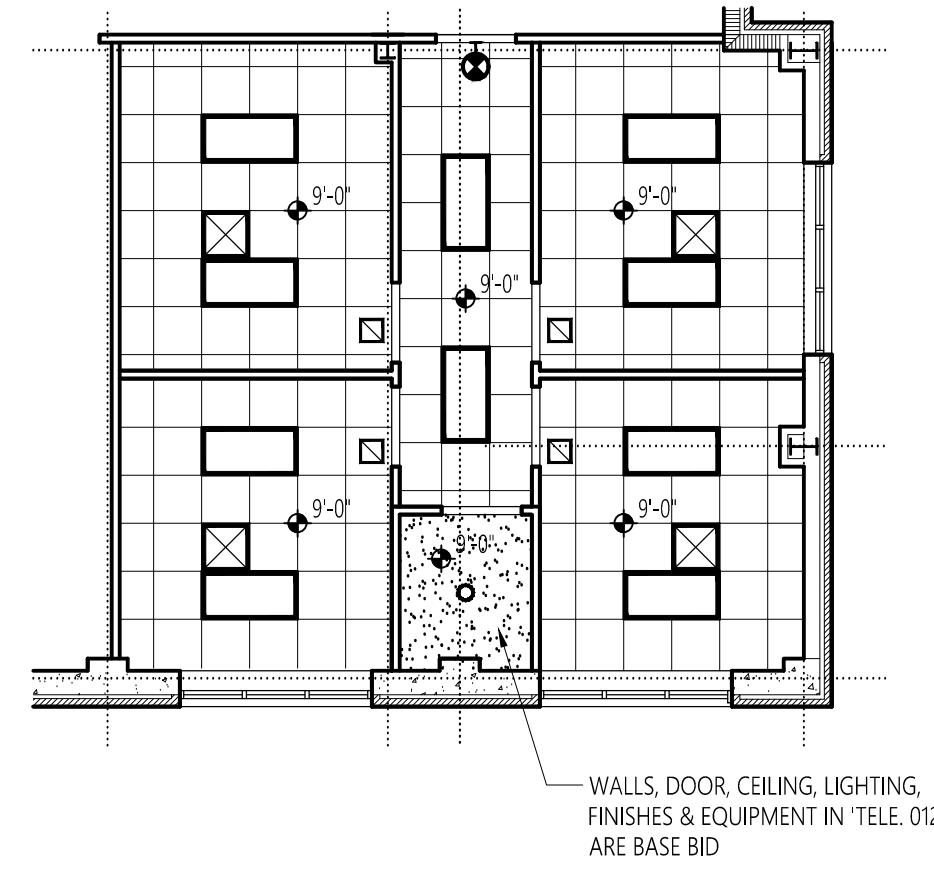
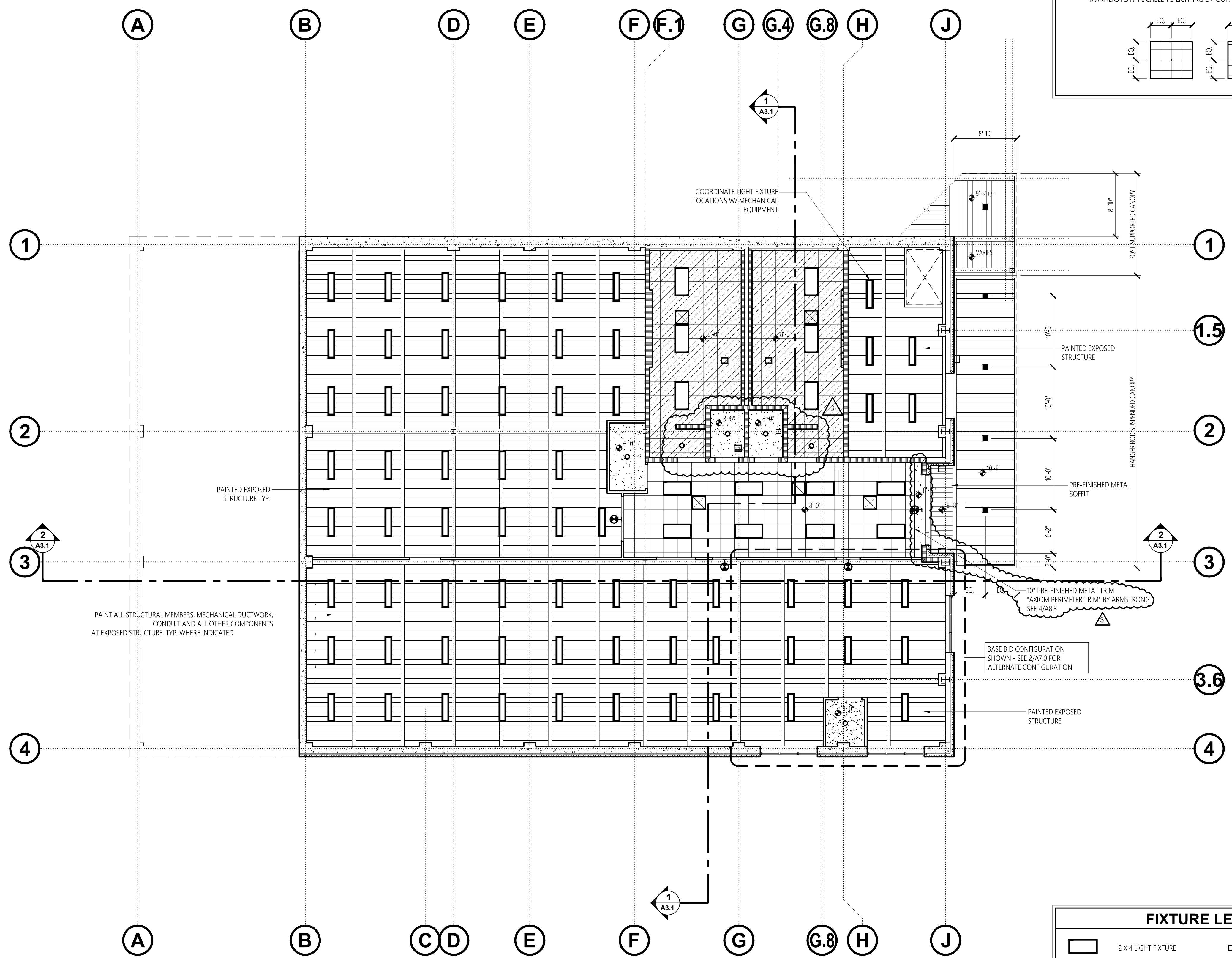
SHEET TITLE:
**BASEMENT FLOOR
REFLECTED CEILING
PLAN**

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A7.0

GENERAL NOTES

- GENERAL CONTRACTOR TO COORDINATE WITH ALL DISCIPLINES (STRUCTURAL, PLUMBING, MECHANICAL, ELECTRICAL, AND SPRINKLER) PRIOR TO CEILING INSTALLATION. REPORT ANY DISCREPANCIES TO ARCHITECT.
- CEILINGS SHALL BE LAID OUT TO CENTER POINT OF ROOM IN ONE OF THE FOLLOWING MANNERS AS APPLICABLE TO LIGHTING LAYOUT.

2 REFLECTED CEILING PLAN (ALTERNATE)
A7.0 SCALE: 1/8" = 1'-0"

1 BASEMENT FLOOR REFLECTED CEILING PLAN (BASE BID)
A7.0 SCALE: 1/8" = 1'-0"

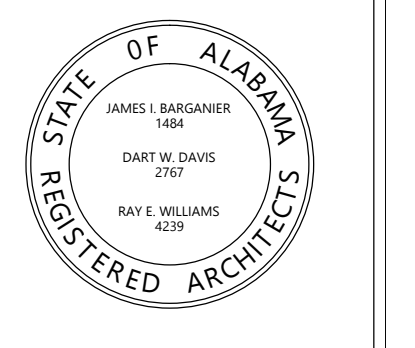
FIXTURE LEGEND

	2 X 4 LIGHT FIXTURE		EXTERIOR WALL-MOUNTED FIXTURE
	1 X 4 LIGHT FIXTURE		UNDER-CANOPY FIXTURE
	4' FLUORESCENT FIXTURE		RECESSED 2-WAY FIXTURE
	WALL-MOUNTED FIXTURE		RETURN AIR GRILLE
	RECESSED LIGHT FIXTURE		SUPPLY AIR DIFFUSER
	EXIT LIGHT		EXHAUST FAN
	PENDANT FIXTURE		

CEILING LEGEND

	LAY-IN ACOUSTICAL CEILING TILE (ACT-1)
	LAY-IN ACOUSTICAL CEILING W/ VINYL-FACED TILES (ACT-2)
	PAINTED GYPSUM BOARD

No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION
Project Number 15-255

SHEET TITLE:
DOOR & WINDOW SCHEDULES

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A8.1

BASEMENT DOOR SCHEDULE															
NO.	DOOR						FRAME		LABEL	SIGNAGE	DETAILS			REMARKS	ALTERNATE
	WIDTH	HEIGHT	THICK	TYPE	MAT'L.	TYPE	MAT'L.	HEAD			JAMB	SILL			
001A	PAIR 3'-0"	7'-0"	1 3/4"	1	ALUM	A	ALUM	-	EXIT	4/A8.3	5/A8.3	6/A8.3	SEE GENERAL NOTE 1 (THIS SHEET)		
002A	PAIR 3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	45	ELECTRICAL	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		
004A	PAIR 3'-0"	7'-0"	1 3/4"	12	PHM	C	PHM	-	EXIT	4/A8.2	5/A8.2	6/A8.2			
005A	3'-0"	7'-0"	1 3/4"	2	SCW	F	PHM	-	JANITOR	4/A8.4	5/A8.4	6/A8.4			
005B	3'-0"	7'-0"	1 3/4"	3	SCW	F	PHM	-	MECHANICAL	4/A8.4	5/A8.4	6/A8.4			
008A	PAIR 3'-0"	7'-0"	1 3/4"	3	SCW	F	PHM	45	EXIT	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		
008B	4'-0"	7'-0"	1 3/4"	5	SCW	K	PHM	45	UNIFORM STORAGE	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		
009A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	45	UNIFORM STORAGE	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		
009B	5'-6"	3'-10"	-	4	STEEL	SPECS	SPECS	45	-	SPECS	SPECS	SPECS			
010A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	-	OFFICE 100	1/A8.4	2/A8.4	3/A8.4			
011A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	-	OFFICE 101	1/A8.4	2/A8.4	3/A8.4			
012A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	-	DATA	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		
014A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	-	OFFICE 102	1/A8.4	2/A8.4	3/A8.4			
015A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	-	OFFICE 103	1/A8.4	2/A8.4	3/A8.4			
016A	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	45	TELECOMMUNICATIONS	1/A8.4	2/A8.4	3/A8.4	SEE GENERAL NOTE 1 (THIS SHEET)		

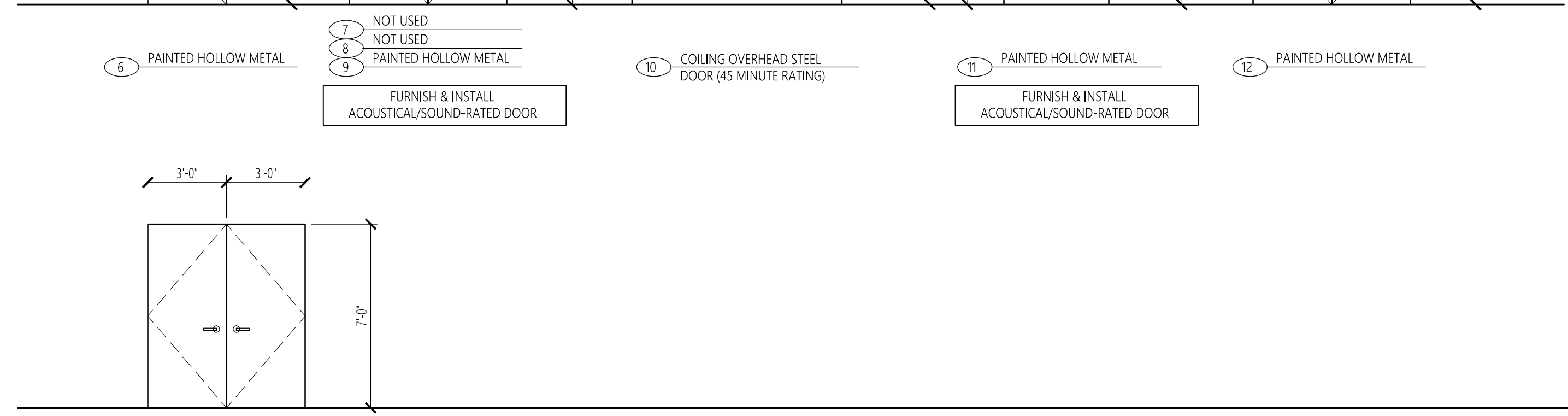
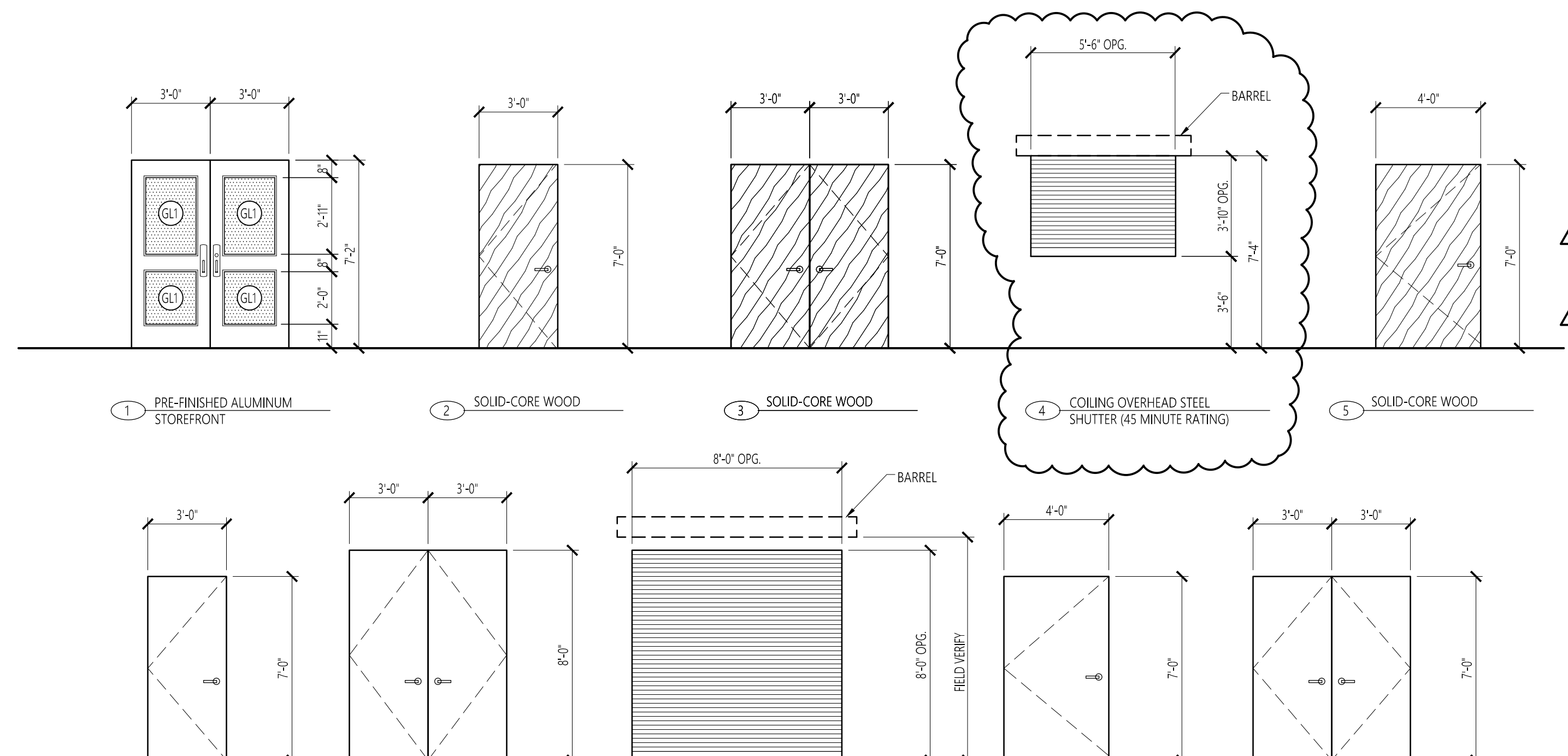
FIRST FLOOR DOOR SCHEDULE															
NO.	DOOR						FRAME		LABEL	SIGNAGE	DETAILS			REMARKS	ALTERNATE
	WIDTH	HEIGHT	THICK	TYPE	MAT'L.	TYPE	MAT'L.	HEAD			JAMB	SILL			
100A	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	H	PHM	45	EXIT	1/A8.2	2/A8.2	3/A8.2	ACOUSTICAL/SOUND-RATED (STC 51 MIN.) SEE GENERAL NOTE 1 (THIS SHEET)		
100B	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	H	PHM	90	EXIT	1/A8.2	2/A8.2	3/A8.2	ACOUSTICAL/SOUND-RATED (STC-51 MIN.)		
100C	4'-0"	7'-0"	1 3/4"	11	PHM	J	PHM	45	EXIT	1/A8.2	2/A8.2	3/A8.2	ACOUSTICAL/SOUND-RATED (STC 51 MIN.) SEE GENERAL NOTE 1 (THIS SHEET)		
101A	8'-0"	8'-0"	SPECS	10	STEEL	SPECS	SPECS	45	-	1/A8.3	2/A8.3	3/A8.3			
101B	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	H	PHM	-	PERCUSSION STORAGE	7/A8.4	8/A8.4	-	ACOUSTICAL/SOUND-RATED (STC 51 MIN.)		
101C	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	H	PHM	-	PERCUSSION STORAGE	7/A8.4	8/A8.4	-	ACOUSTICAL/SOUND-RATED (STC 51 MIN.)		
102A	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	H	PHM	-	CHAIR STORAGE	7/A8.4	8/A8.4	-	ACOUSTICAL/SOUND-RATED (STC 51 MIN.)		
103A	PAIR 3'-0"	8'-0"	1 3/4"	1	ALUM	G	ALUM	-	EXIT	1/A8.5	2/A8.5	3/A8.5	SEE GENERAL NOTE 1 (THIS SHEET)		
104A.1	3'-0"	7'-0"	1 3/4"	1	PHM	VERIFY	VERIFY	-	EXIT	-	-	-	NEW DOOR IN EXISTING FRAME, HM FRAME AND DOOR		
104B.1	3'-0"	7'-0"	1 3/4"	1	PHM	VERIFY	VERIFY	-	EXIT	-	-	-	NEW DOOR AND FRAME IN EXISTING OPENING, HM FRAME AND DOOR		
105A	PAIR 3'-0"	8'-0"	1 3/4"	9	PHM	EXISTING	PHM	-	MECHANICAL	-	-	-	NEW DOOR IN EXISTING FRAME, REPAIR FRAME. SEE GENERAL NOTE 1 (THIS SHEET)		

GENERAL NOTES

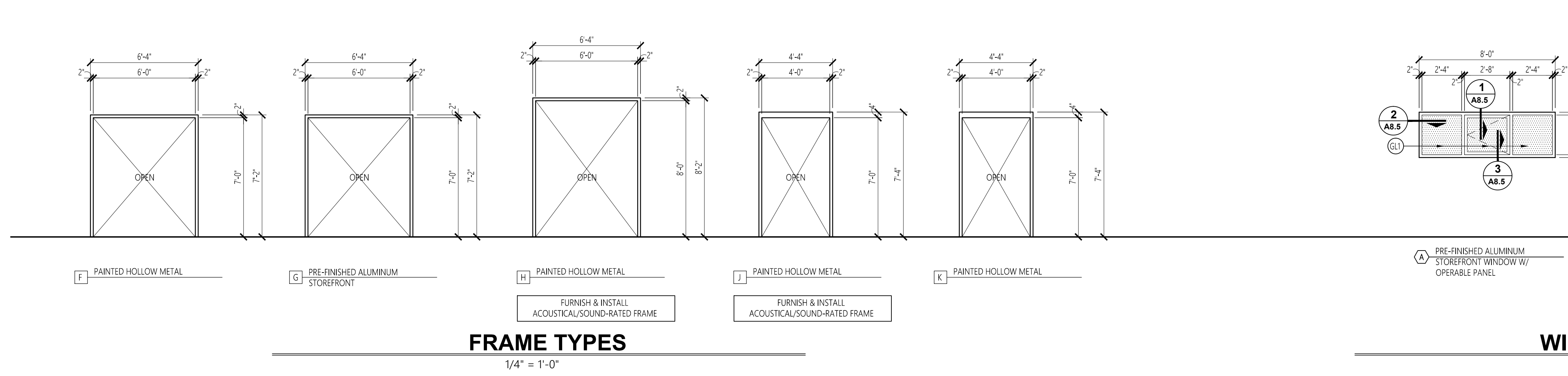
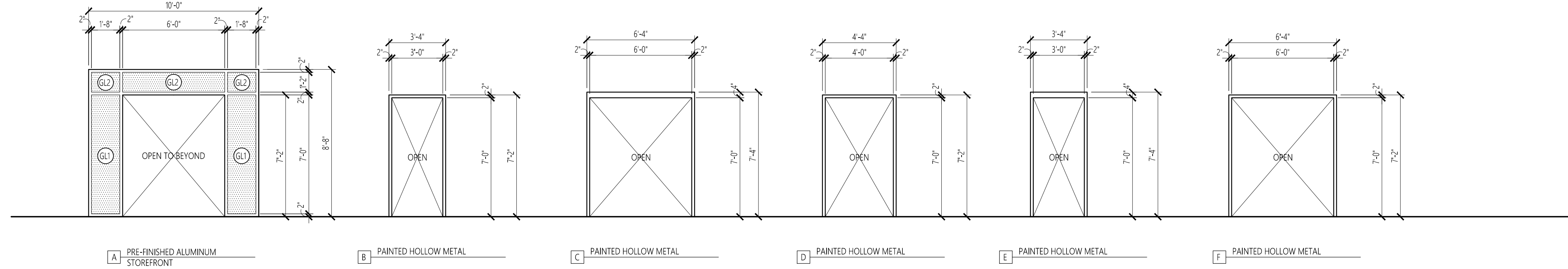
- FURNISH & INSTALL DOOR ACCESS CARD READER AT INDICATED DOOR.
- SIGNAGE IS FOR PRICING PURPOSES ONLY. FINAL TEXT FOR SIGNAGE SHALL BE SUPPLIED BY OWNER. ALLOW FOR UP TO 25 CHARACTERS ON EACH SIGN (BRAILLE AND SIGHTED).
- ABBREVIATIONS: ALUM = ALUMINUM, SCW = SOLID CORE WOOD, PHM = PAINTED HOLLOW METAL, STL = PAINTED STEEL, SPECS = SEE SPECIFICATIONS

GLAZING SCHEDULE

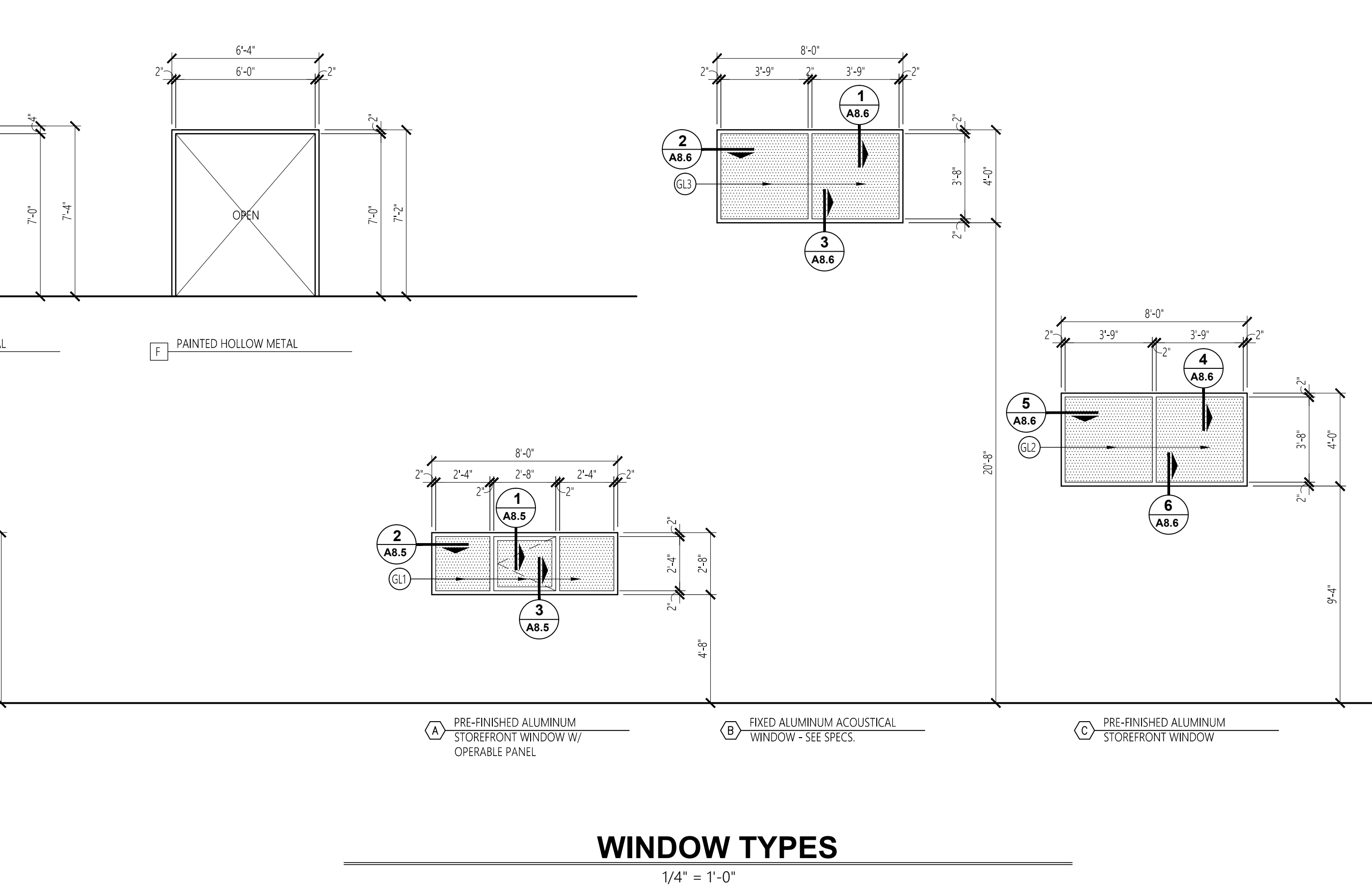
(GL1) 1" TH. TINTED INSULATED, TEMPERED GLASS LOW-E GLASS
 (GL2) 1" TH. TINTED INSULATED LOW-E GLASS
 (GL3) ACOUSTICAL SOUND RATED GLASS - SEE SPECS.



DOOR TYPES
1/4" = 1'-0"

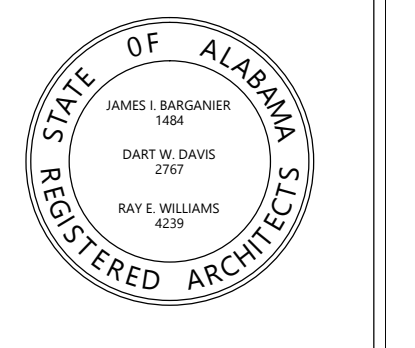


LOUVER TYPES
1/4" = 1'-0"



WINDOW TYPES
1/4" = 1'-0"

No.	Revision	Date
1	△ Addm. #2	7-13-17
2	△ Addm. #3	7-20-17



Project Number: 2015-255
BARGANER DAVIS SIMS
 Drawn By:

**GOODWIN HALL - RENOVATION
 AND
 BAND REHEARSAL HALL ADDITION**
 Project Number 15-255

SHEET TITLE:
DOOR DETAILS

DRAWN BY:
 -

CHECKED BY:
 -

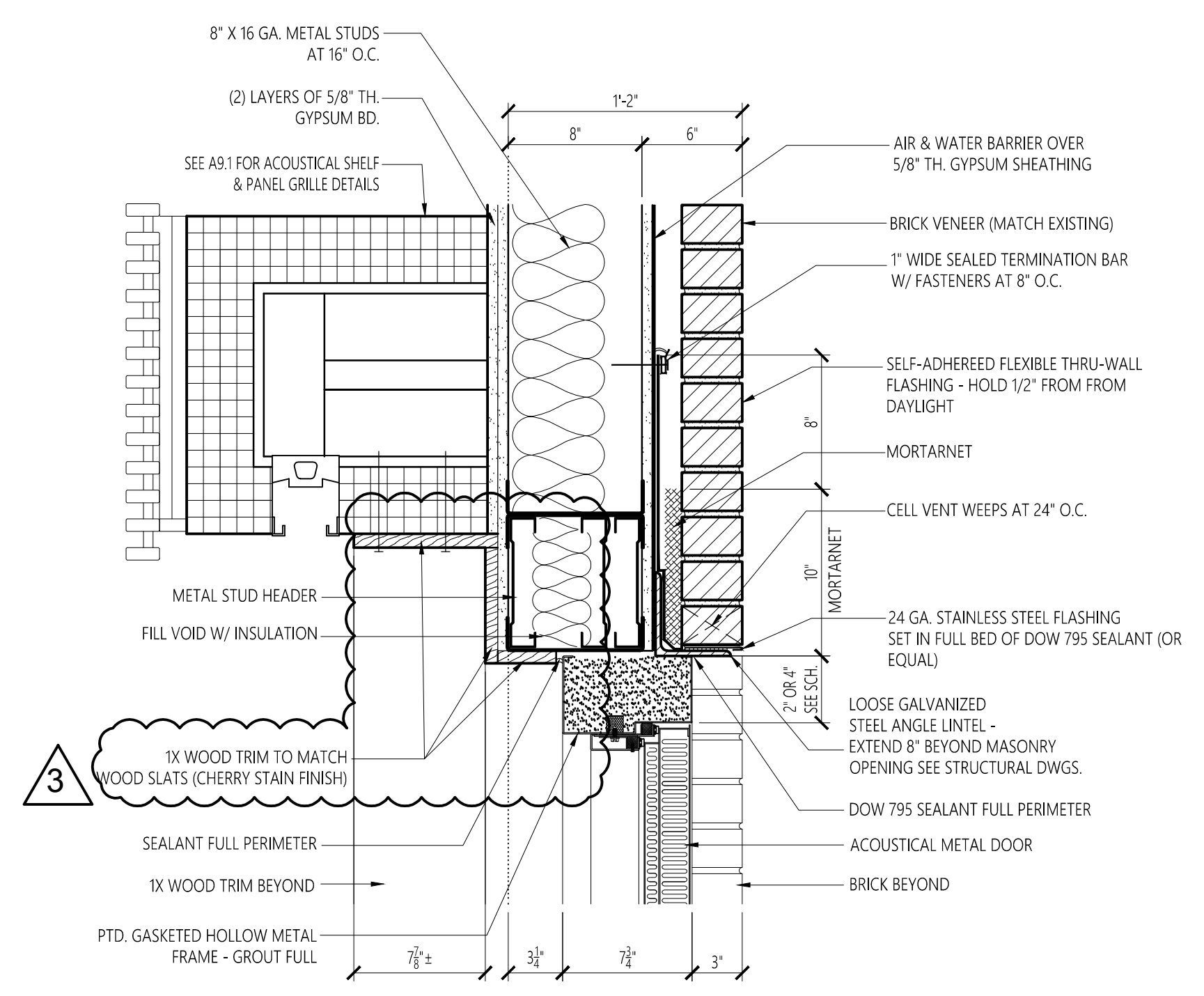
DATE:
 6-14-2017

FILE NUMBER:
 -

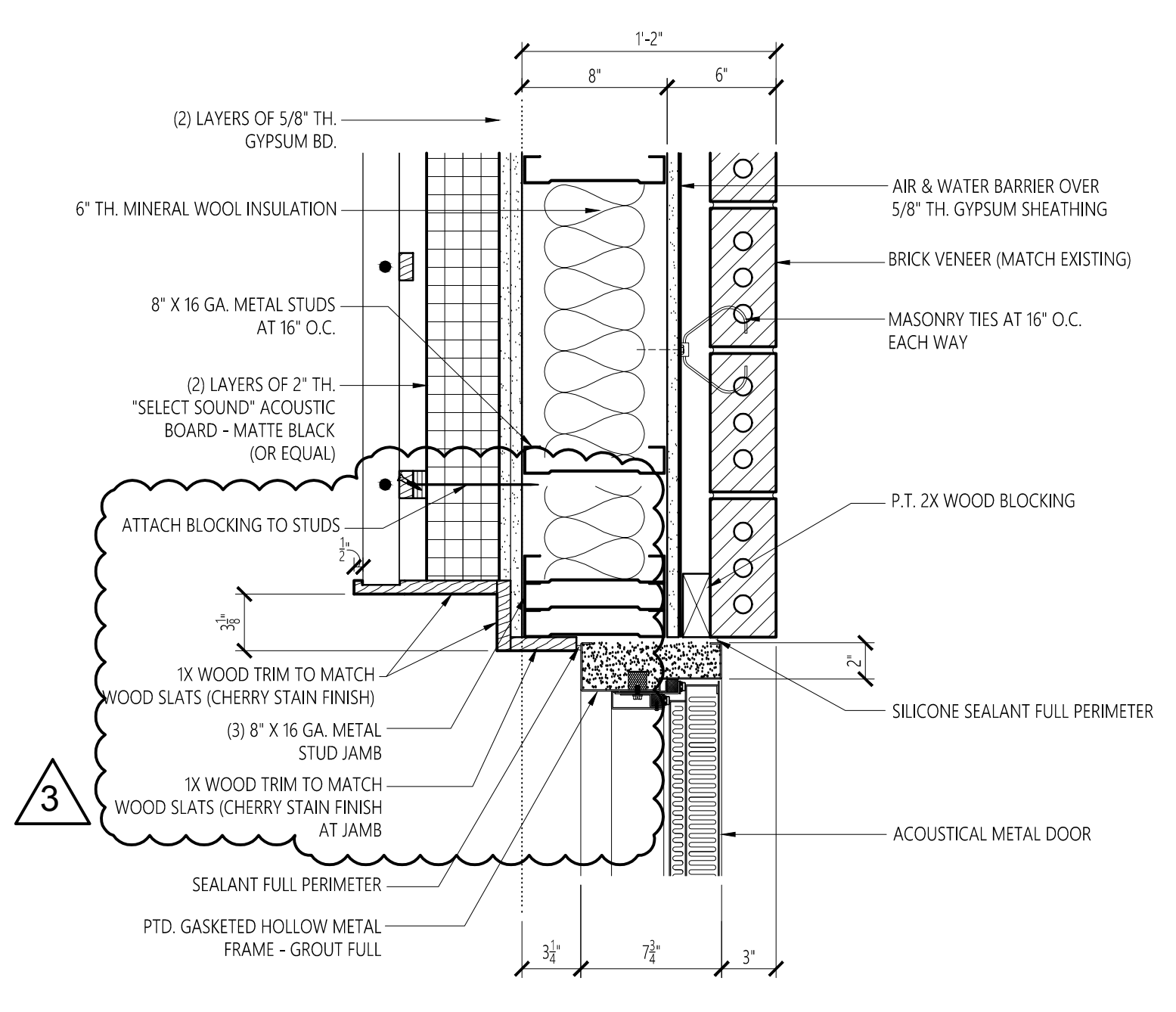
PROJECT NUMBER:
 16-111

SHEET NUMBER:

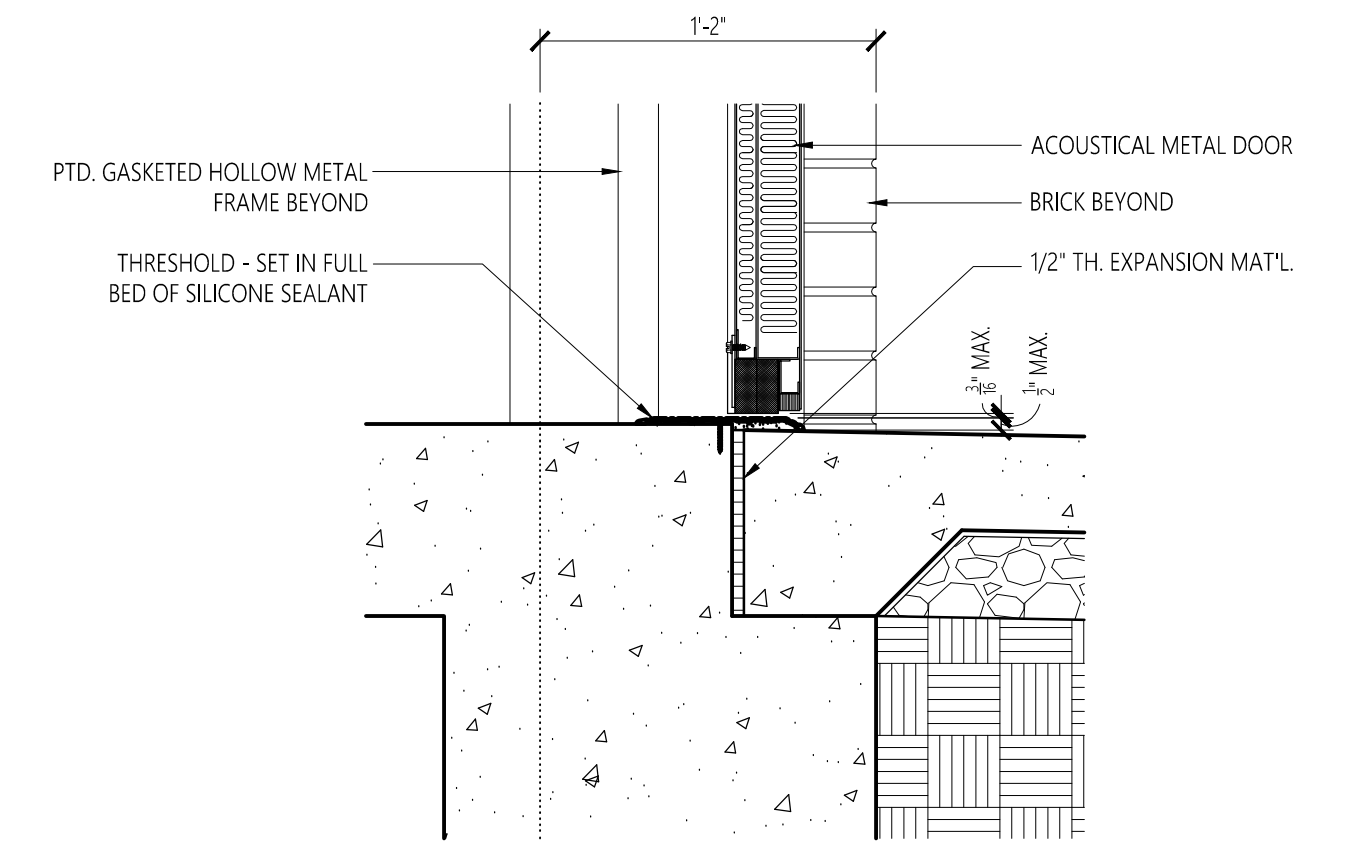
A8.2



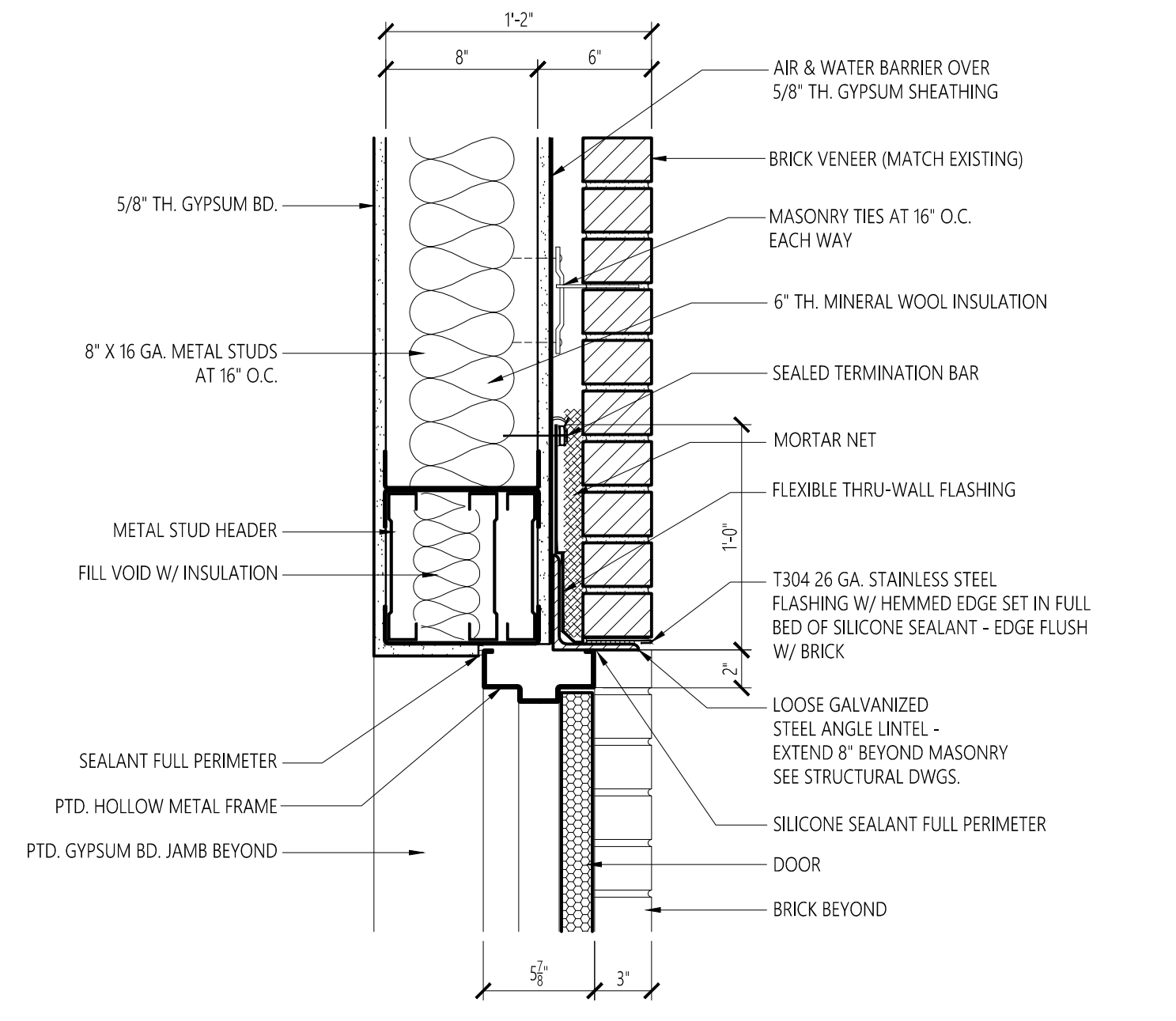
1 DOOR HEAD DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"



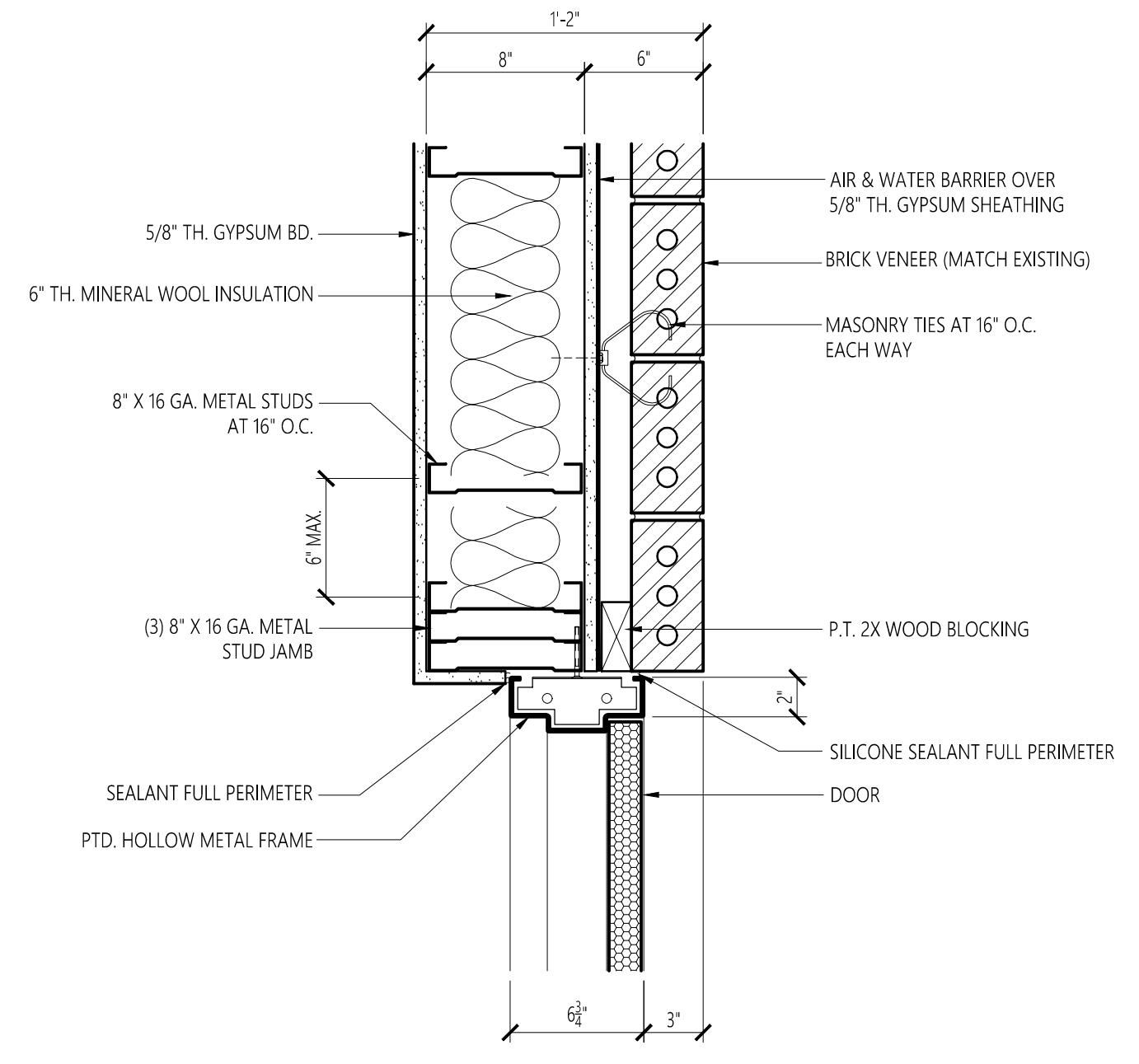
2 DOOR JAMB DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"



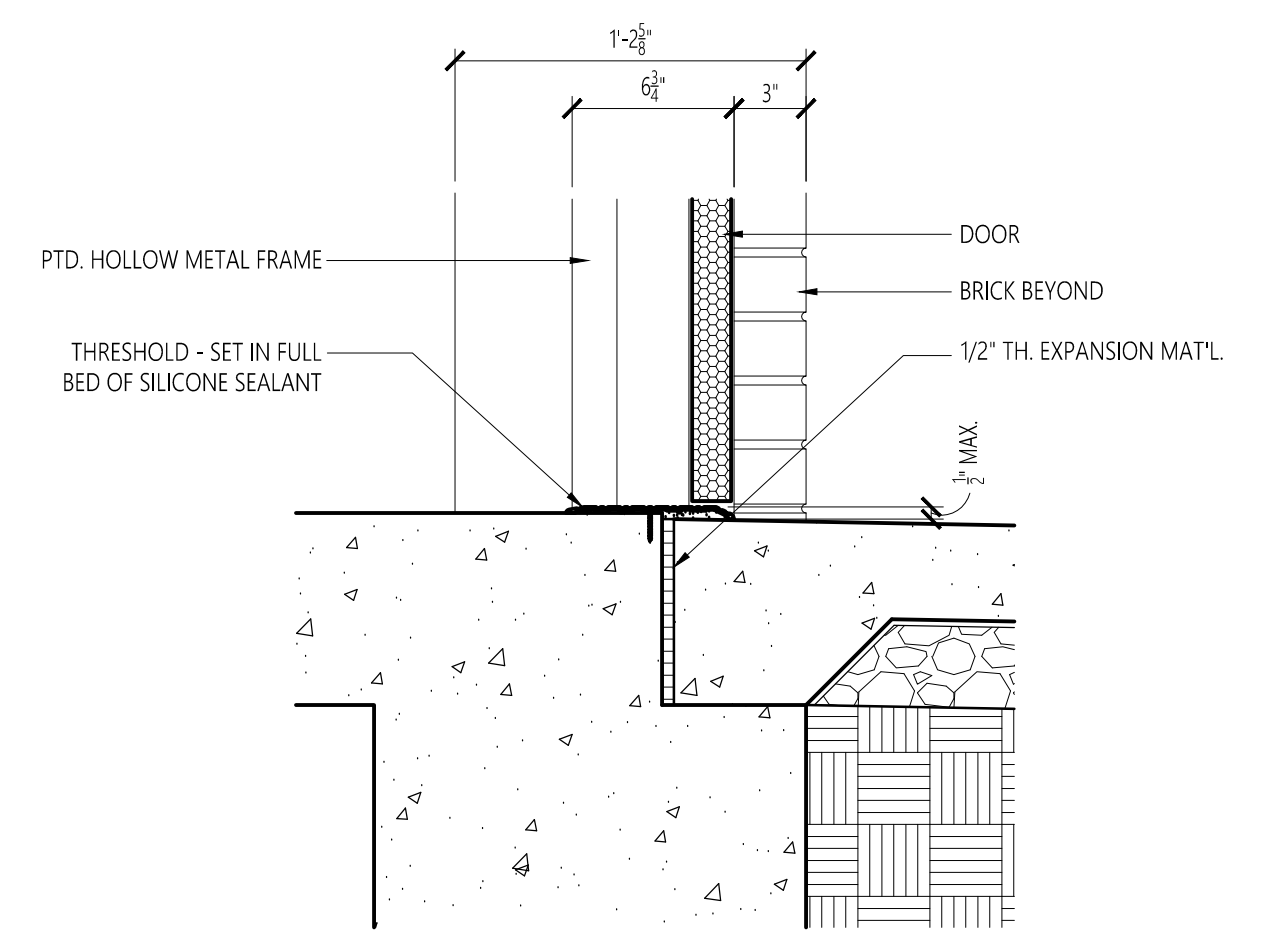
3 DOOR SILL DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"



4 DOOR HEAD DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"

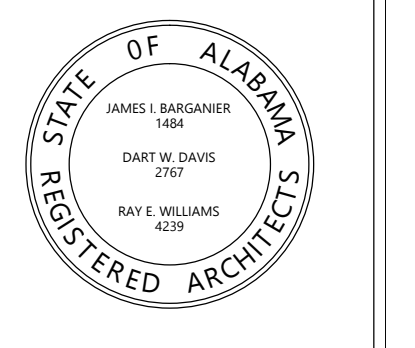


5 DOOR JAMB DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"



6 DOOR SILL DETAIL
 A8.2 SCALE: 1 1/2" = 1'-0"

No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



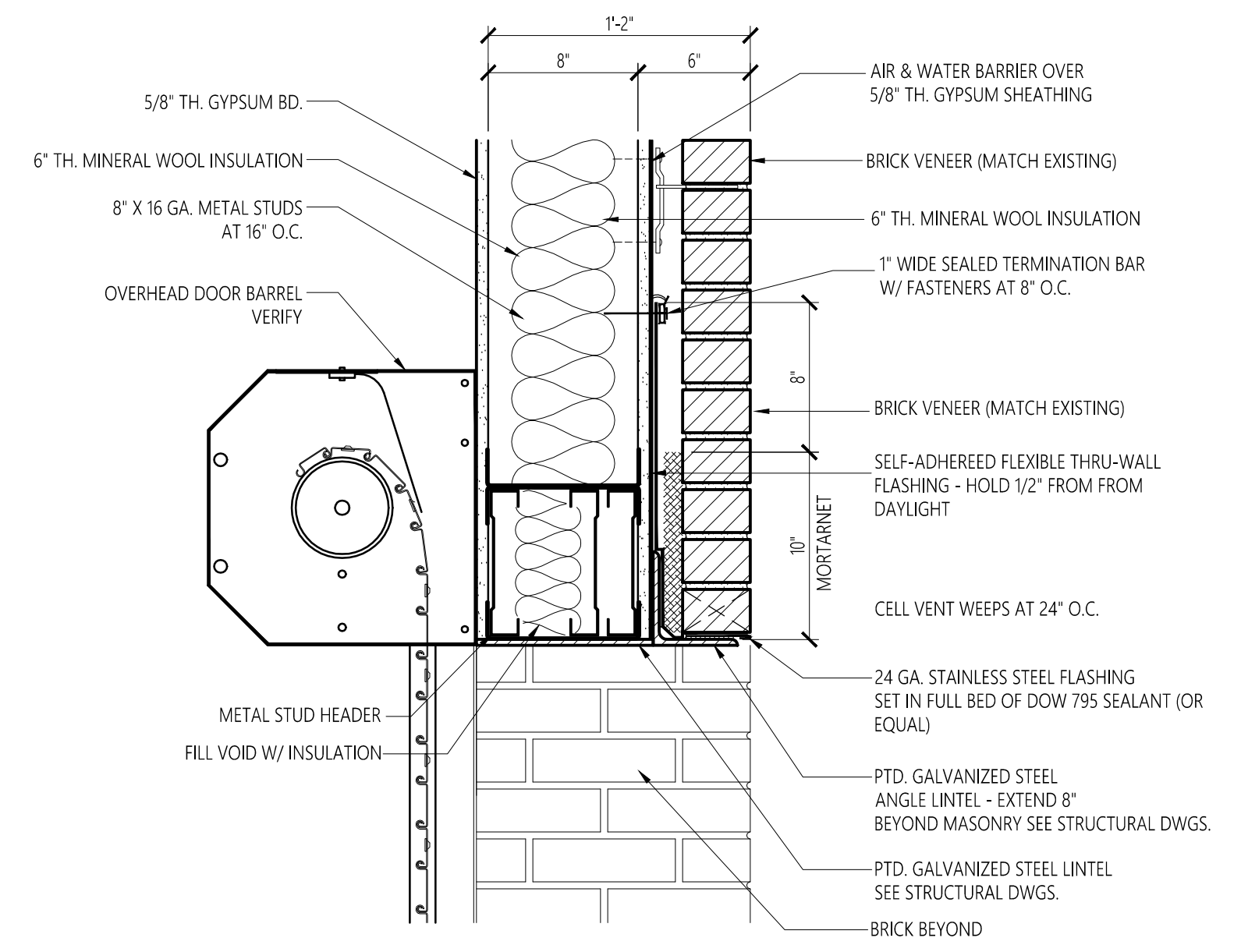
Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

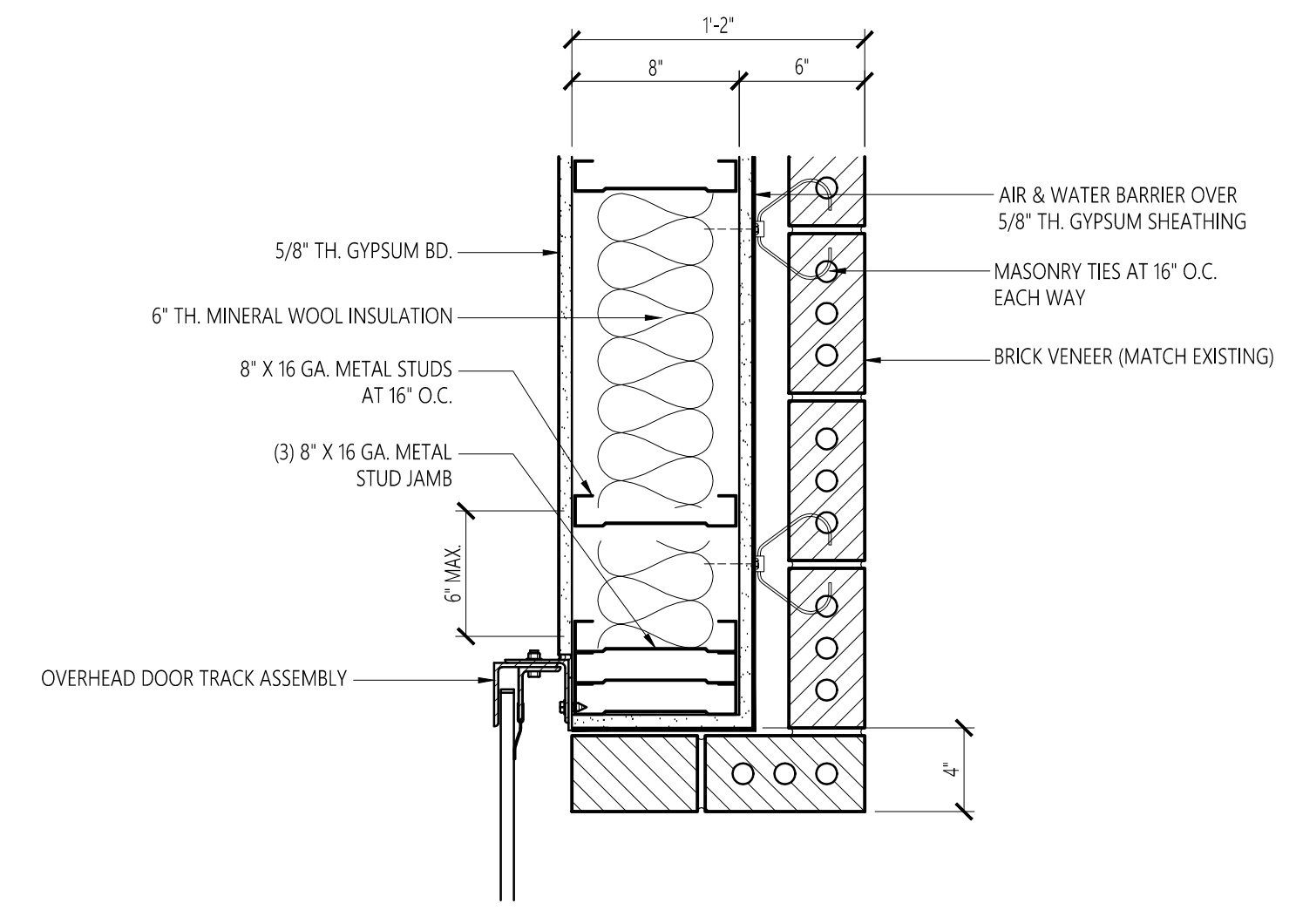
SHEET TITLE:
DOOR DETAILS

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

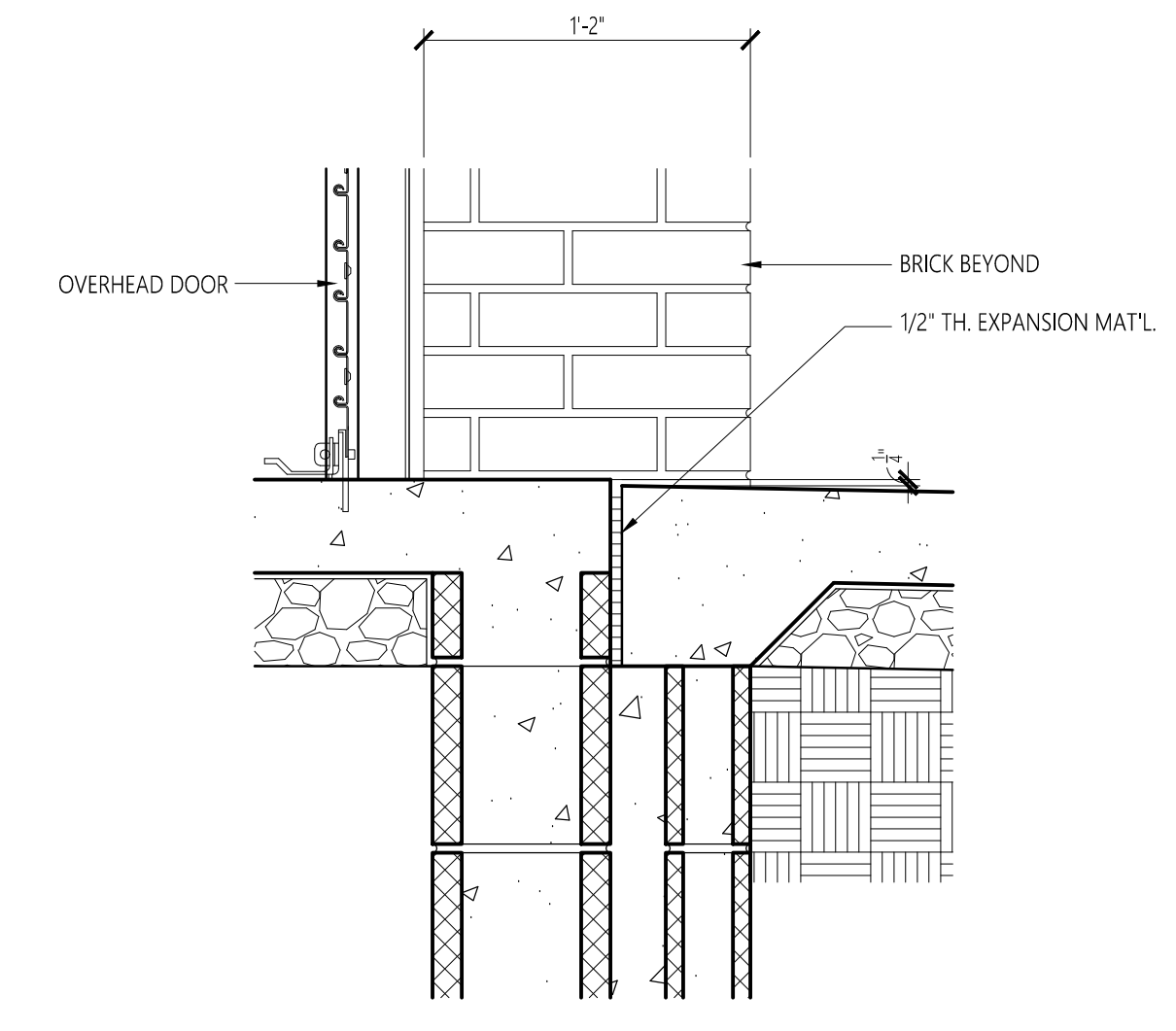
A8.3



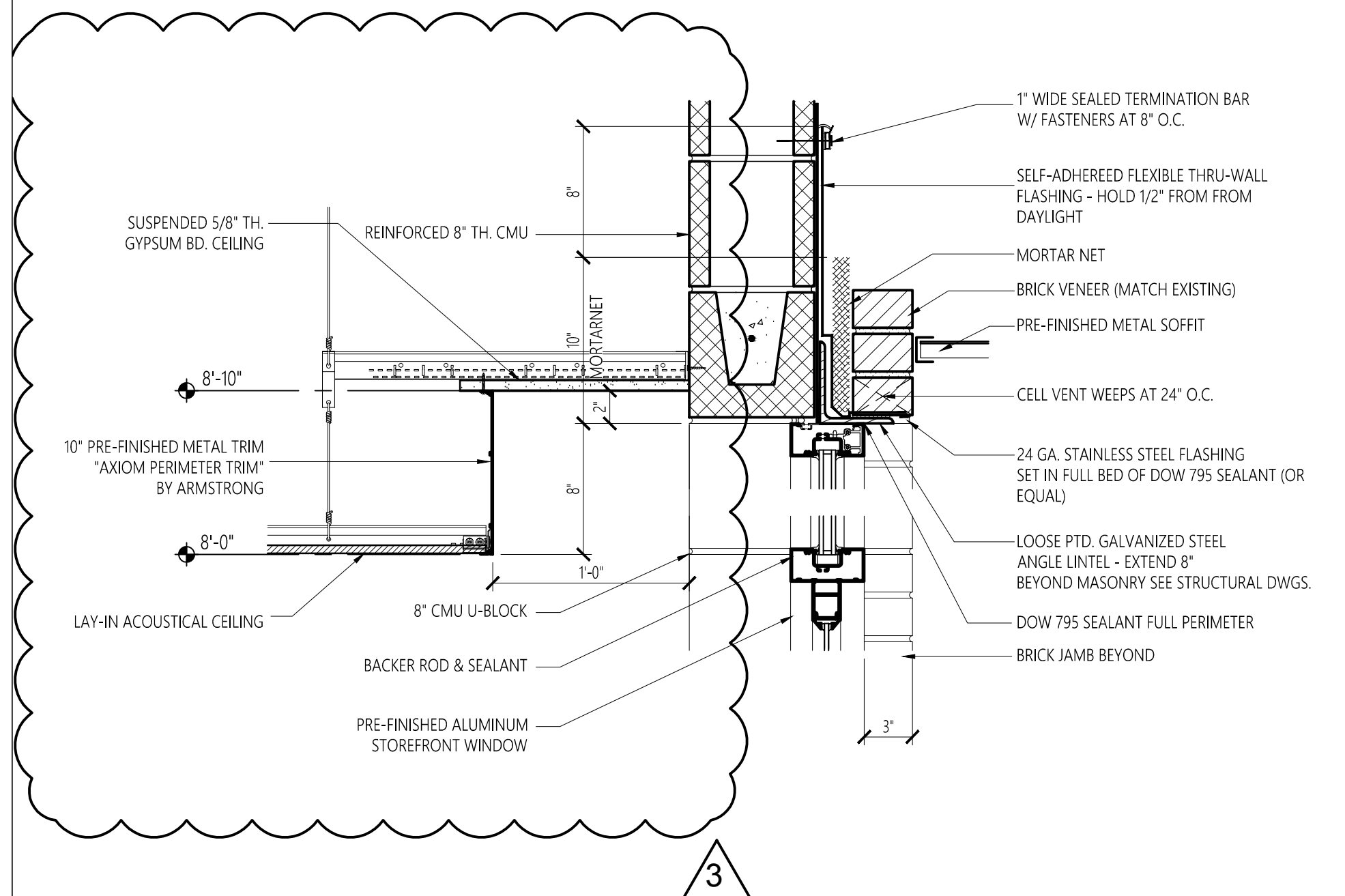
1 DOOR HEAD DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



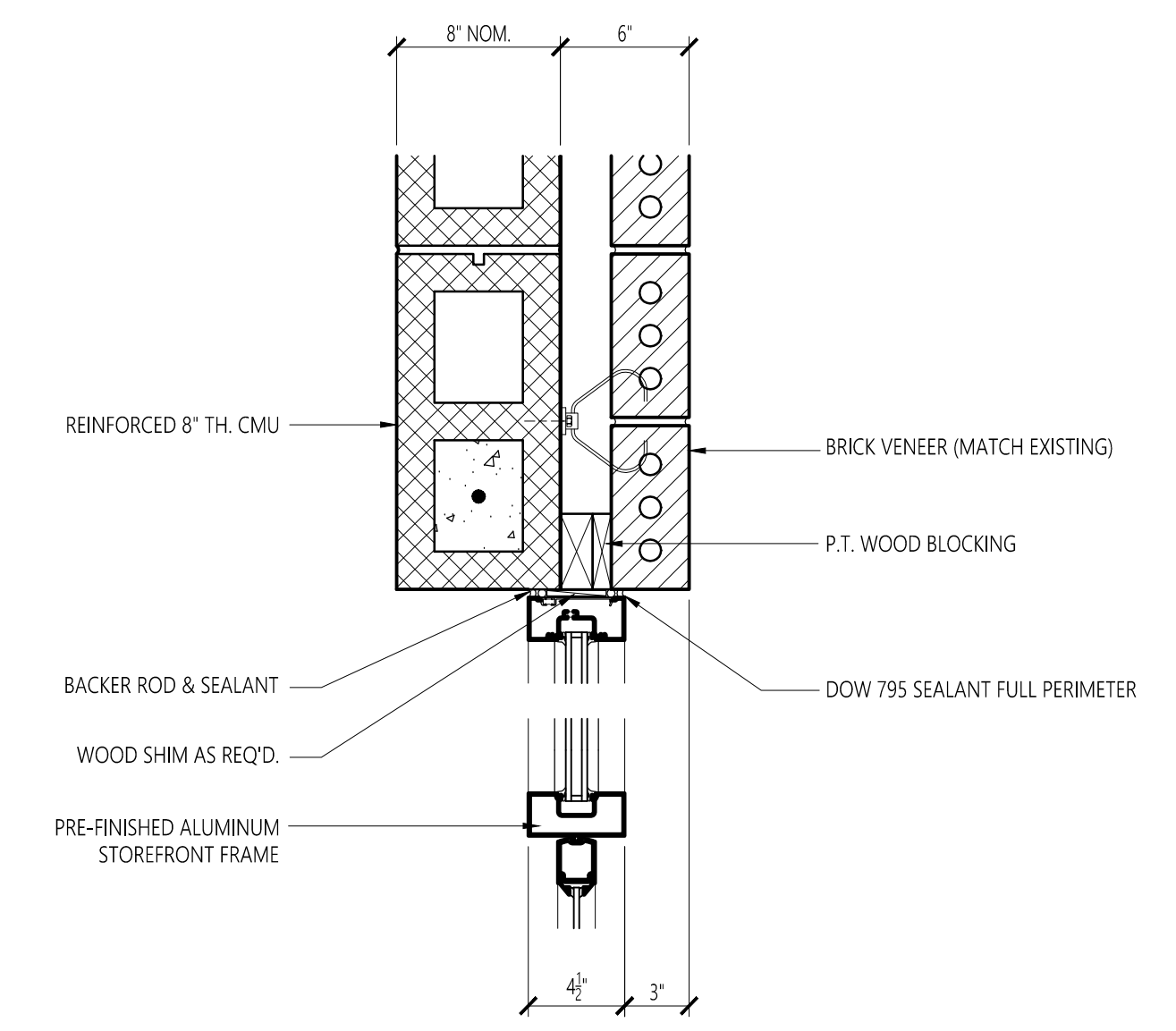
2 DOOR JAMB DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



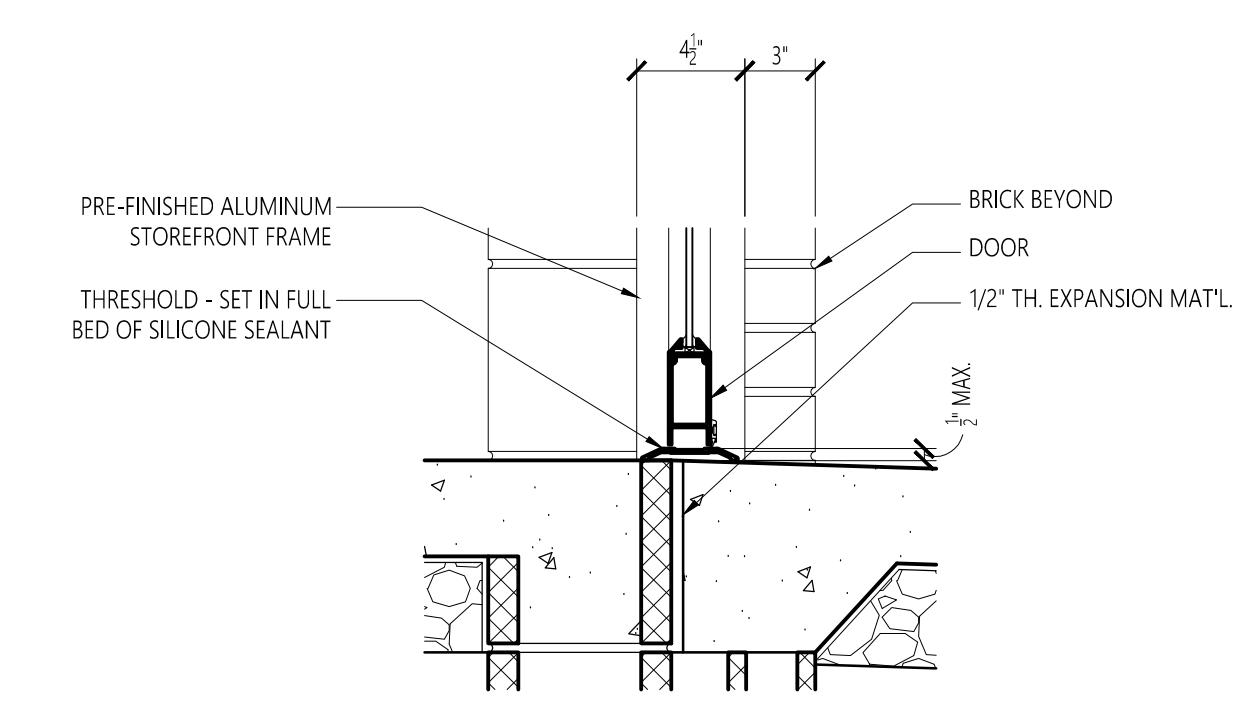
3 DOOR SILL DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



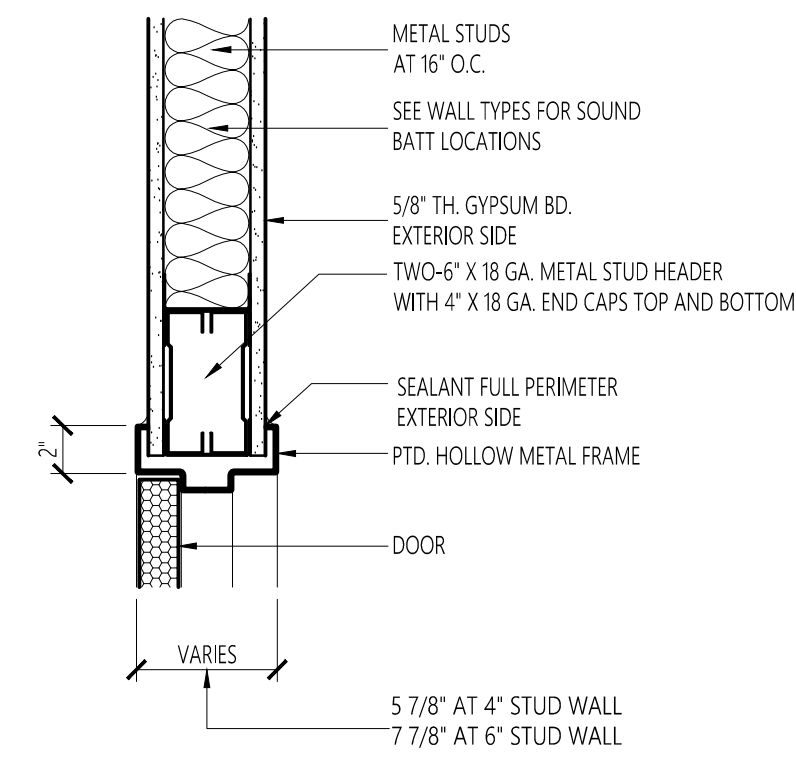
4 DOOR HEAD DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



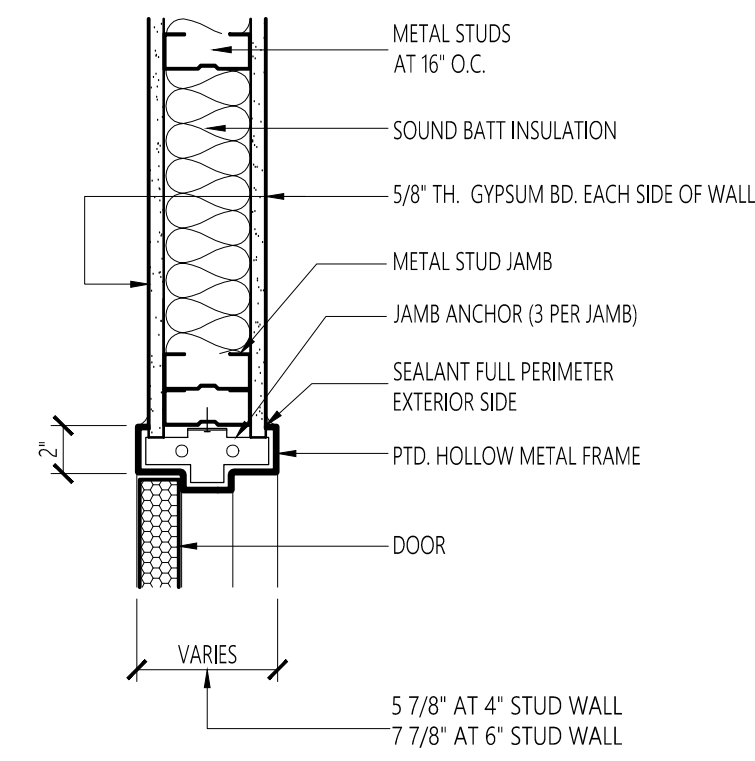
5 DOOR JAMB DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



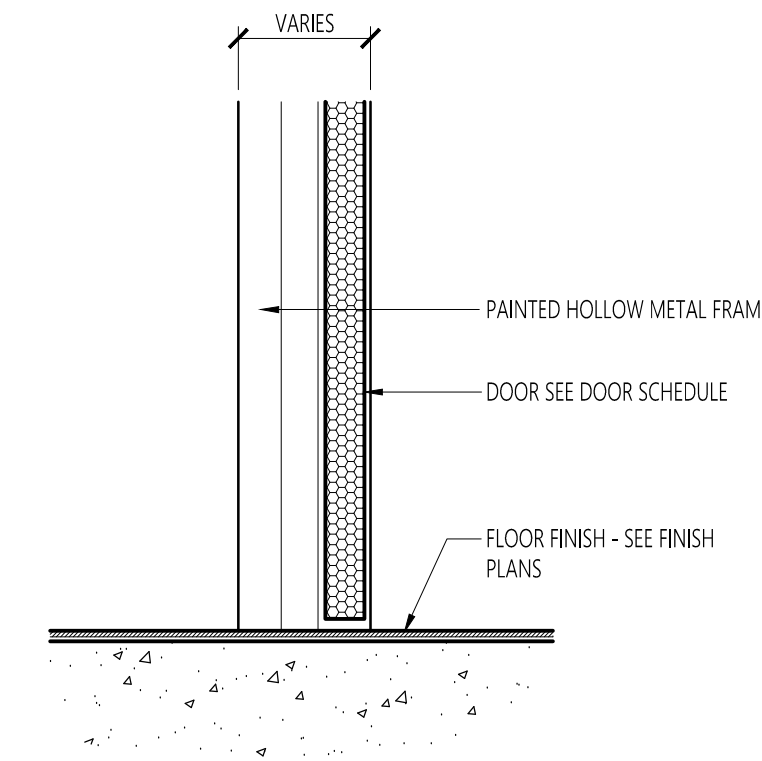
6 DOOR SILL DETAIL
A8.3 SCALE: 1 1/2" = 1'-0"



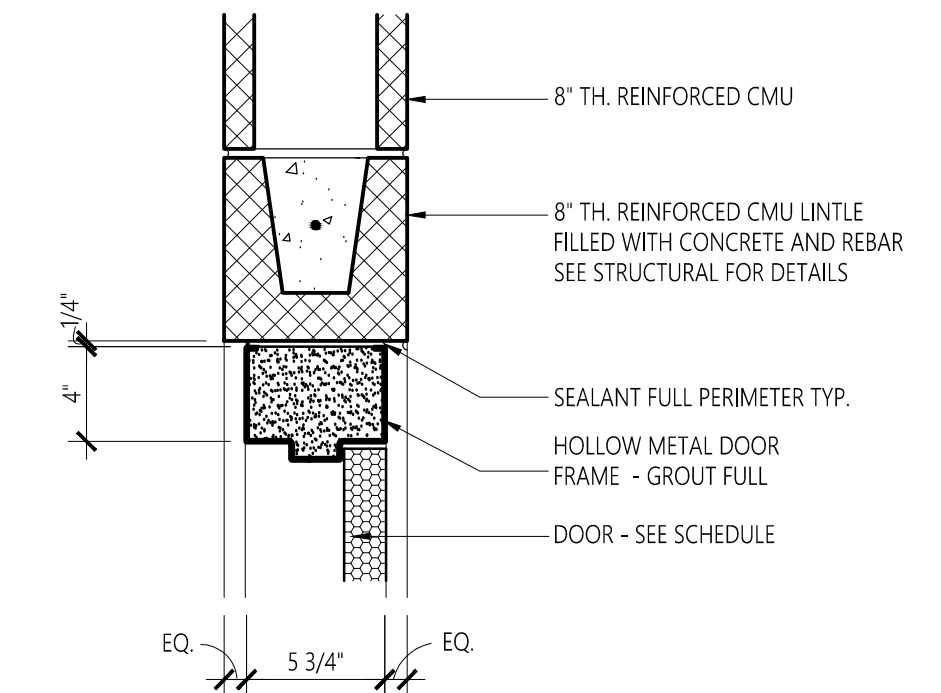
1 DOOR HEAD DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



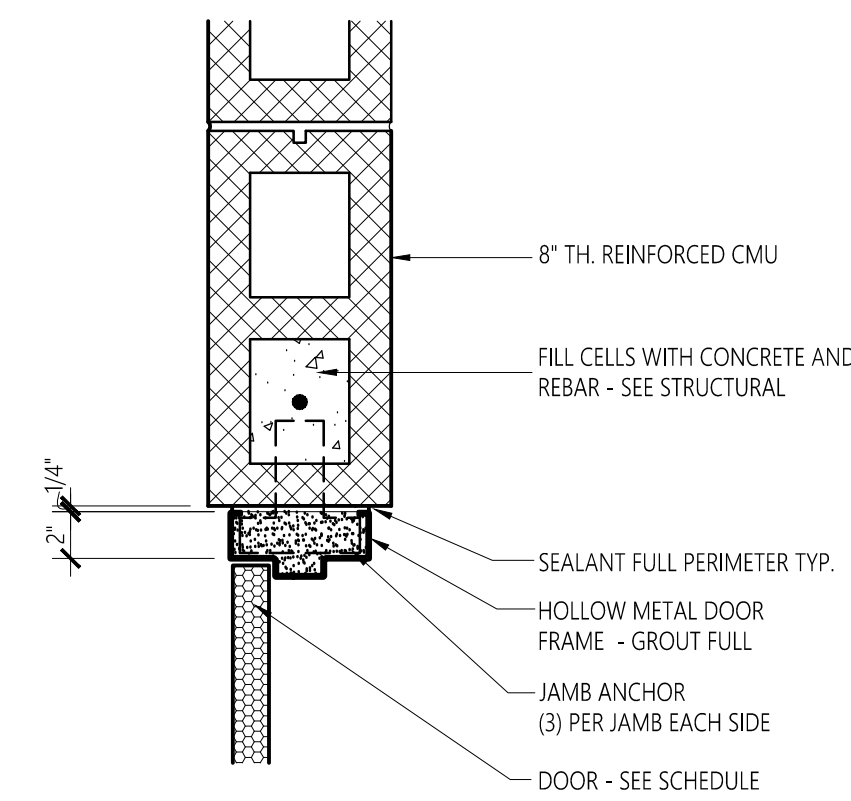
2 DOOR JAMB DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



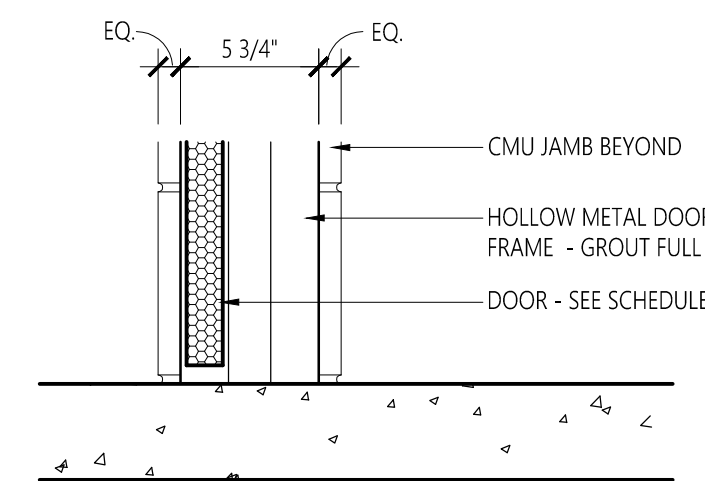
3 DOOR SILL DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



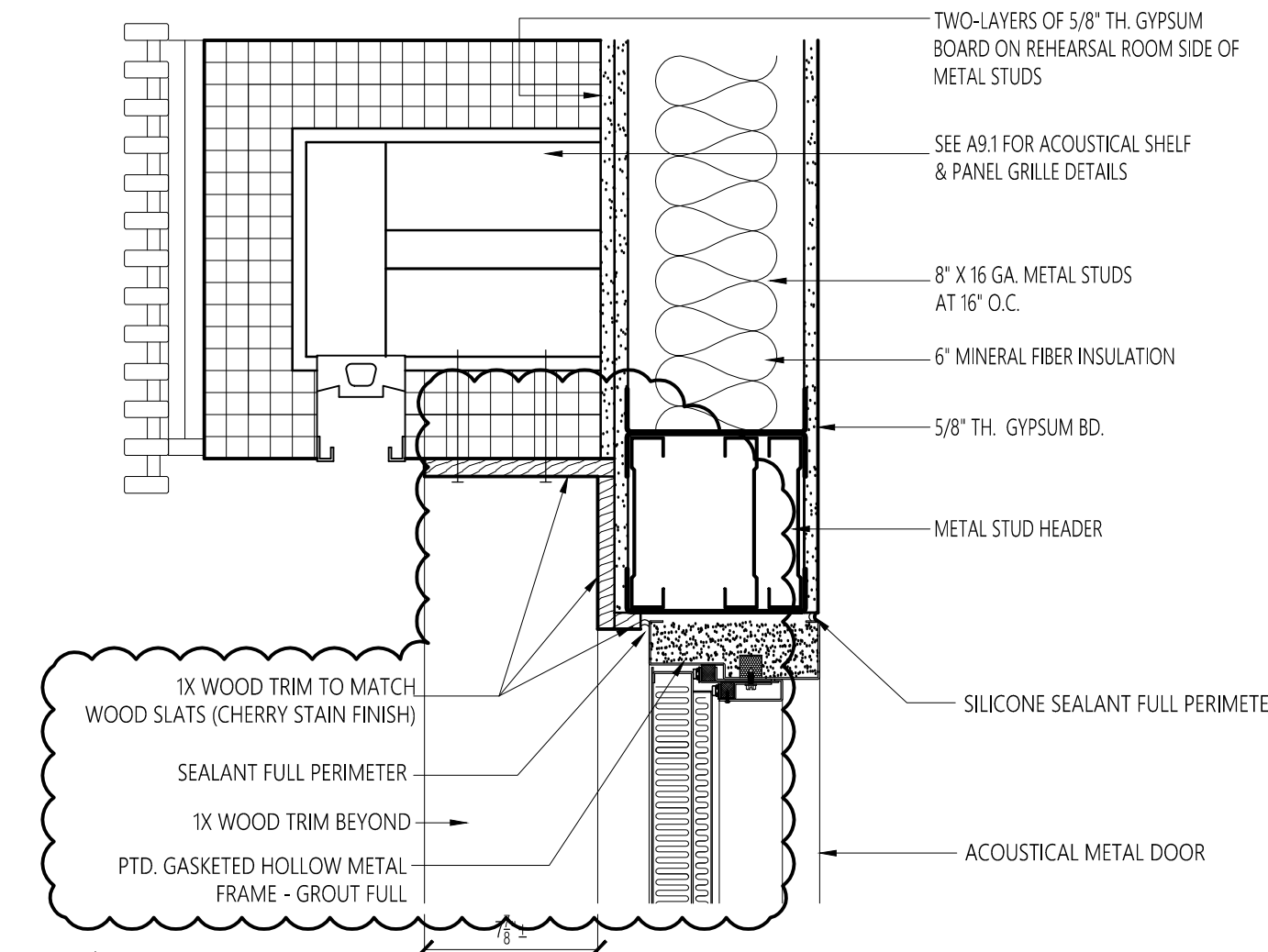
4 DOOR HEAD DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



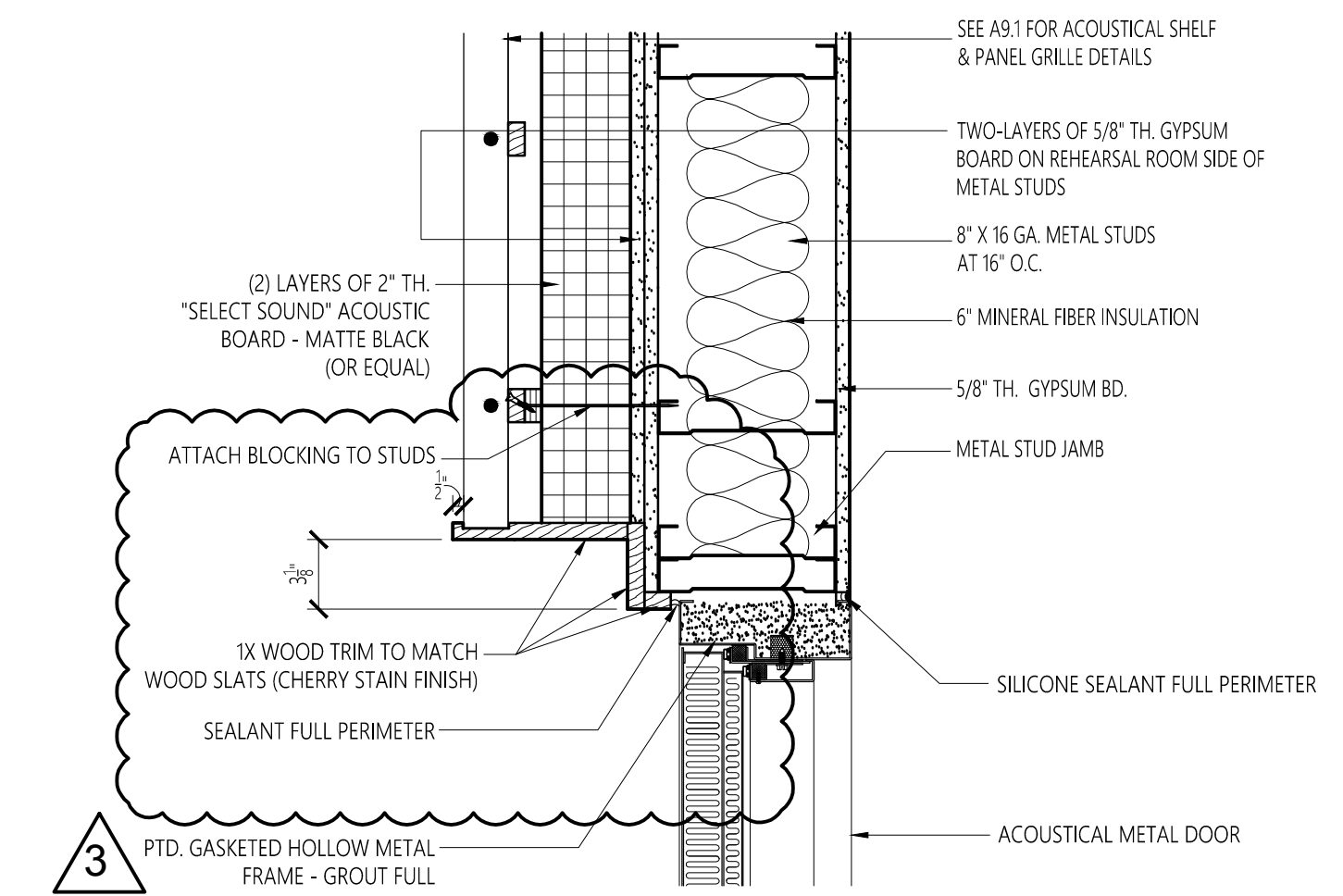
5 DOOR JAMB DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



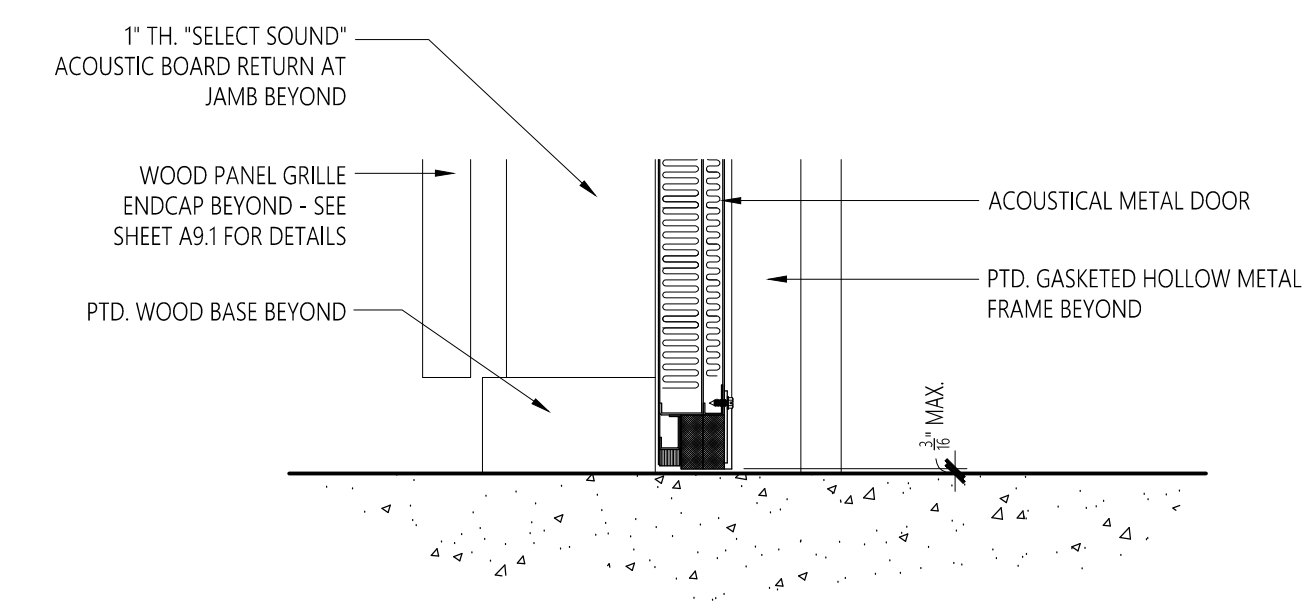
6 DOOR SILL DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



7 DOOR HEAD DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"

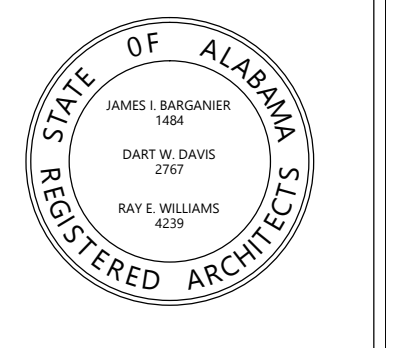


8 DOOR JAMB DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"



9 DOOR SILL DETAIL
A8.4 SCALE: 1 1/2" = 1'-0"

No.	Revision	Date
1	Addm. #2	7-13-17
2	Addm. #3	7-20-17



Project Number: 2015-255
BARGANIER DAVIS SIMS
Drawn By:

GOODWIN HALL - RENOVATION AND BAND REHEARSAL HALL ADDITION
Project Number 15-255

SHEET TITLE:
DOOR DETAILS

DRAWN BY:
-
CHECKED BY:
-
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
16-111
SHEET NUMBER:

A8.4

ROOM FINISH SCHEDULE									
ROOM NUMBER	ROOM NAME	FLOOR	BASE	WALL				CEILING	REMARKS
				NORTH	EAST	SOUTH	WEST		
101	VESTIBULE	VCT	RUBBER	PAINT	PAINT	PAINT	PAINT	-	
102	PRACTICE RM/STORAGE	VCT	RUBBER	PAINT	PAINT	PAINT	PAINT	LAY-IN	
103	OFFICE	CARPET	RUBBER	PAINT	PAINT	PAINT	PAINT	LAY-IN	
104	CONCERT ENSEMBLE REHEARSAL	LVT	RUBBER	-	-	-	-	-	REMOVE EXISTING FLOORING
105	PERCUSSION PRACTICE RM	-	RUBBER	-	-	-	-	LAY-IN	NEW RUBBER BASE AT NEW PARTITION
106	MECHANICAL	-	-	-	-	-	-	-	
107	LOBBY & DISPLAY ARCHIVE	-	-	-	-	-	-	-	PAINT WALLS AT NEW WALLS-NEW RUBBER BASE AT NEW WALL
108	CHAIR/STAND STORAGE	VCT	RUBBER	PAINT	PAINT	PAINT	PAINT	PAINT	CLEAN AND WAX EXISTING FLOOR
109	CHAIR/STAND STORAGE	VCT	RUBBER	PAINT	PAINT	PAINT	PAINT	PAINT	CLEAN AND WAX EXISTING FLOOR
110	NEW OFFICE	CARPET	RUBBER	PAINT	PAINT	PAINT	PAINT	LAY-IN	
111	OFFICE	-	-	-	-	-	-	-	
112	OFFICE	-	-	-	-	-	-	-	PAINT WALL AT INFILLED DOOR-NEW RUBBER BASE AT INFILLED WALL
113	OFFICE	-	-	-	-	-	-	-	
114	CONFERENCE/T.A. OFFICE	CARPET	RUBBER	PAINT	PAINT	PAINT	PAINT	-	
115	CORRIDOR	VCT	RUBBER	PAINT	PAINT	PAINT	PAINT	-	NEW RUBBER BASE AT NEW PARTITION
116	CORRIDOR	CARPET	RUBBER	PAINT	PAINT	PAINT	PAINT	ACOUSTICAL	MATCH EXISTING FLOORING AND CEILING TILE
201	MEZZANINE/LIBRARY	CARPET	RUBBER	PAINT	PAINT	PAINT	PAINT	-	

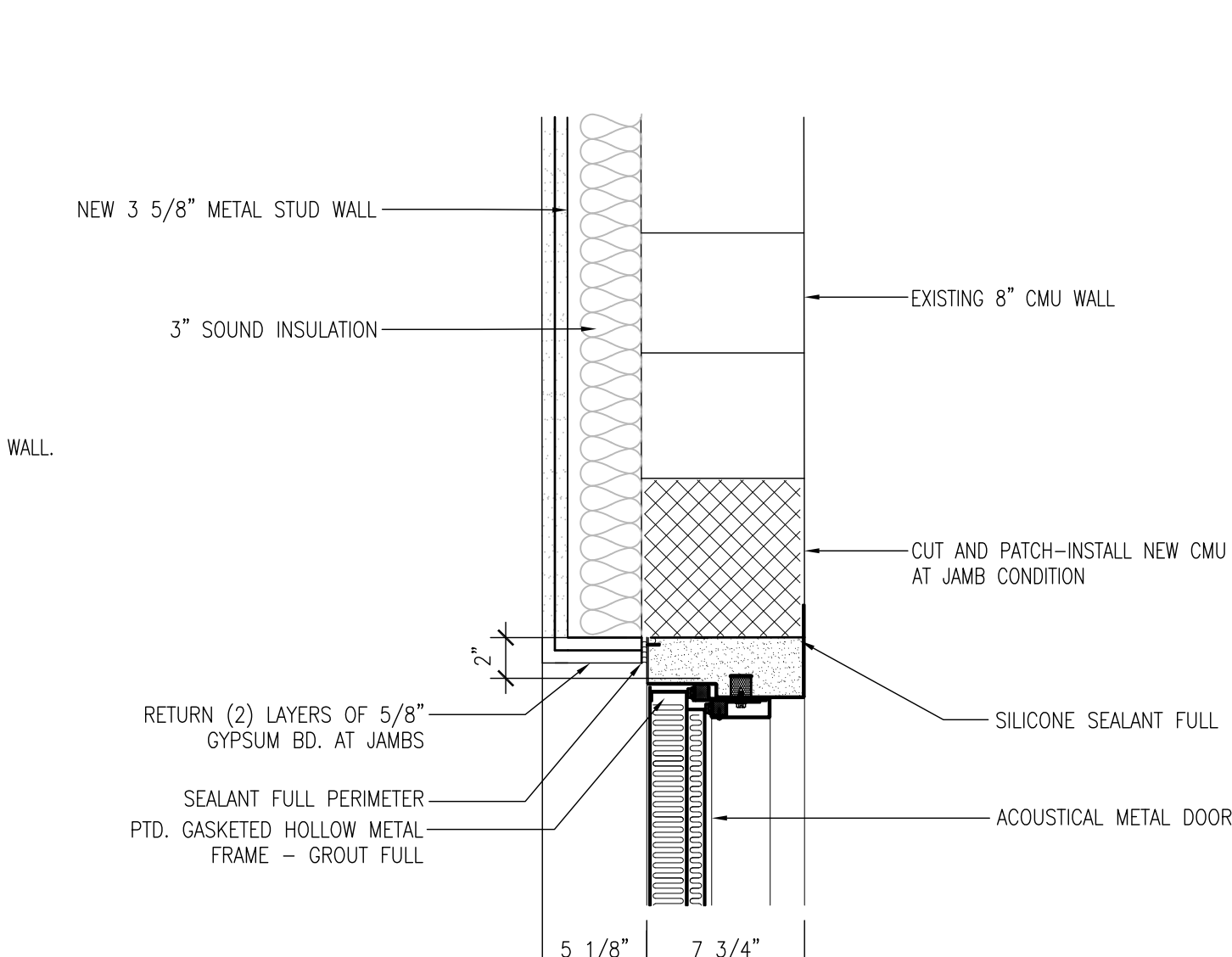
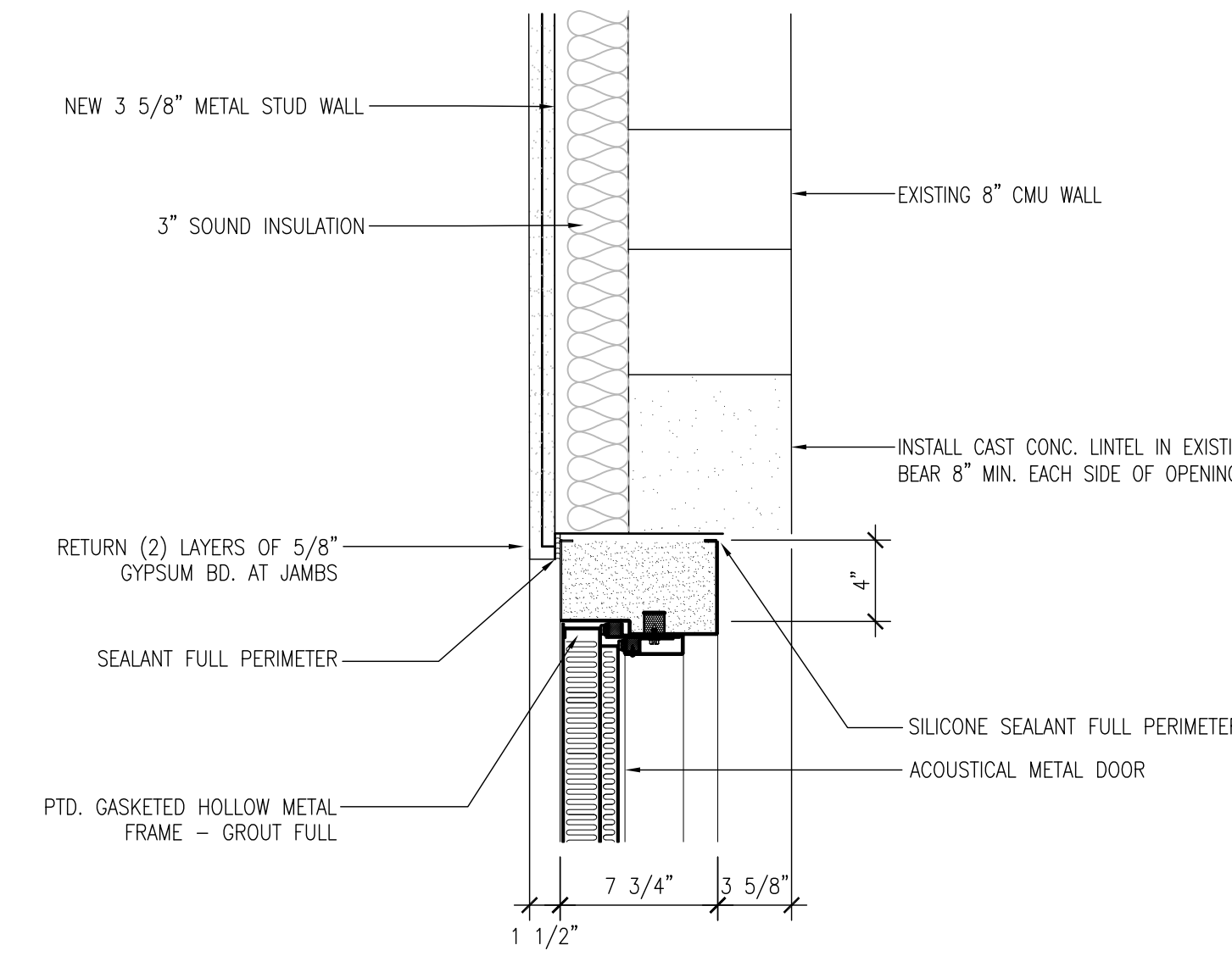
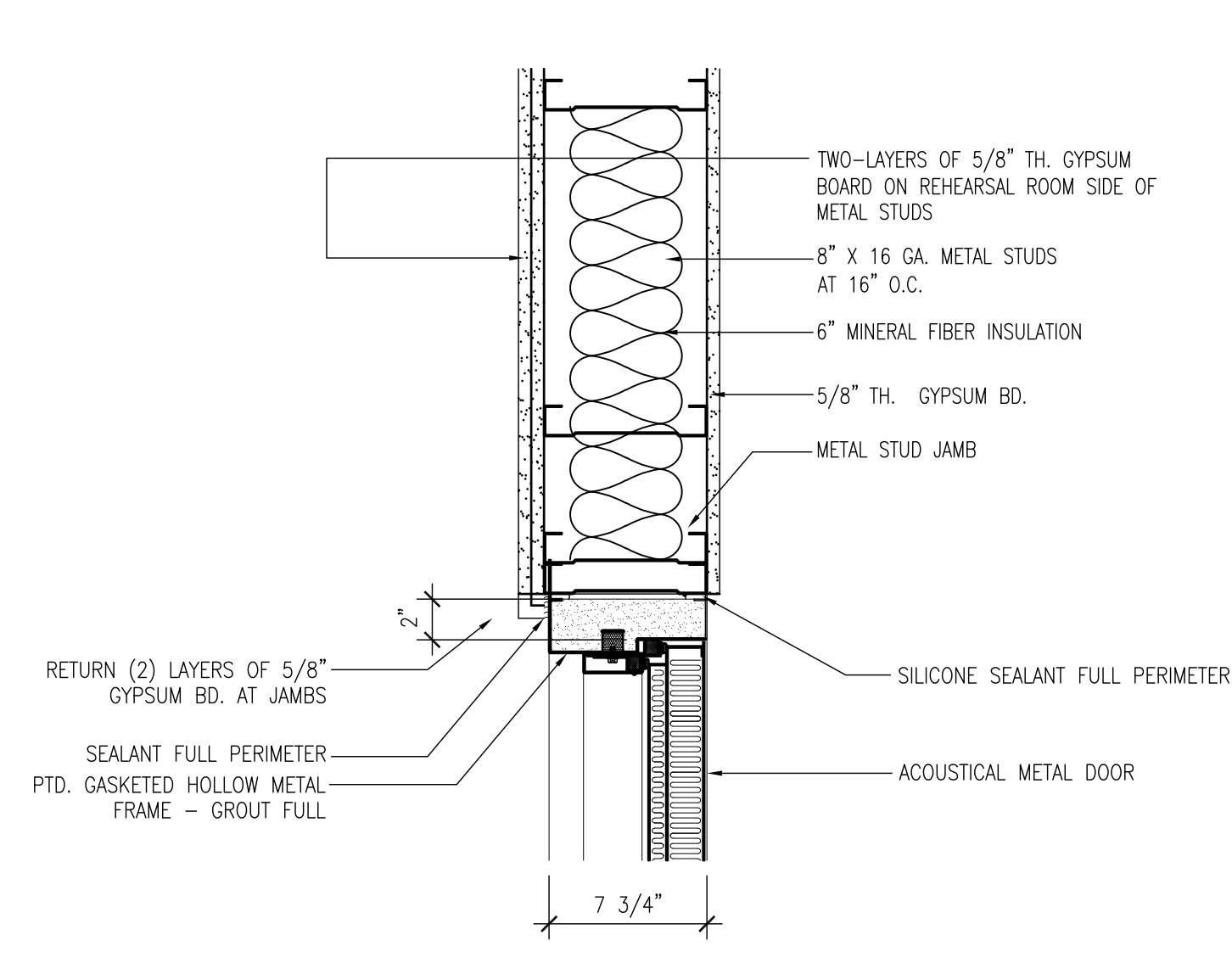
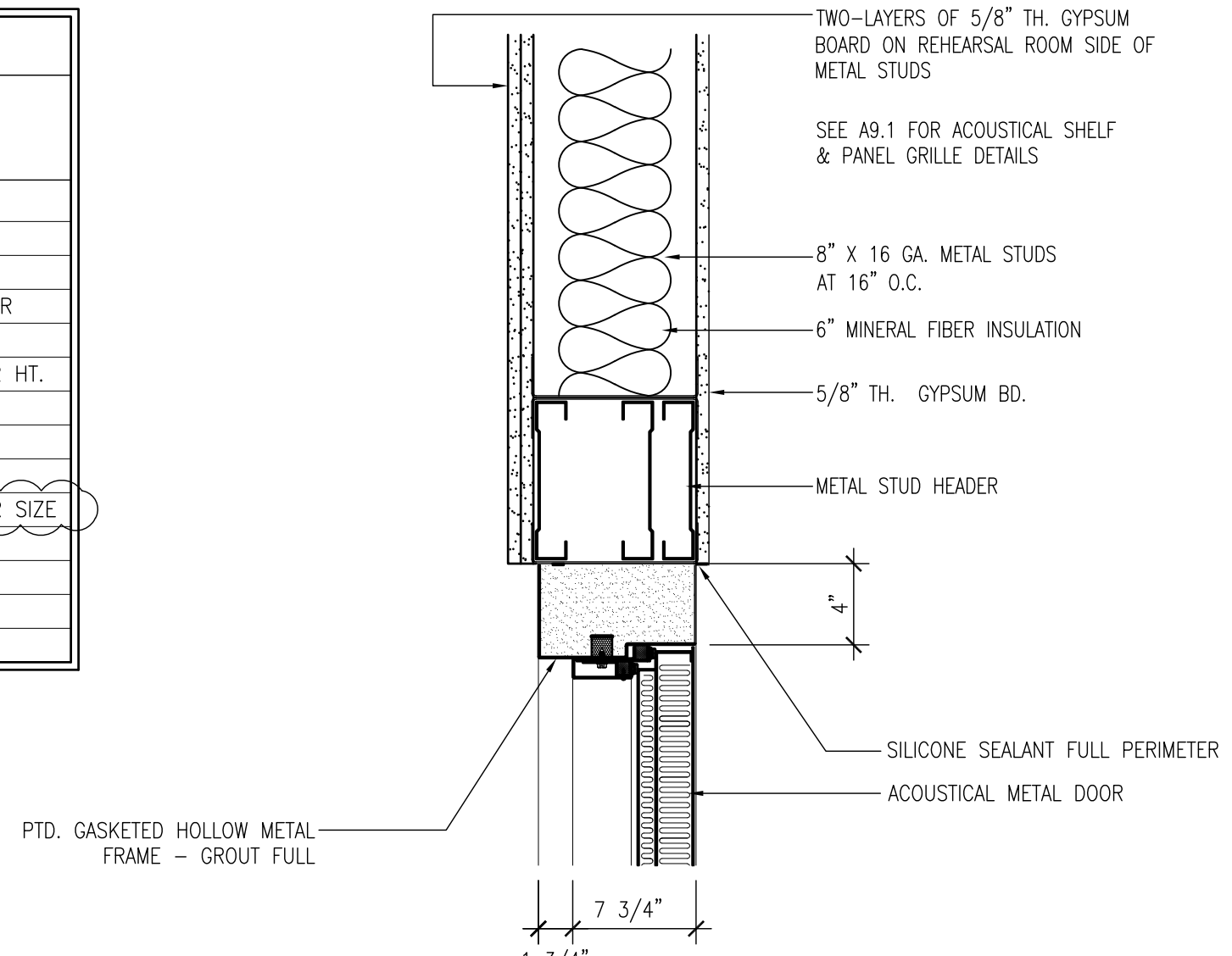
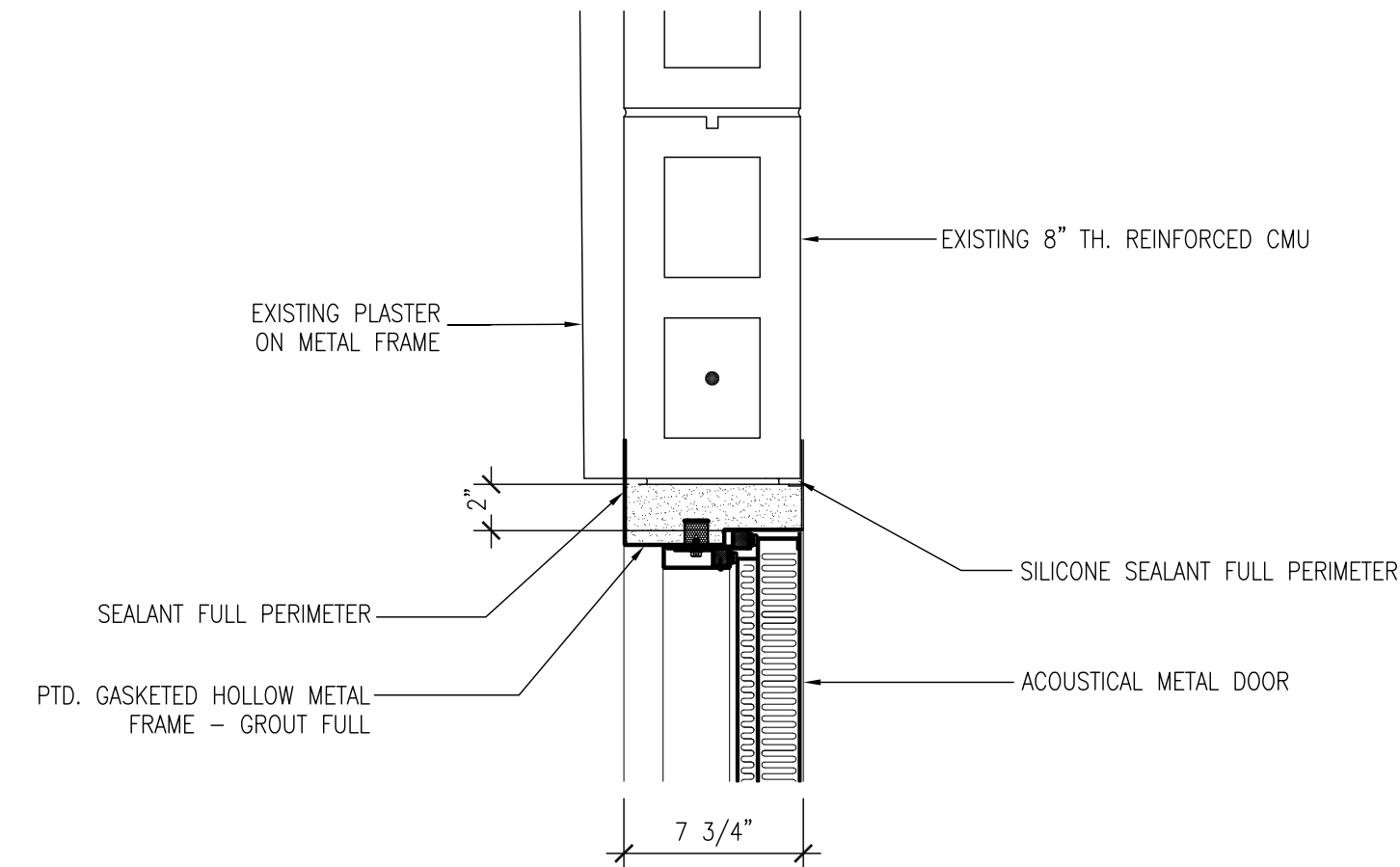
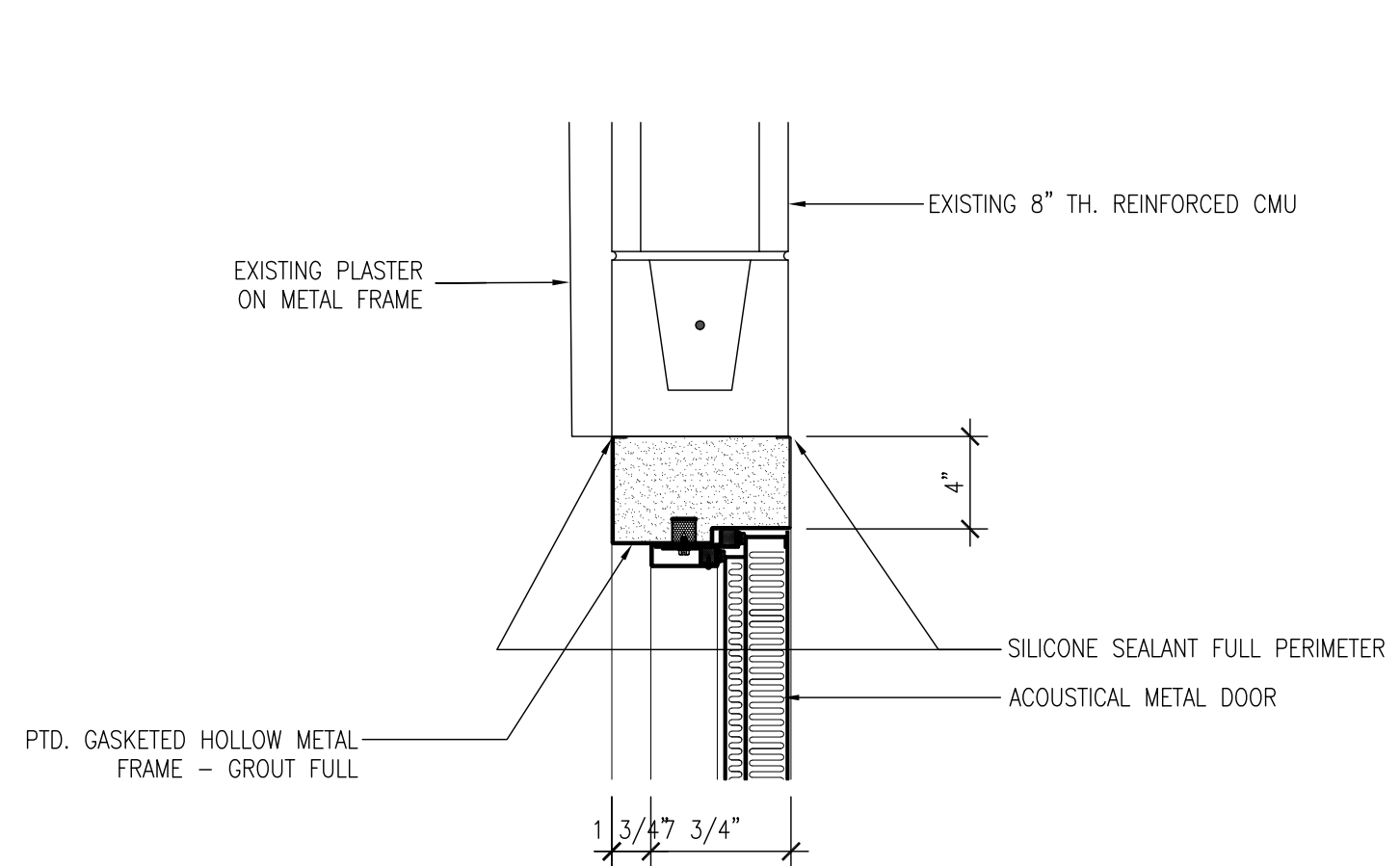
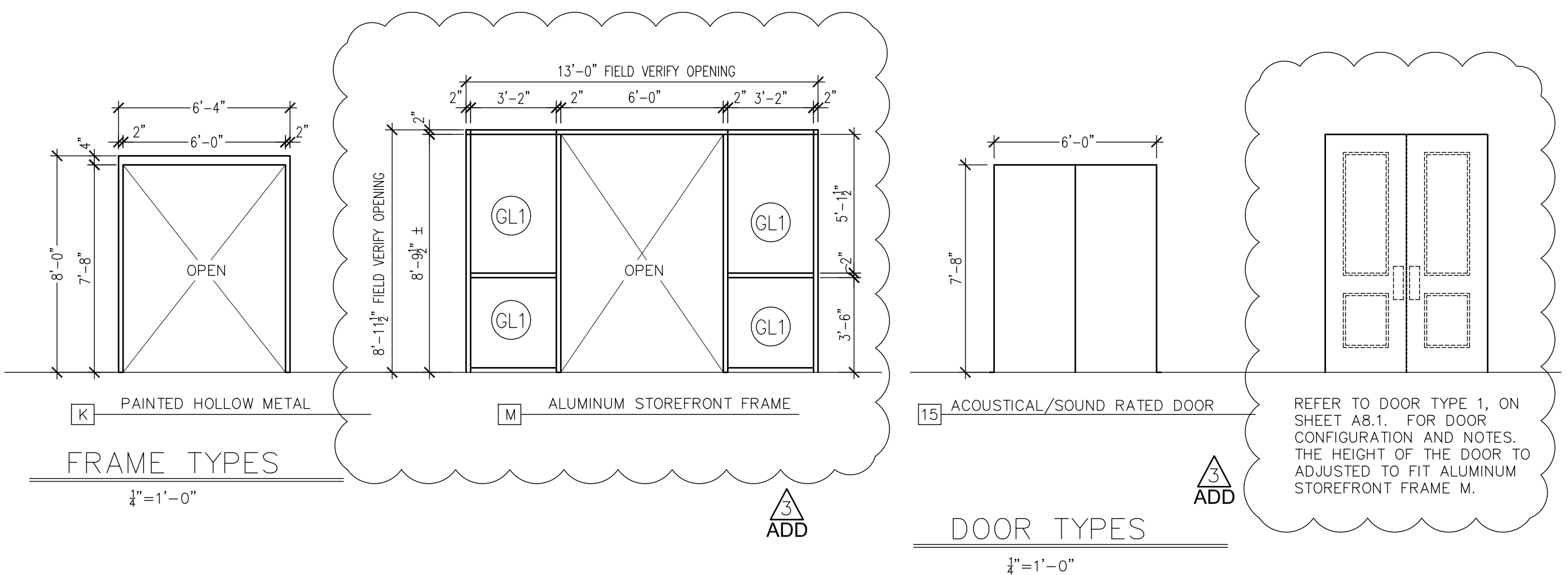
GENERAL NOTES

- 1.) ALL NEW PARTITIONS TO BE PAINTED TO MATCH ADJACENT SURFACE
- 2.) ALL NEW PARTITIONS TO RECEIVE NEW RUBBER BASE TO MATCH EXISTING

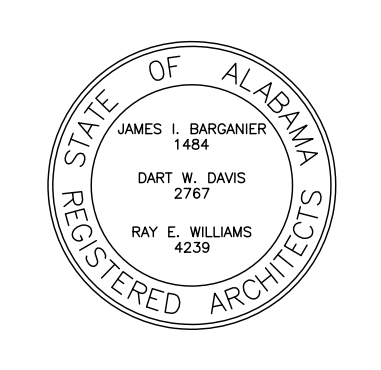
DOOR SCHEDULE												
NO.	DOOR				FRAME		LABEL	SIGNAGE	DETAILS			REMARKS
	WIDTH	HEIGHT	THICK	TYPE	MAT'L.	TYPE			MAT'L.	HEAD	JAMB	
101	NO WORK											
102	4'-0"	7'-0"	1 3/4"	11	HM	J	HM	PRACTICE	7/AR5.0	8/AR5.0	3/AR2.2(SIM)	STC-51 ACOUSTICAL DOOR
103	4'-0"	7'-0"	1 3/4"	11	HM	J	HM	OFFICE	7/AR5.0	8/AR5.0	3/AR2.2(SIM)	STC-51 ACOUSTICAL DOOR
104A-1	PR. 3'-0"	7'-8"	1 3/4"	15	HM	K	HM	VESTIBULE	1/AR5.0	2/AR5.0	3/AR2.2(SIM)	STC-51 ACOUSTICAL DOOR-REPLACE EXISTING HM FRAME & DOOR
104B-1	NO WORK											
104C	PR. 3'-0"	7'-8"	1 3/4"	15	HM	K	HM	VESTIBULE	1/AR5.0(SIM)	5/AR5.0		EXISTING DOOR TO REMAIN NEW DOOR TO BE INCLUDED IN BASE BID-VERIFY EXISTING DOOR HT.
104D	NO WORK											
105A	4'-0"	7'-0"	1 3/4"	11	HM	J	HM	PERCUSSION PRACTICE	4/AR5.0	5/AR5.0	3/AR2.2(SIM)	STC-51 ACOUSTICAL DOOR
105B	4'-0"	7'-0"	1 3/4"	11	HM	J	HM	OFFICE	7/AR5.0	8/AR5.0	3/AR2.2(SIM)	STC-51 ACOUSTICAL DOOR
107	PR. 3'-0"	8'-9 1/2"	1 3/4"	1	ALUM	M	ALUM	OFFICE	1/AR7.0	2/AR7.0	3/AR7.0	NEW DOOR TO BE INCLUDED IN BASE BID-VERIFY EXISTING DOOR SIZE
108	PR. 3'-0"	7'-0"	1 3/4"	3	SCW	C	HM	STORAGE	1/AR8.4	2/AR8.4		
109	PR. 3'-0"	7'-0"	1 3/4"	3	SCW	C	HM	STORAGE	1/AR8.4	2/AR8.4		
110	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	OFFICE	1/AR8.4	2/AR8.4		6"x18" VIEW PANEL- INCLUDED IN BASE BID
114	3'-0"	7'-0"	1 3/4"	2	SCW	B	PHM	CONFERENCE	1/AR8.4	2/AR8.4		6"x18" VIEW PANEL- INCLUDED IN BASE BID

NOTE:

SEE A8.1 FOR ADDITIONAL DOOR AND FRAME TYPES



No.	Revision	Date
1	ADDENDUM	7/13/17
2	ADDENDUM	7/20/17



Project Number: 2016-111
BARGANIER DAVIS SIMS
 Drawn By:

GOODWIN HALL - RENOVATION AND BAND REHEARSAL HALL ADDITION
 Project Number 15-255

SHEET TITLE:
DOOR SCHEDULE/ ROOM FINISH SCHEDULE

DRAWN BY:
 JBR

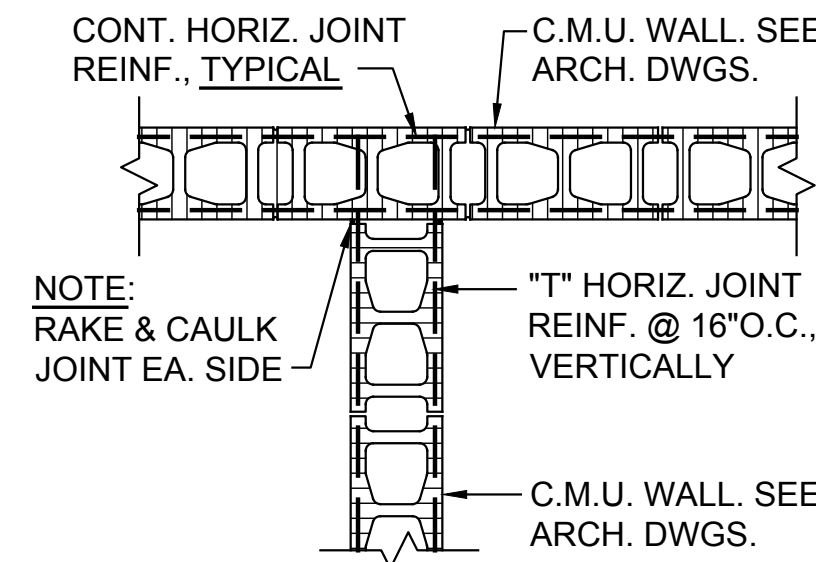
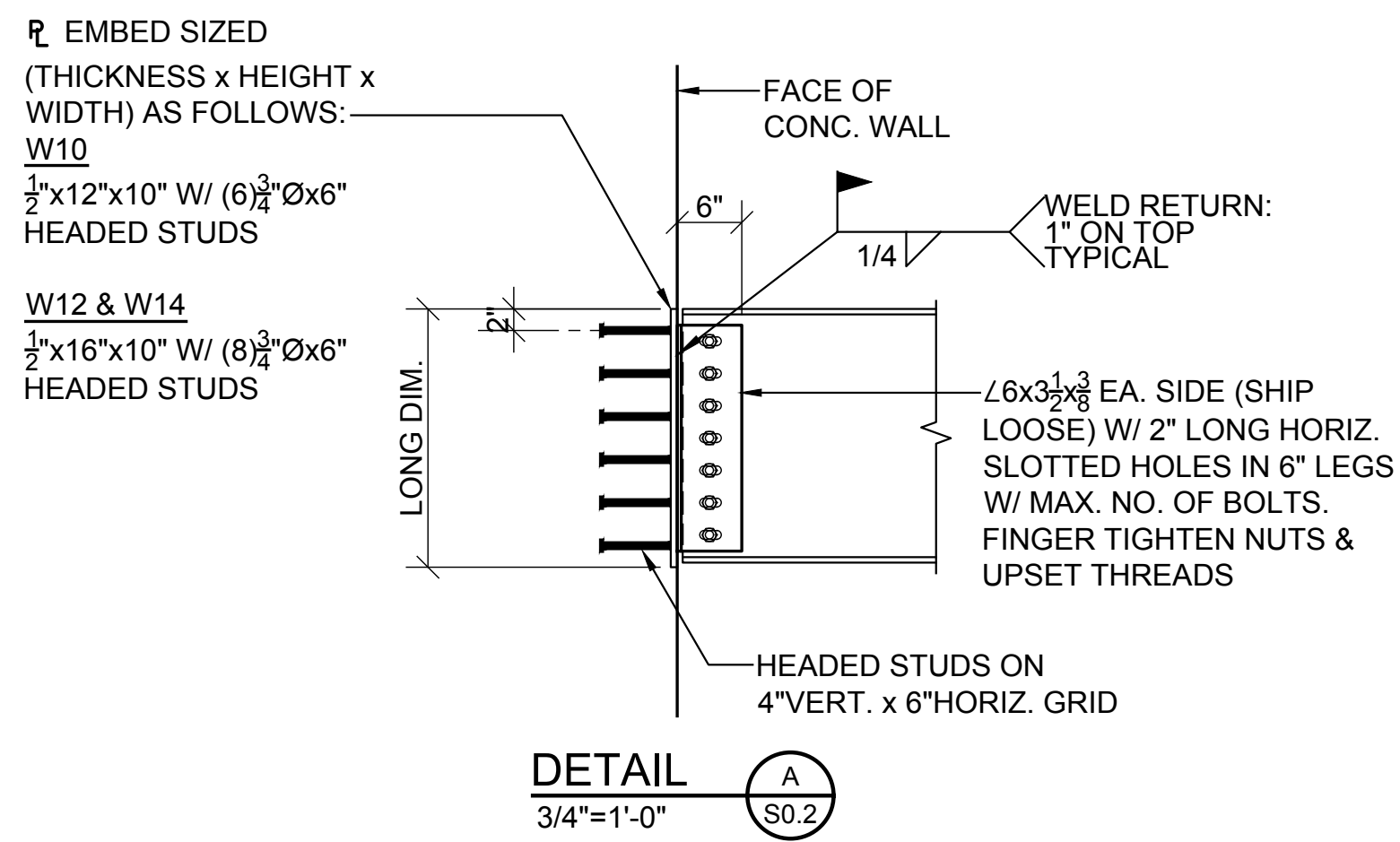
CHECKED BY:
 -

DATE:
 6-14-2017

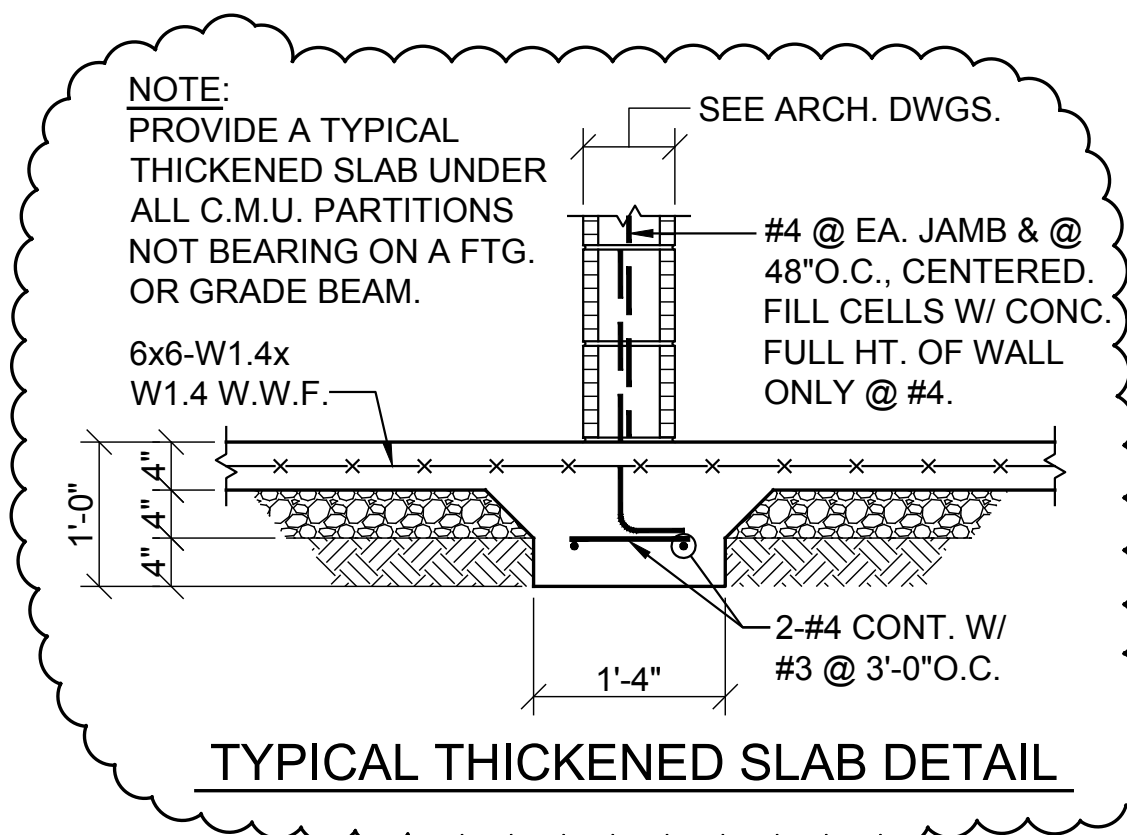
FILE NUMBER:
 -

PROJECT NUMBER:
 16-111

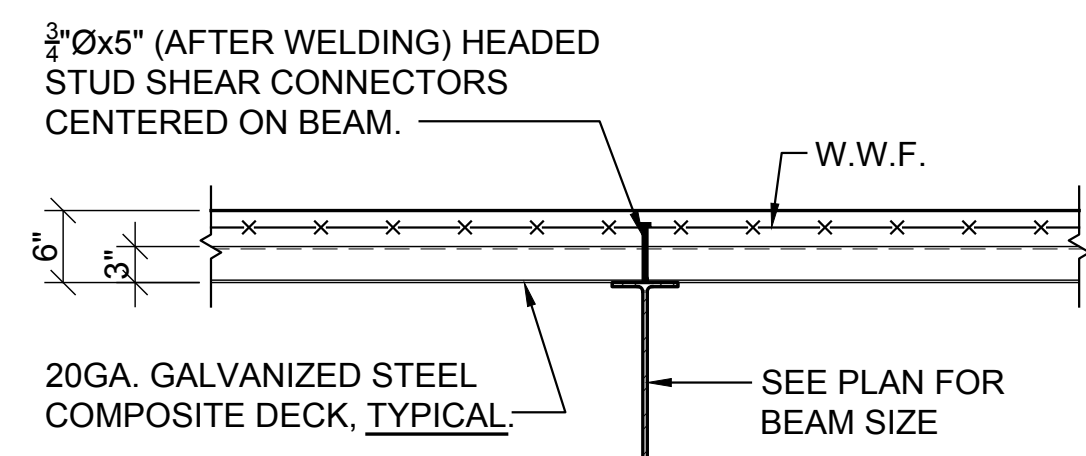
SHEET NUMBER:



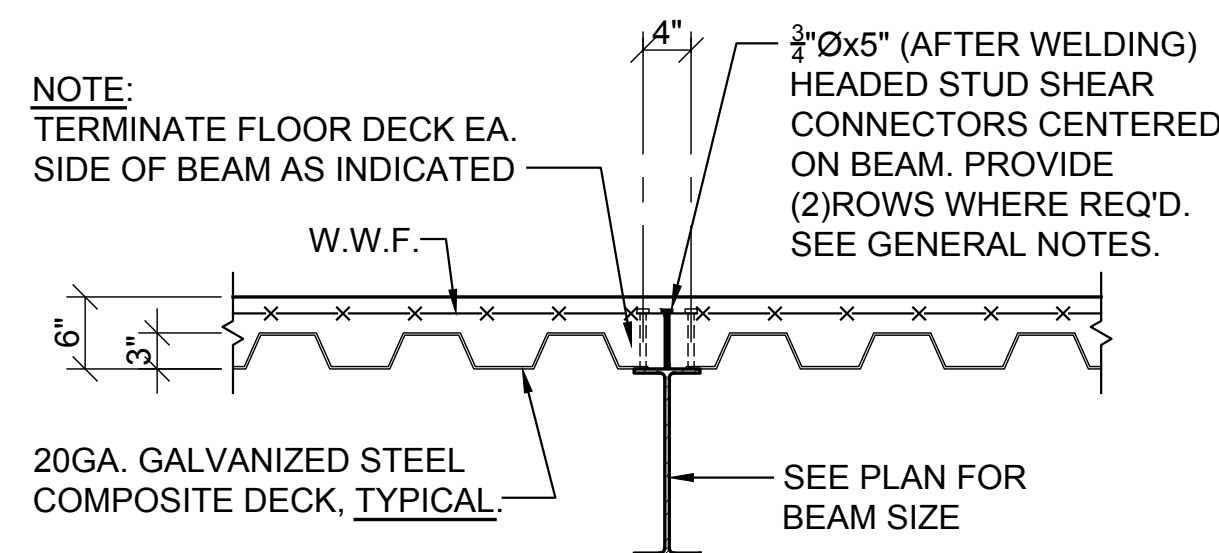
TYPICAL DETAIL AT WALL INTERSECTION



TYPICAL THICKENED SLAB DETAIL

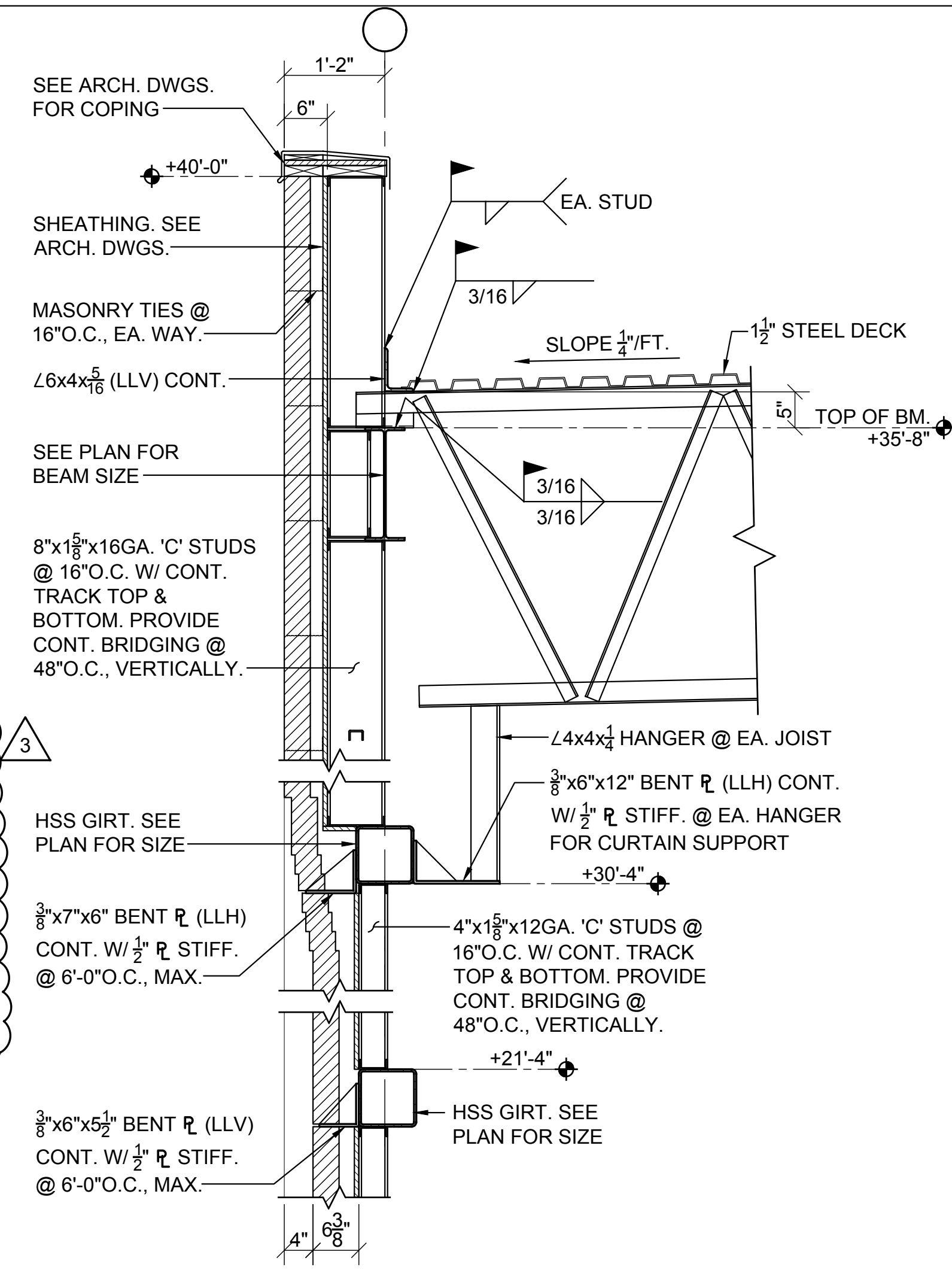


DECK SPAN PERPENDICULAR TO BEAM

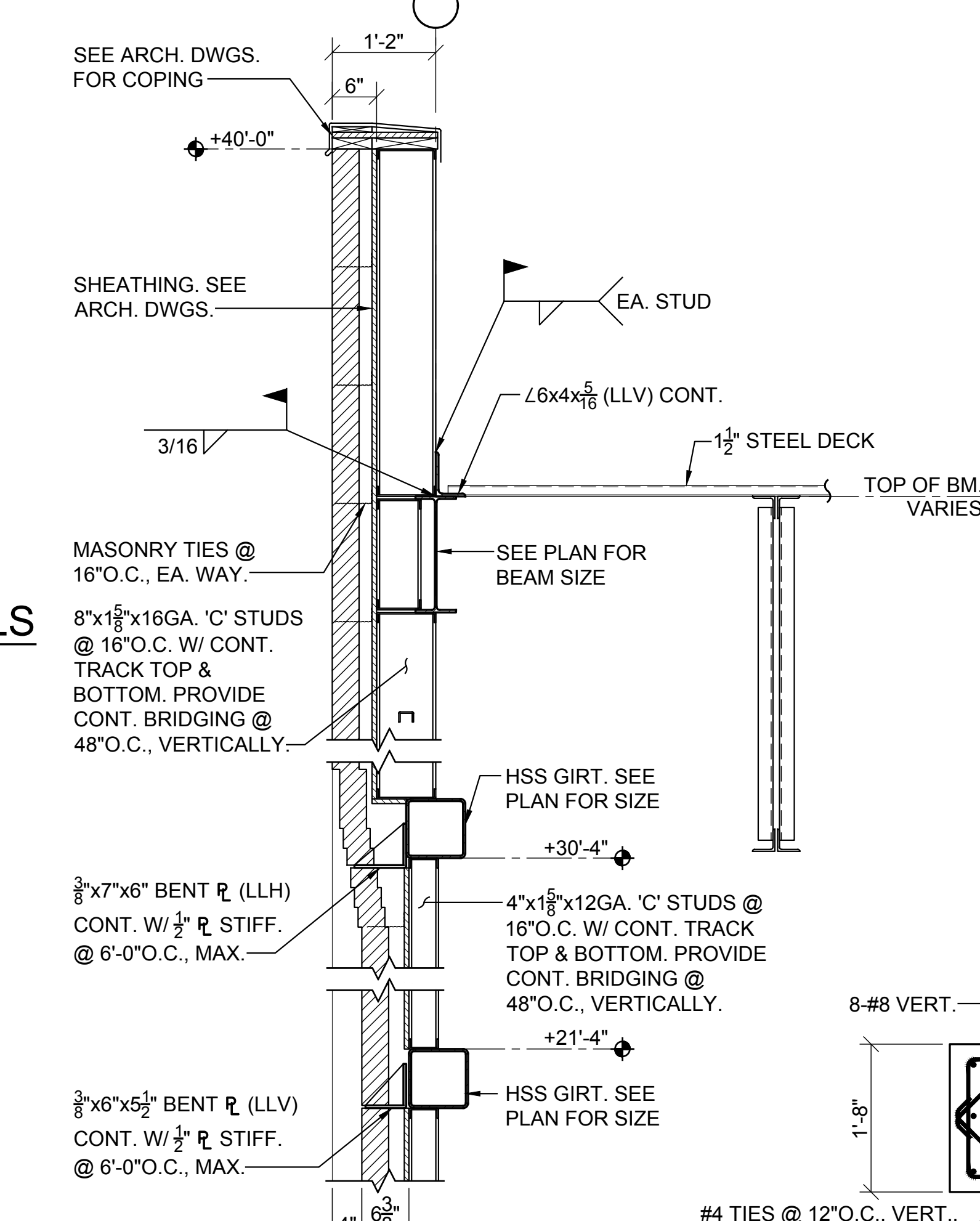


DECK SPAN PARALLEL TO BEAM

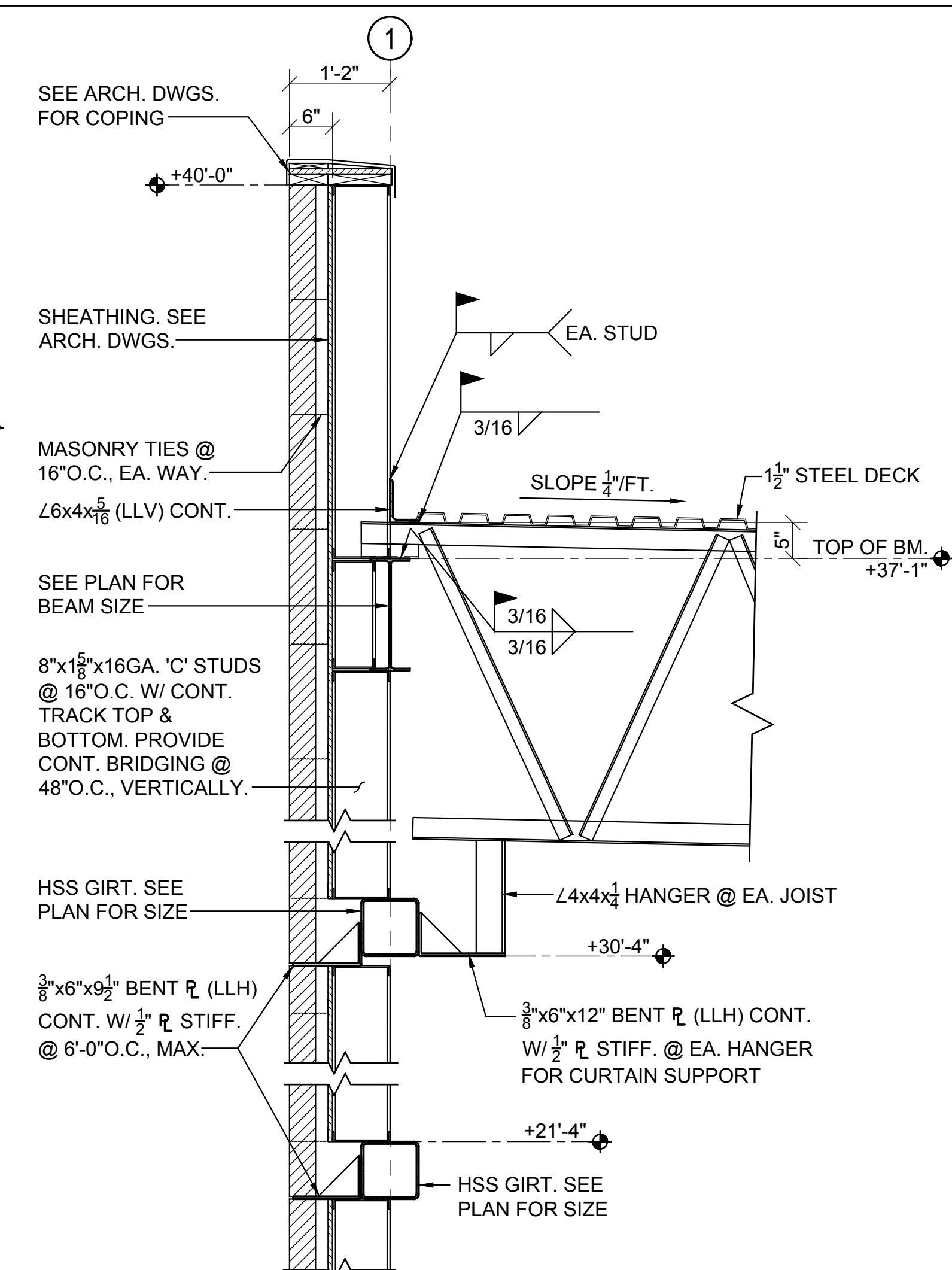
TYPICAL COMPOSITE FLOOR SLAB DETAILS



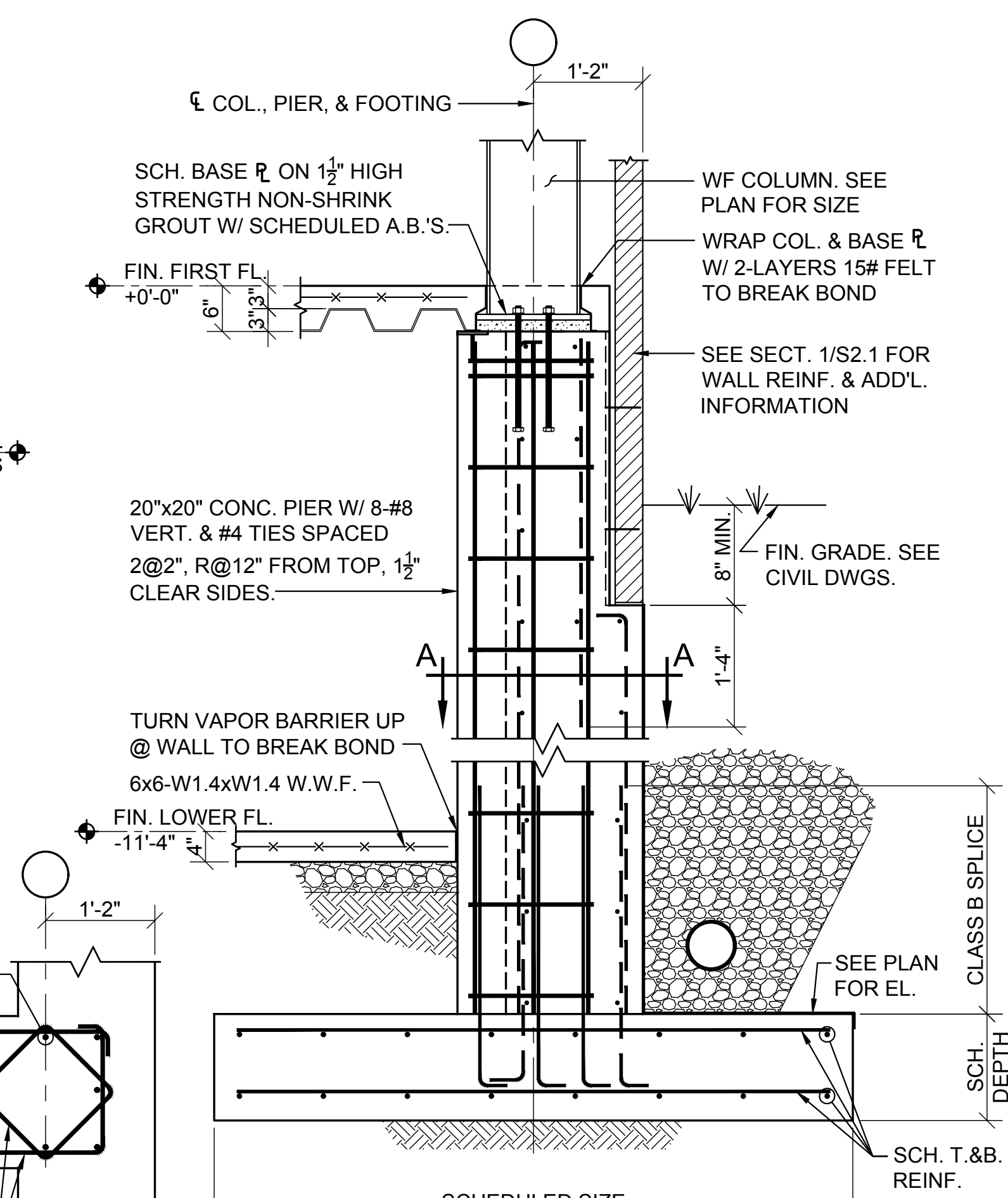
SECTION 1
3/4"=1'-0"



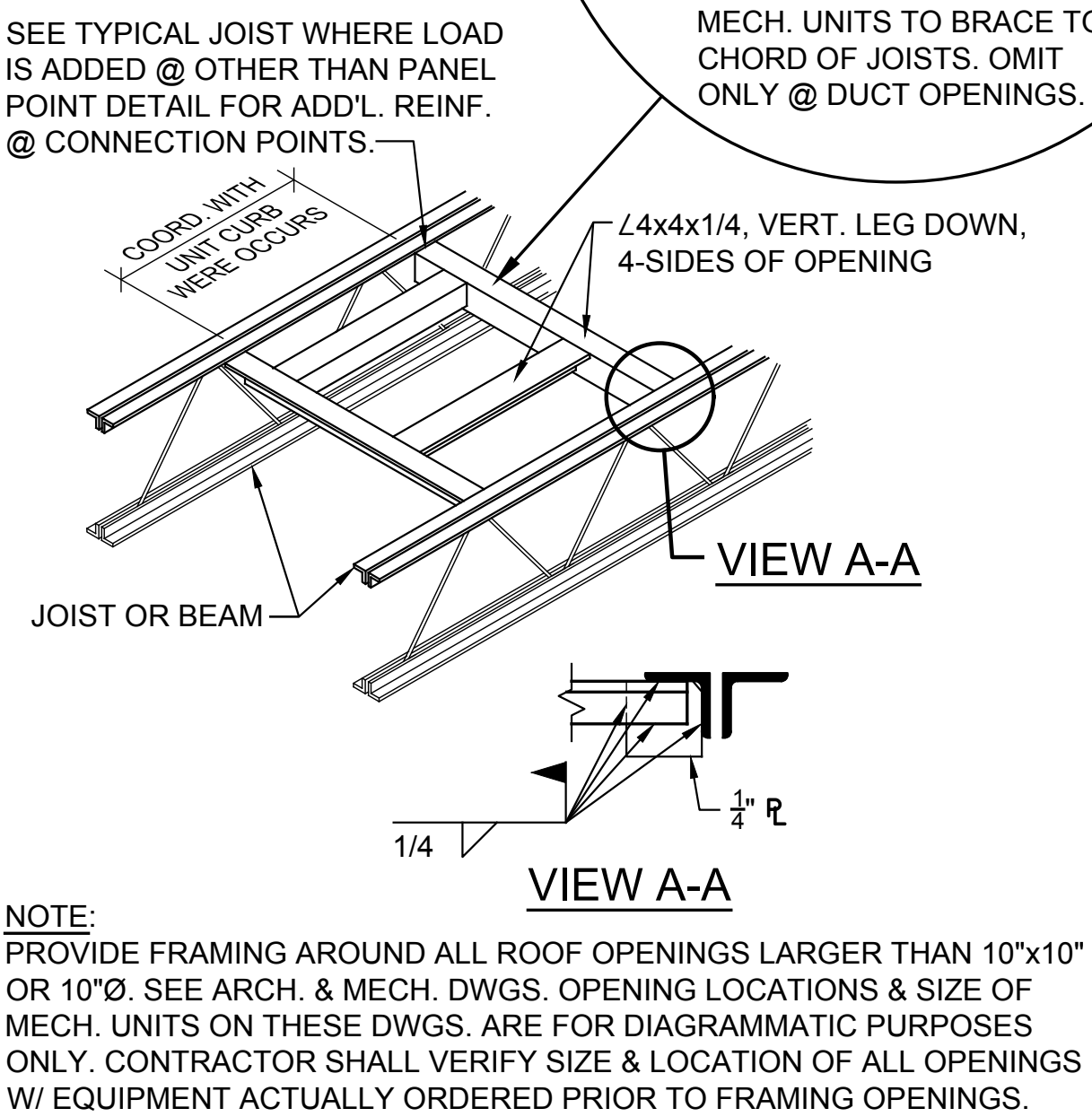
SECTION 3
3/4"=1'-0"



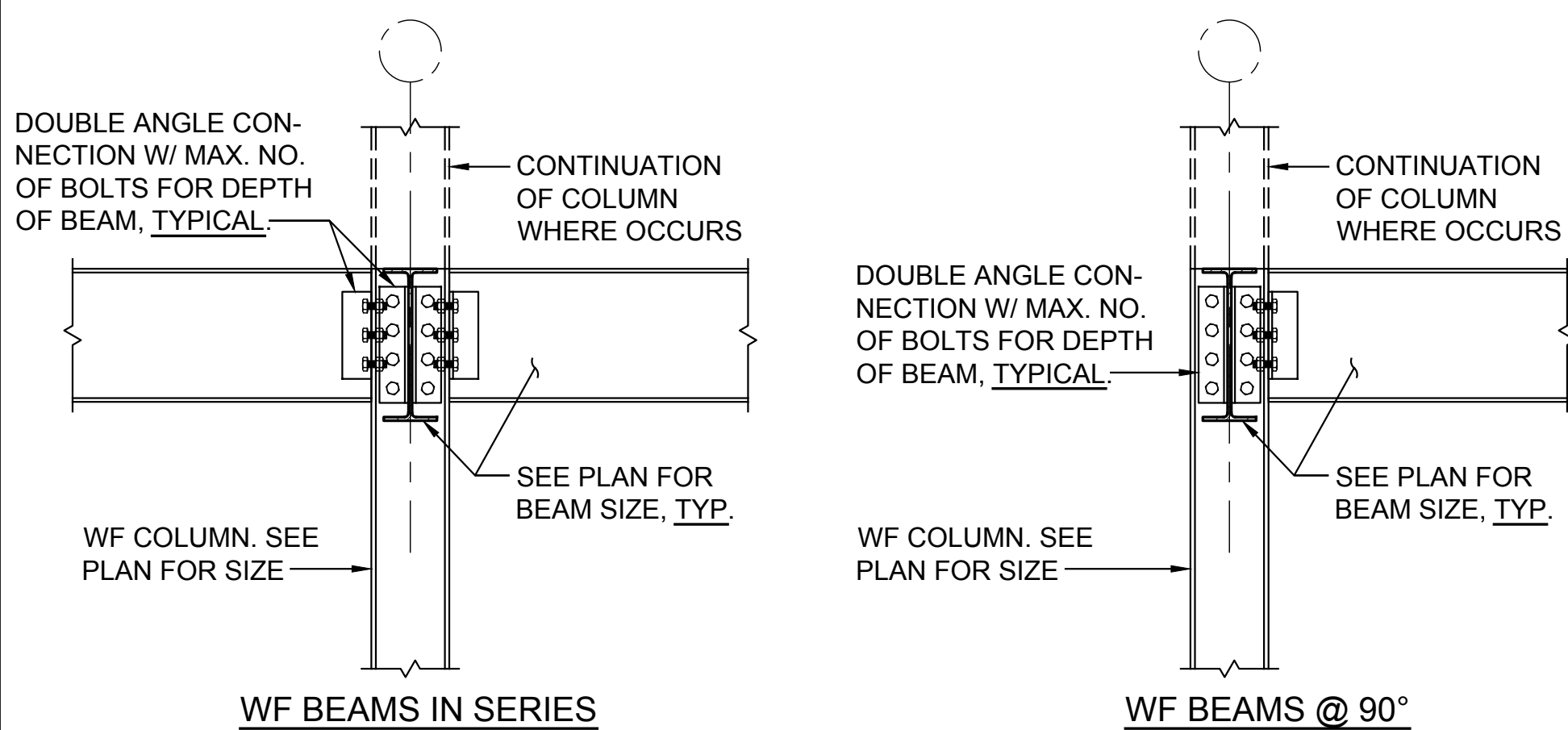
SECTION 2
3/4"=1'-0"



DETAIL B
3/4"=1'-0"



TYPICAL ROOF OPENING FRAMING DETAIL



TYPICAL WF BEAM TO WF COLUMN CONNECTION DETAILS

AUBURN
UNIVERSITY
Facilities Management
1161 West Samford Avenue
Auburn University, AL 36849
Phone: (334) 844-4810
Fax: (334) 844-9458
Safety is our first priority.
Think Safety. Act Safely.

No.	Revision	Date
3	Adendum #3	7-20-17

06-14-17

Project Number: 2016-111
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
TYPICAL DETAILS

DRAWN BY:
Casey

CHECKED BY:
JWD

DATE:
6-14-2017

FILE NUMBER:
-

PROJECT NUMBER:
16-111

SHEET NUMBER:
S0.2
XX



AUBURN

UNIVERSITY

Facilities Management

1161 West Samford Avenue

Auburn University, AL 36849

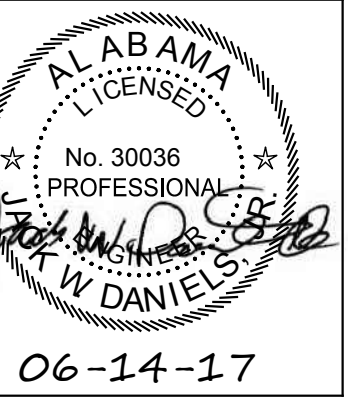
Phone: (334) 844-4810

Fax: (334) 844-9458

Safety is our first priority.

Think Safety. Act Safely.

No.	Revision	Date
3	Adendum #3	7-20-17



Project Number: 2016-111
 Drawn By:
BARGANIER DAVIS SIMS

**GOODWIN HALL - RENOVATION
 AND
 BAND REHEARSAL HALL ADDITION**
 Project Number 15-255

SHEET TITLE:
 LOWER FLOOR &
 FOUNDATION PLAN

DRAWN BY:
 Casey

CHECKED BY:
 JWD

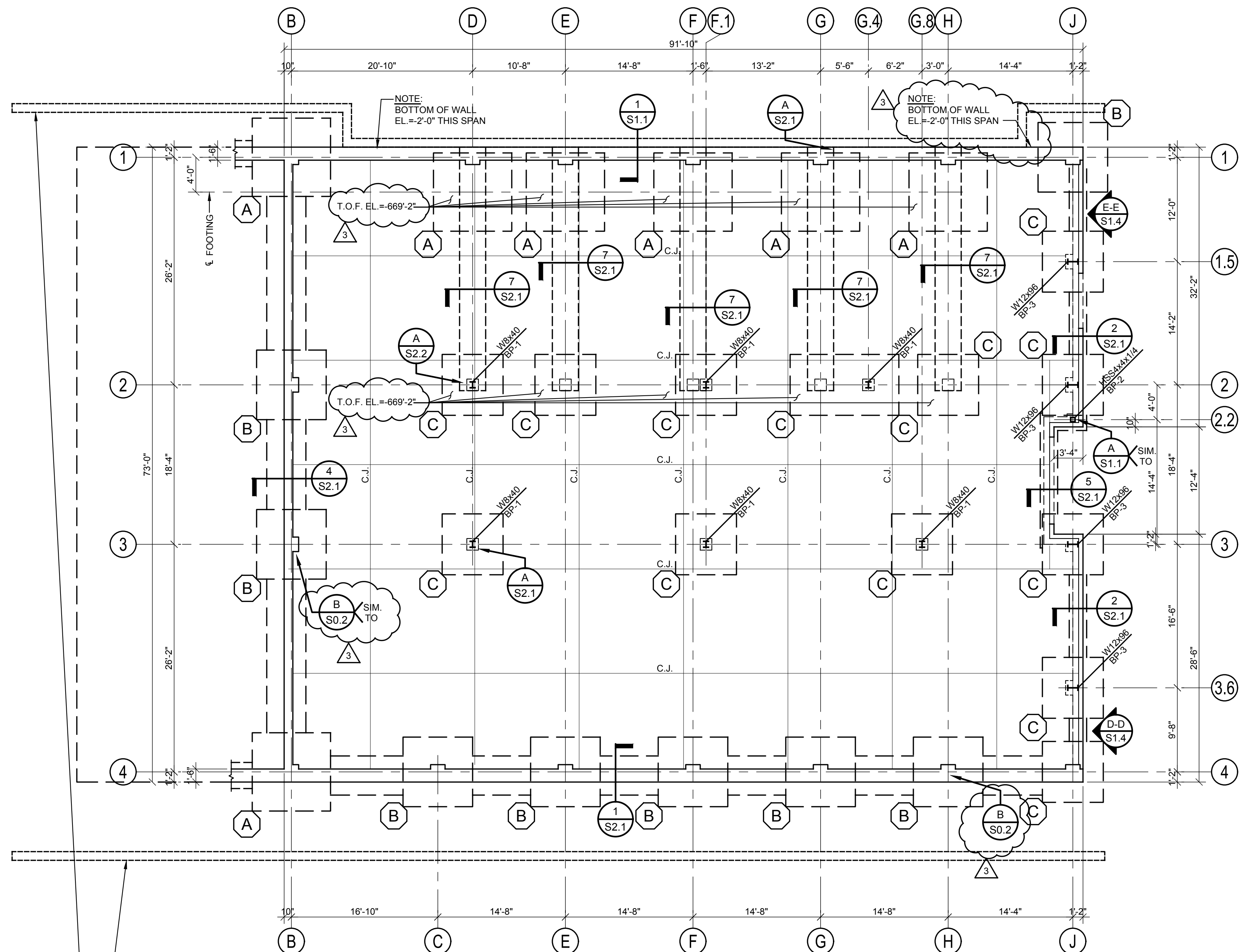
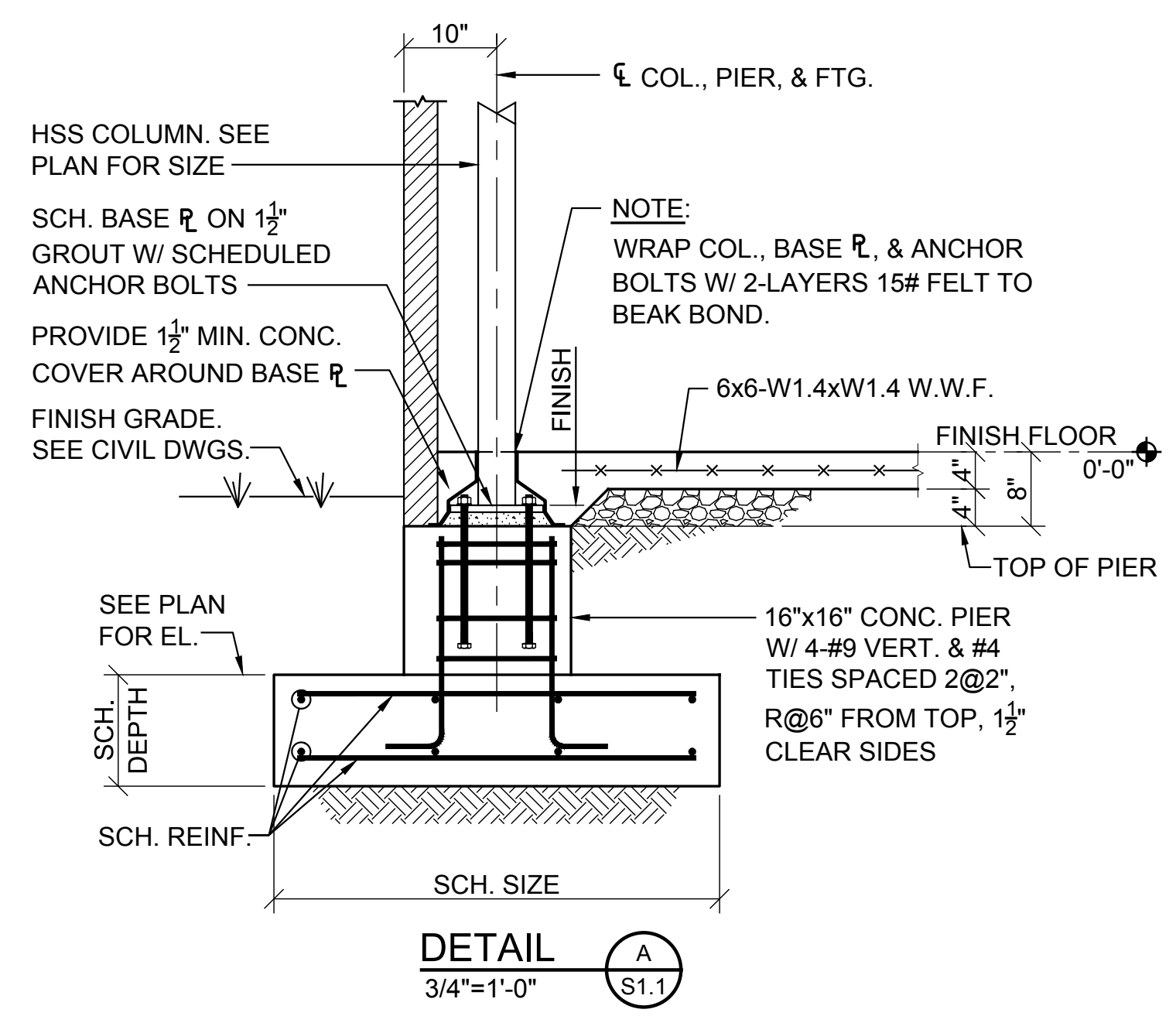
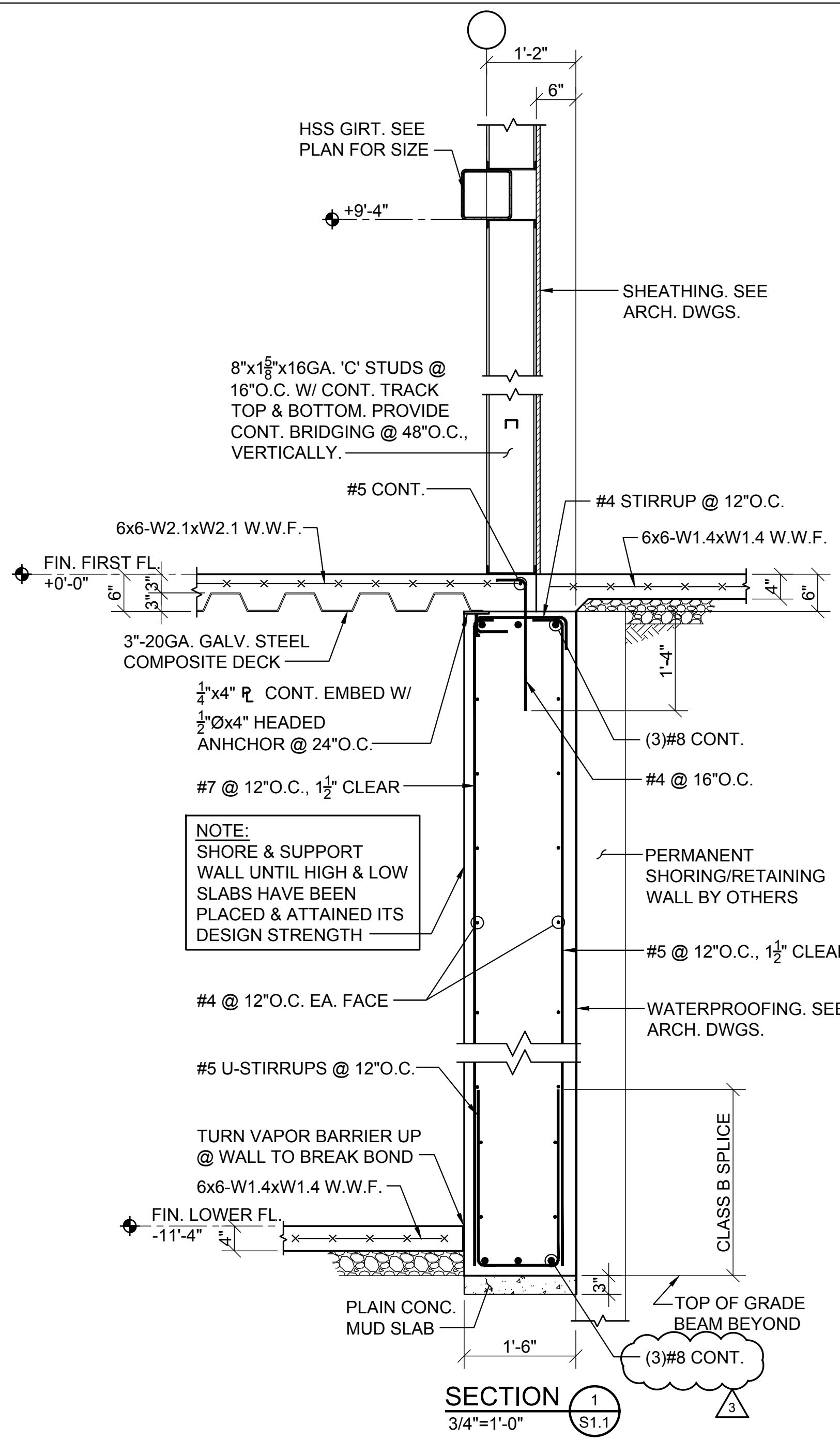
DATE:
 6-14-2017

FILE NUMBER:
 .

PROJECT NUMBER:
 16-111

SHEET NUMBER:

S1.1
 XX

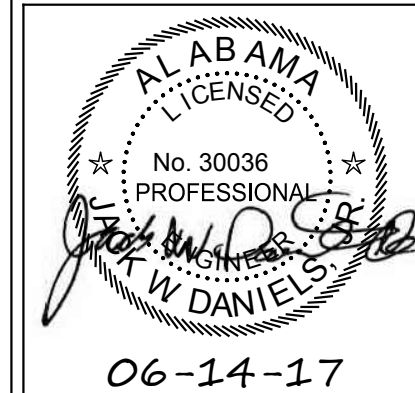


FLOOR CONSTRUCTION
 4" THICK CONCRETE SLAB W/
 6x6-W1.4xW1.4 W.W.F. OVER VAPOR
 BARRIER OVER 4" POROUS FILL.
 FINISH FLOOR EL.= 672'-8" (-1'-4")

NOTE:
 UNLESS NOTED OTHERWISE, TOP
 OF FOOTING EL.=670'-8" (-2'-0")

CONTRACTOR NOTE:
 SHORE AND SUPPORT EXISTING BUILDING FOUNDATIONS AS REQUIRED TO INSTALL PERMANENT RETAINING WALL TO BE DESIGNED BY OTHERS. ALL SHORING & PERMANENT RETAINING WALL DESIGN SHALL BE STAMPED BY AN ENGINEER REGISTERED IN THE STATE OF ALABAMA & SHALL BE SUBMITTED FOR REVIEW. THE LOCATION OF SHORING ILLUSTRATED ON THIS DRAWING IS DIAGRAMMATIC ONLY. THE ILLUSTRATION, ORIENTATION, LIMITS, ETC. OF THE BASEMENT EXCAVATION AND / OR SHORING SHALL BE AS REQUIRED FOR THE CONSTRUCTION OF THIS PROJECT, INCLUDING ALL FOOTINGS, FOUNDATIONS, ETC. BASED ON THE CONTRACTOR'S MEANS, METHODS, TECHNIQUES AND SEQUENCES AT NO ADDITIONAL COST TO THE PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION RAMPS, SLOPES, SHORING, ETC. AS NECESSARY TO COMPLETE THE CONSTRUCTION. CONTRACTOR TO DETERMINE EXACT LOCATION AND COORDINATE WITH DESIGN TEAM.

No.	Revision	Date
3	Adendum #3	7-20-17



Project Number: 2016-111
BARGANIER DAVIS SIMS
Drawn By:

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
FIRST FLOOR FRAMING
& PARTIAL
FOUNDATION PLAN

DRAWN BY:
Casey

CHECKED BY:
JWD

DATE:
6-14-2017

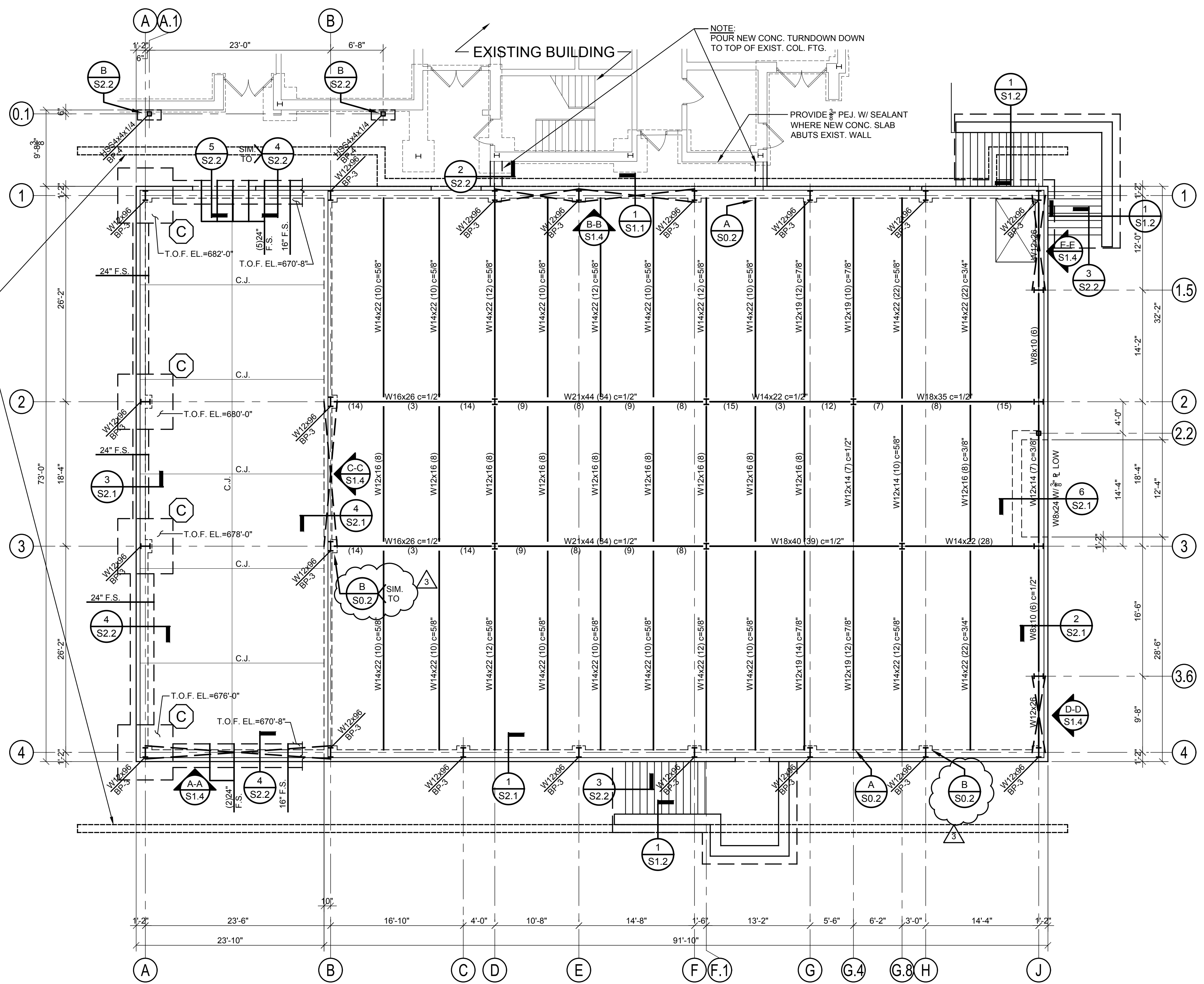
FILE NUMBER:
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PROJECT NUMBER:
16-111

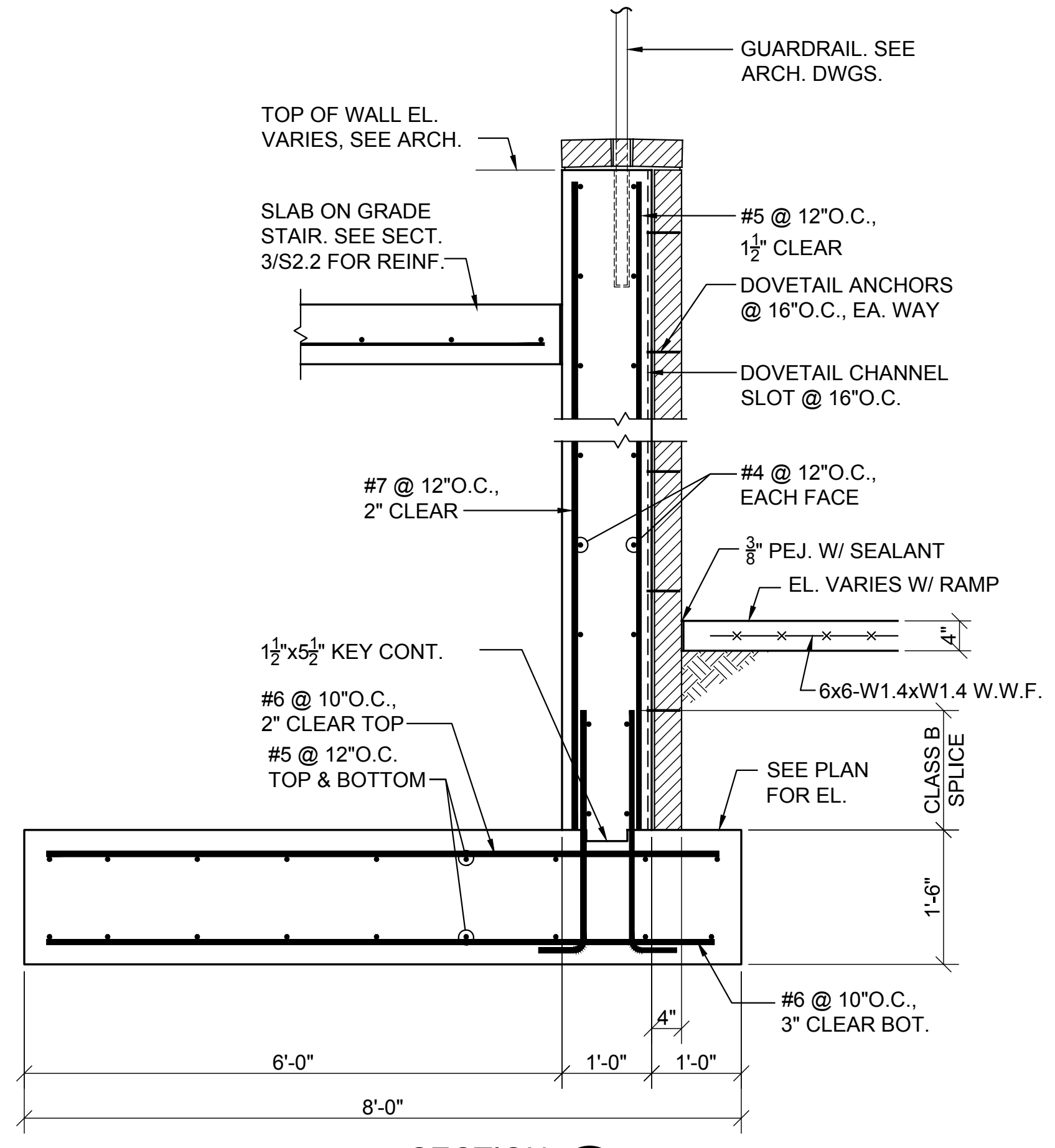
SHEET NUMBER:

S1.2
XX

CONTRACTOR NOTE:
SHORE AND SUPPORT EXISTING BUILDING FOUNDATIONS AS REQUIRED TO INSTALL PERMANENT RETAINING WALL TO BE DESIGNED BY OTHERS. ALL SHORING & PERMANENT RETAINING WALL DESIGN SHALL BE STAMPED BY AN ENGINEER REGISTERED IN THE STATE OF ALABAMA & SHALL BE SUBMITTED FOR REVIEW. THE LOCATION OF SHORING ILLUSTRATED ON THIS DRAWING IS DIAGRAMMATIC ONLY. THE ILLUSTRATION, ORIENTATION, LIMITS, ETC. OF THE BASEMENT EXCAVATION AND / OR SHORING SHALL BE AS REQUIRED FOR THE CONSTRUCTION OF THIS PROJECT, INCLUDING ALL FOOTINGS, FOUNDATIONS, ETC. BASED ON THE CONTRACTOR'S MEANS, METHODS, TECHNIQUES AND SEQUENCES AT NO ADDITIONAL COST TO THE PROJECT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CONSTRUCTION RAMP, SLOPES, SHORING, ETC. AS NECESSARY TO COMPLETE THE CONSTRUCTION. CONTRACTOR TO DETERMINE EXACT LOCATION AND COORDINATE WITH DESIGN TEAM.



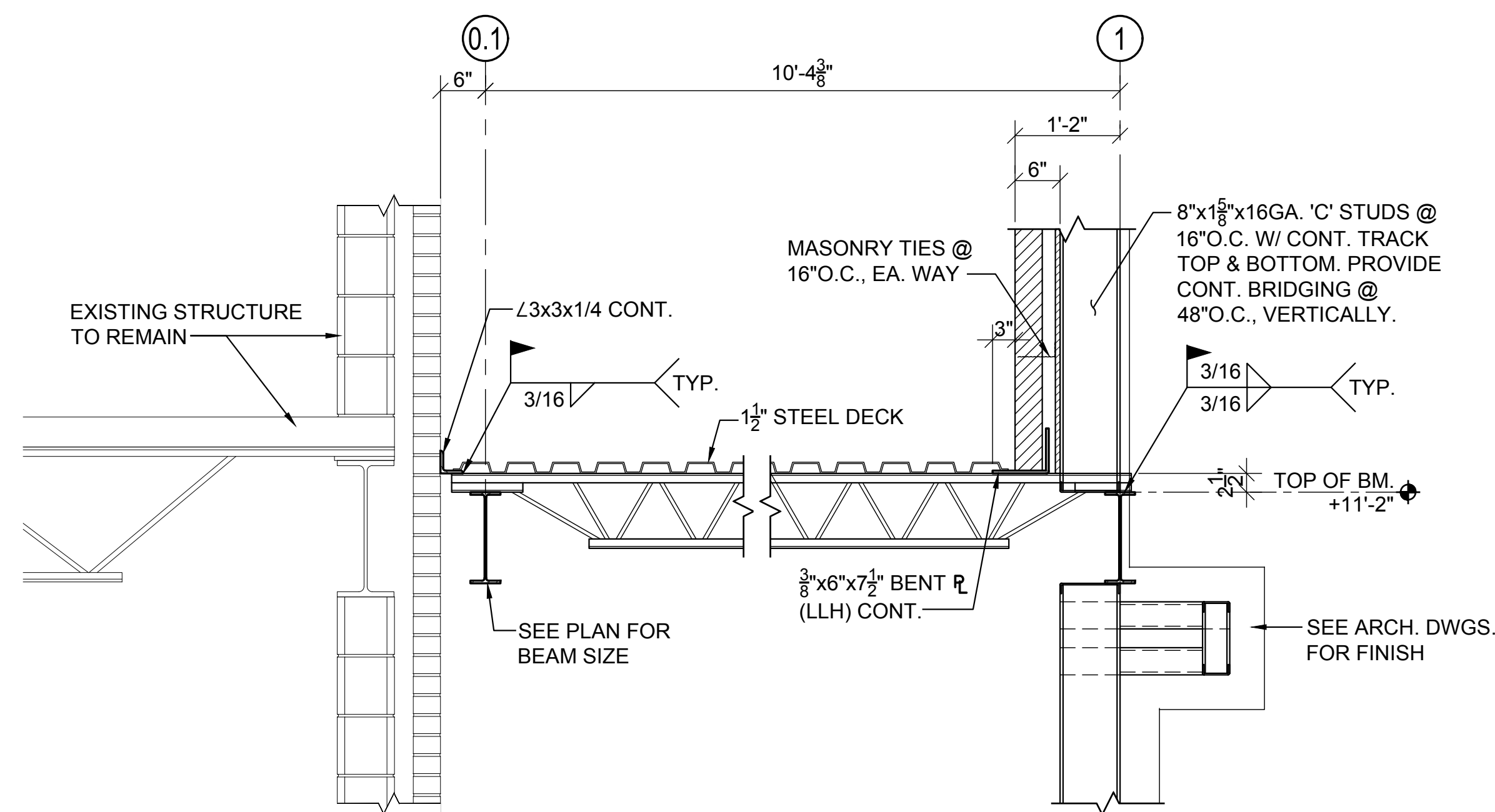
FIRST FLOOR FRAMING PLAN & PARTIAL FOUNDATION PLAN
SCALE: 1/8"=1'-0"



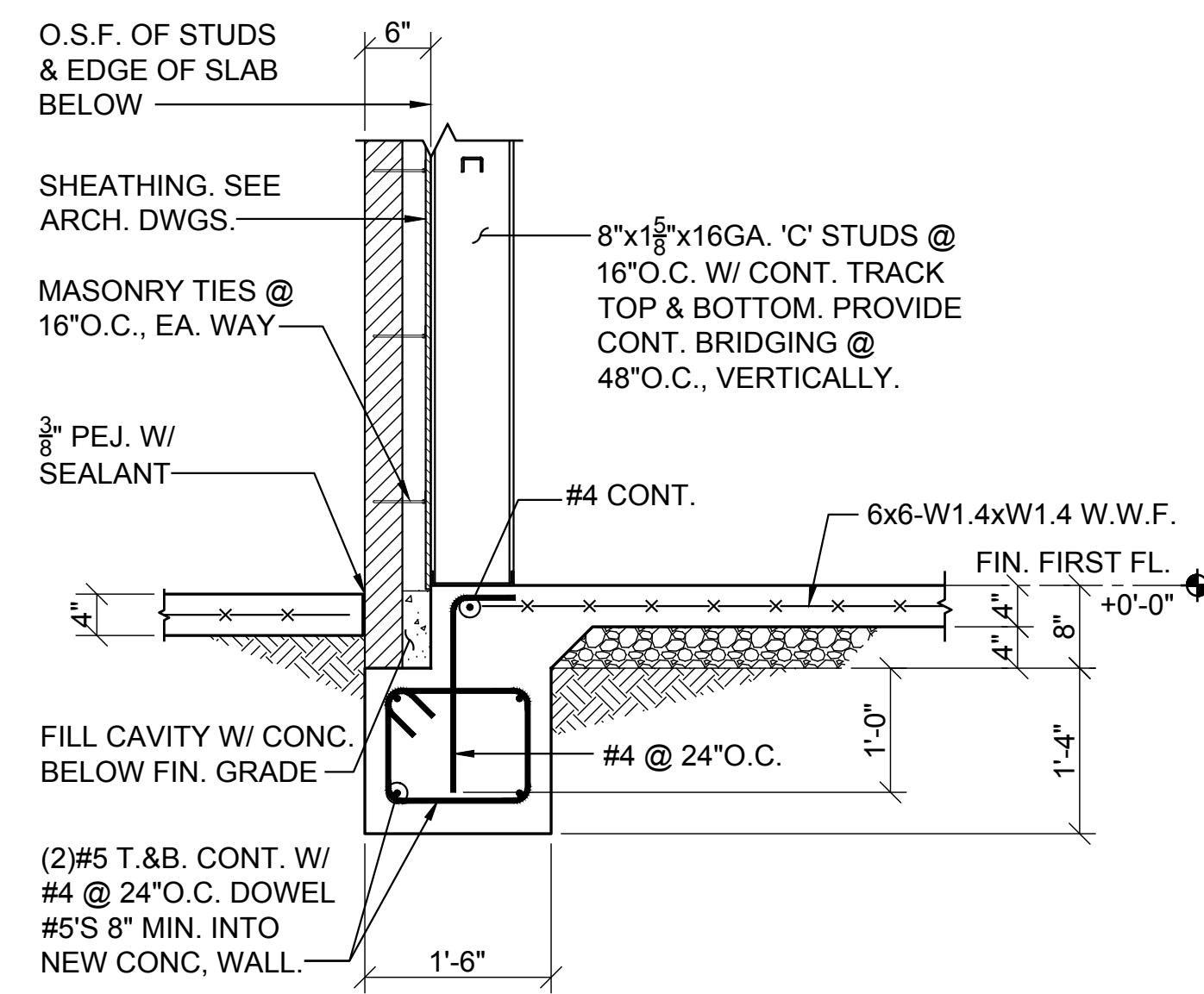
SECTION 1
3/4"=1'-0"

NOTE:
NUMBERS SHOWN @ BEAMS ARE AS FOLLOWS:
BEAM SIZE \rightarrow W16x26 C=1/2" \rightarrow REQ'D. CAMBER IN INCHES @ MID SPAN OF BEAM.
(24)
 \rightarrow NUMBER OF 3/4"x5" (AFTER WELDING) HEADED SHEAR STUD CONNECTORS LOCATED BETWEEN INTERSECTING BEAMS. SEE GENERAL NOTES ON SHEET S0.1 FOR ADDITIONAL INFORMATION.

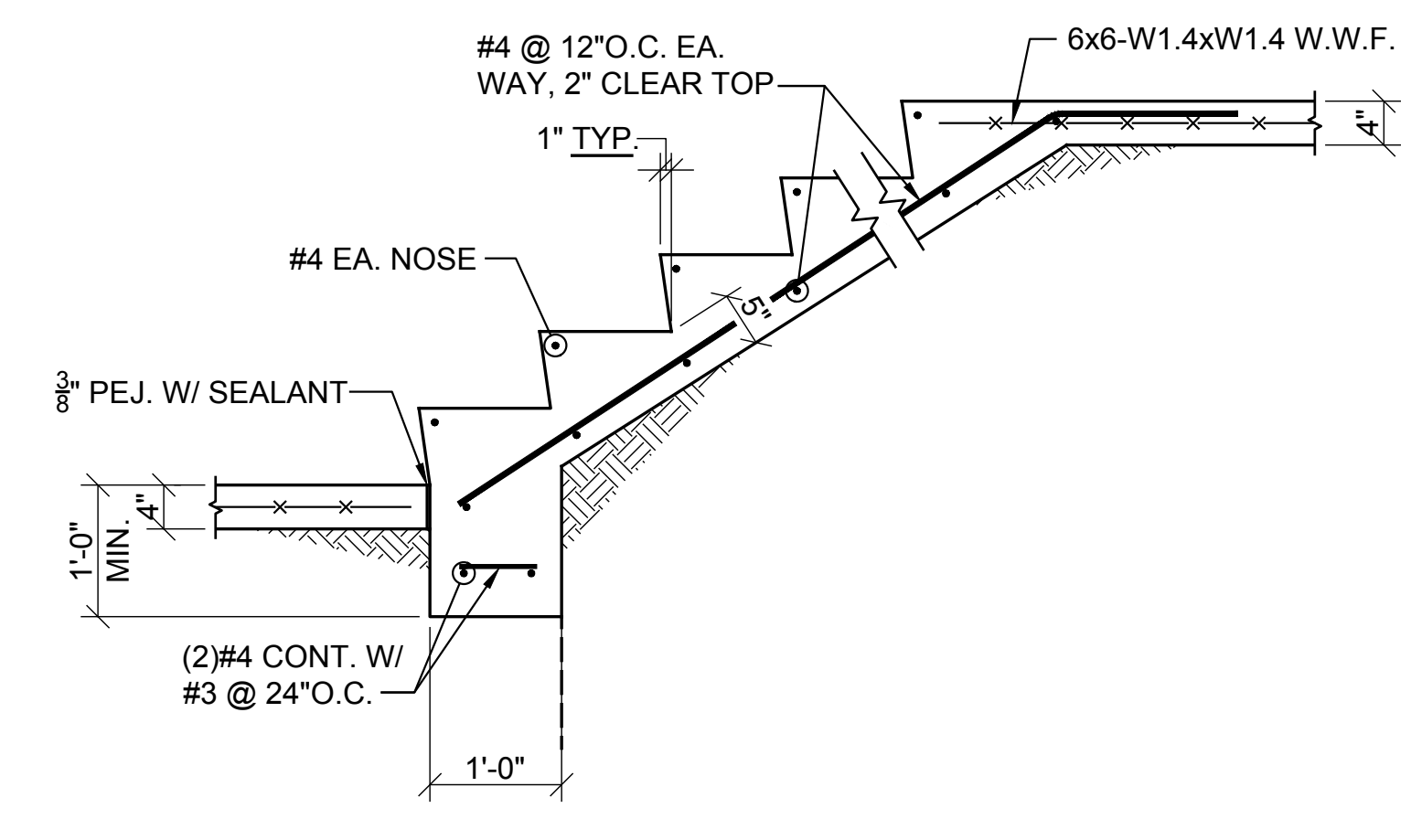
SECOND FLOOR CONSTRUCTION
3" THICK NORMAL WEIGHT CONCRETE SLAB W/ 6x6-W2.1xW2.1 W.W.F. 3/4" CLEAR TOP, OVER 3" DEEP 20GA. COMPOSITE STEEL DECK, (6" TOTAL THICKNESS), W/ THE FOLLOWING MIN. SECTION PROPERTIES:
S=0.55 IN.³ I=0.94 IN.⁴
FINISH FLOOR EL. = 684'-0" (+0'-0")
NOTE:
6"± TOTAL SLAB THICKNESS SHALL BE MAINTAINED @ POINT OF MAXIMUM CAMBER. DO NOT REDUCE THICKNESS @ MID SPAN OF BEAMS BY MORE THAN 1/4"



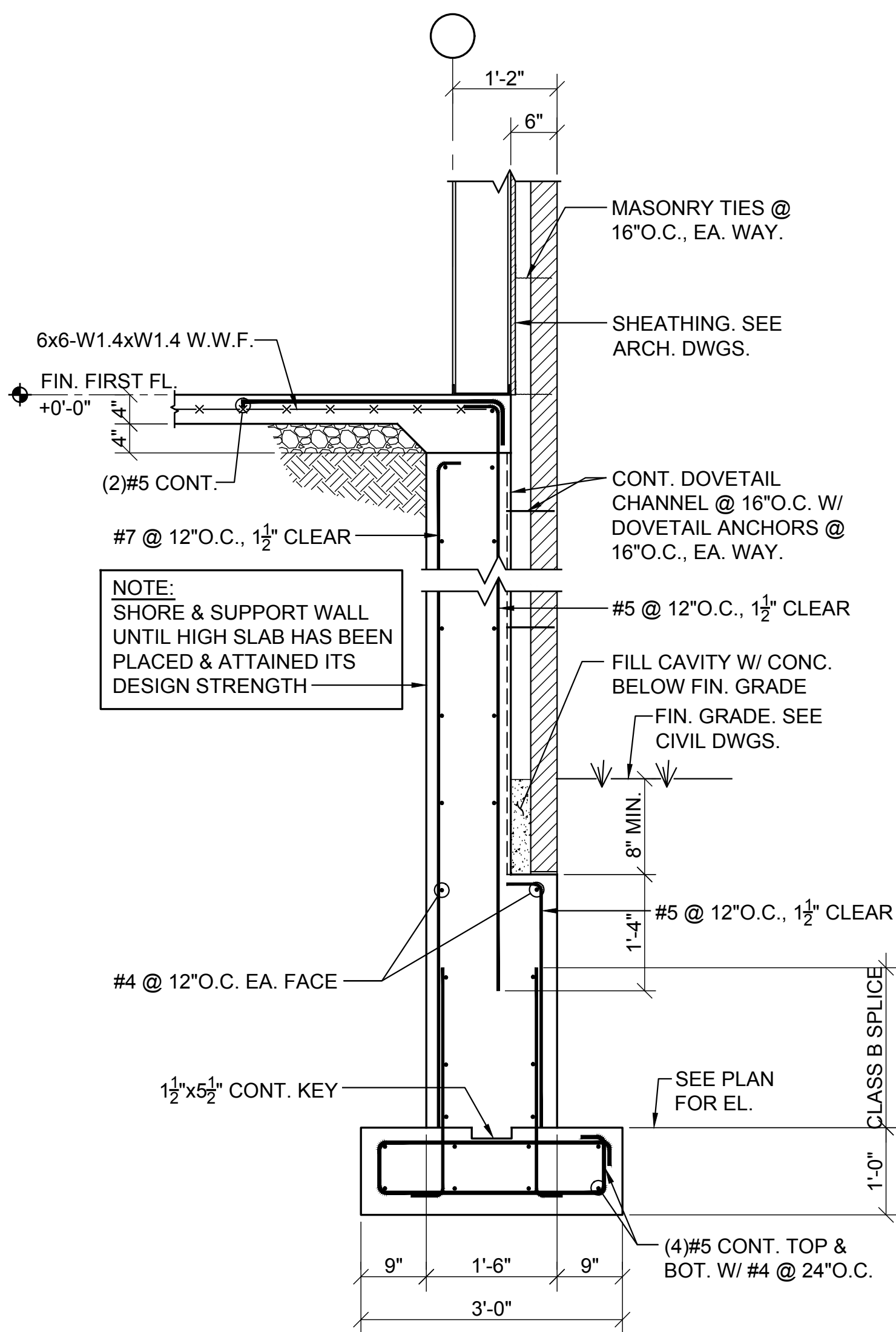
SECTION 1
3/4"=1'-0" S2.2



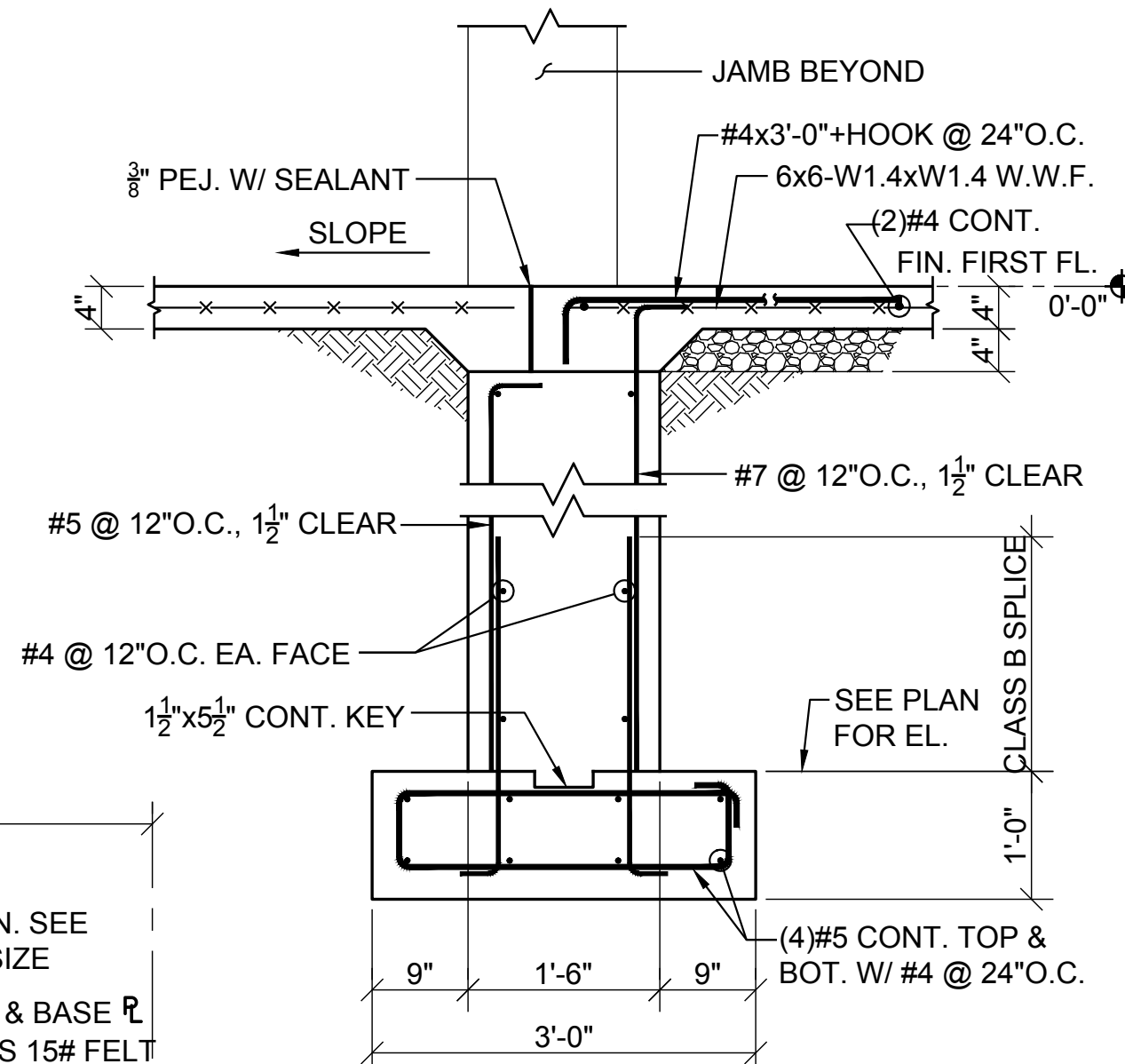
SECTION 2
3/4"=1'-0" S2.2



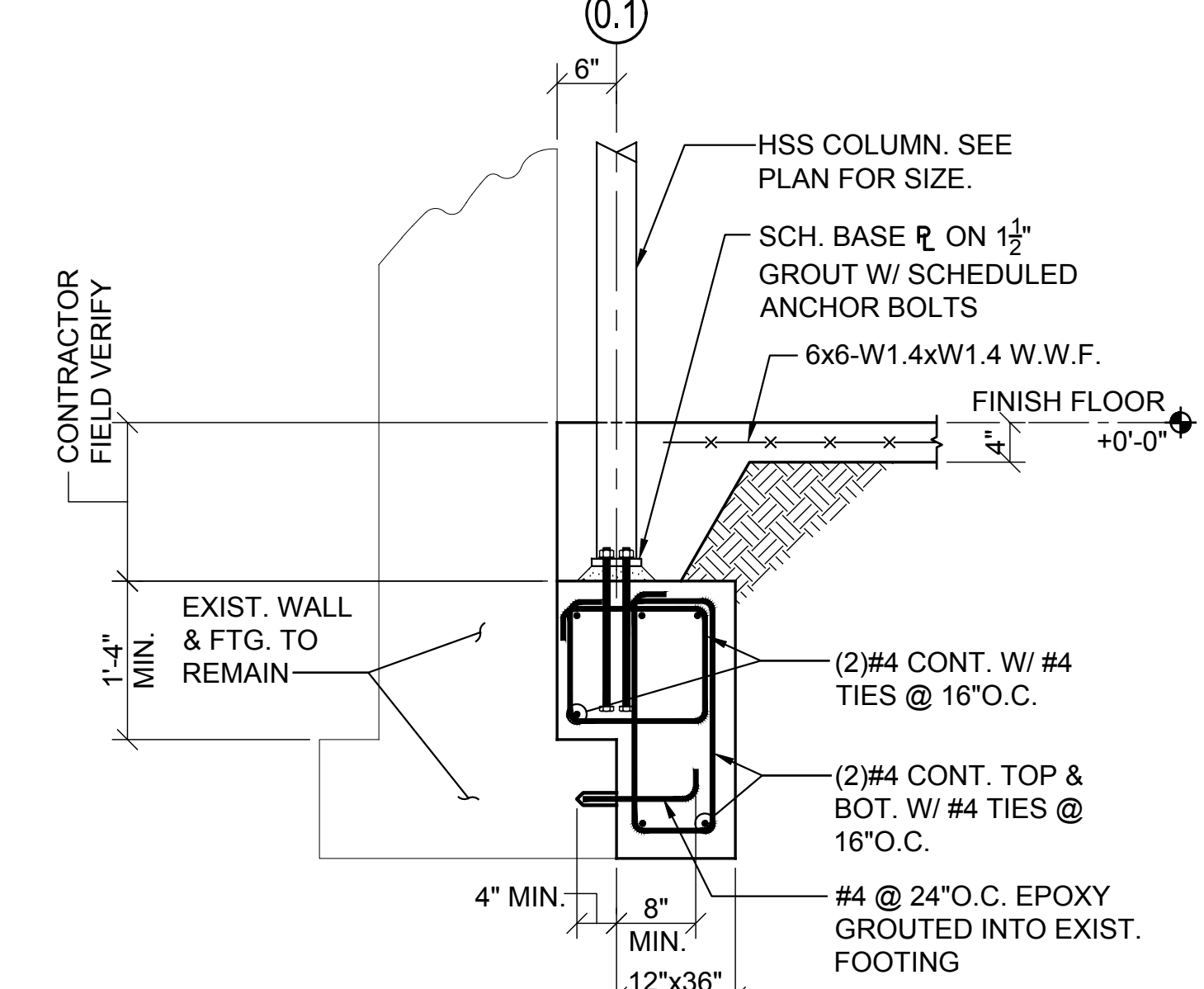
SECTION 3
3/4"=1'-0" S2.2



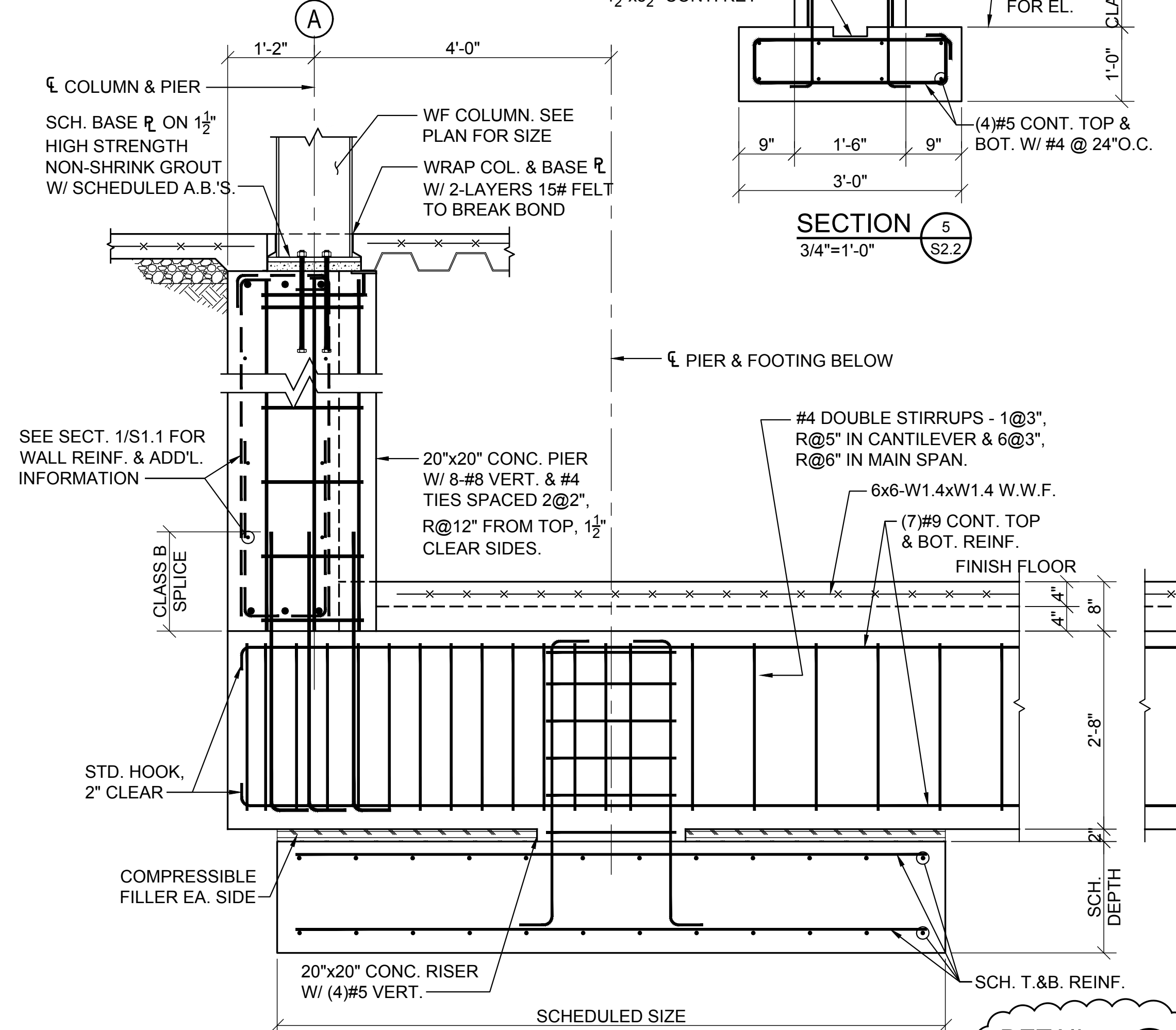
SECTION 4
3/4"=1'-0" S2.2



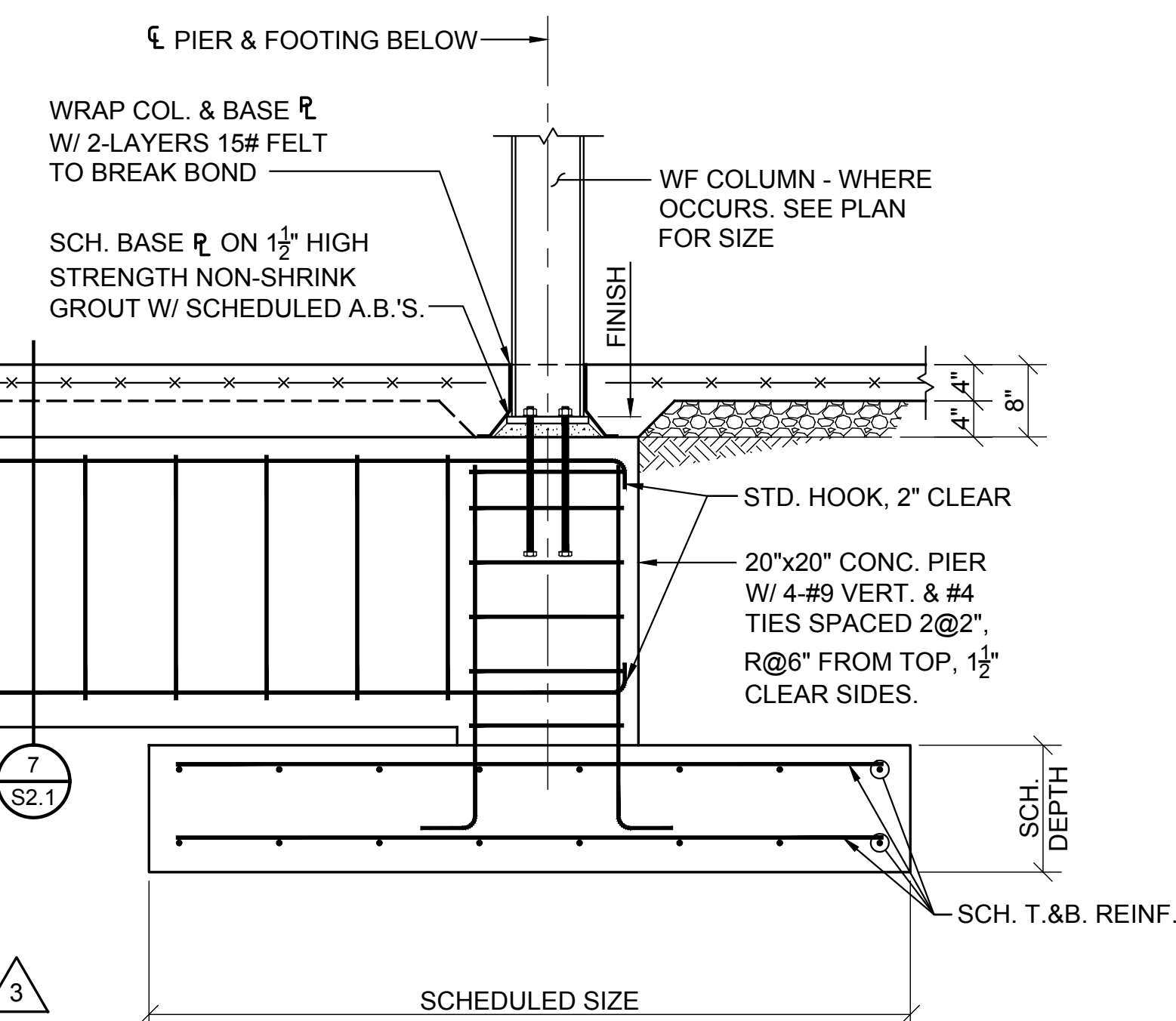
SECTION 5
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DETAIL B
3/4"=1'-0" S2.2

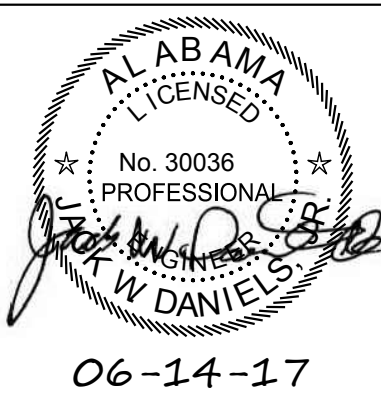


DETAIL A
3/4"=1'-0" S2.2



SECTION 7
3/4"=1'-0" S2.1

No.	Revision	Date
3	Adendum #3	7-20-17



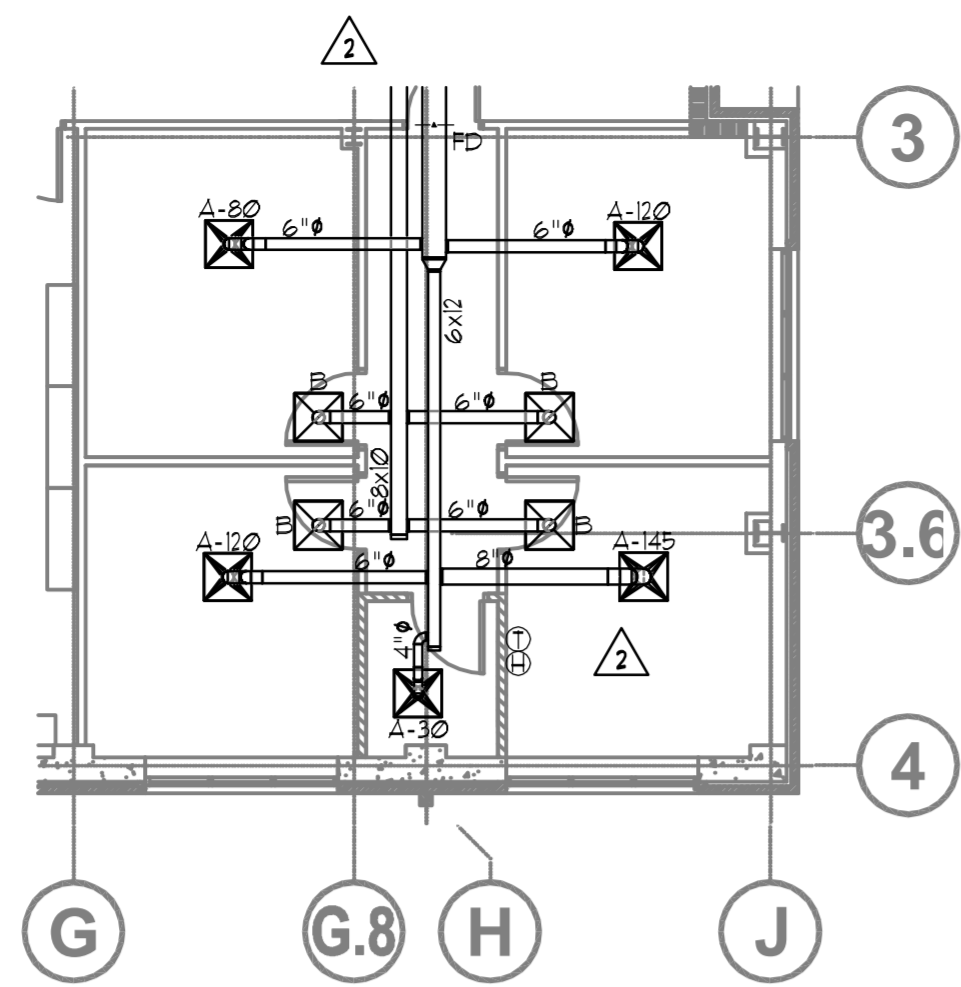
Project Number: 2016-111
Drawn By:
BARGANIER DAVIS SIMS

**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

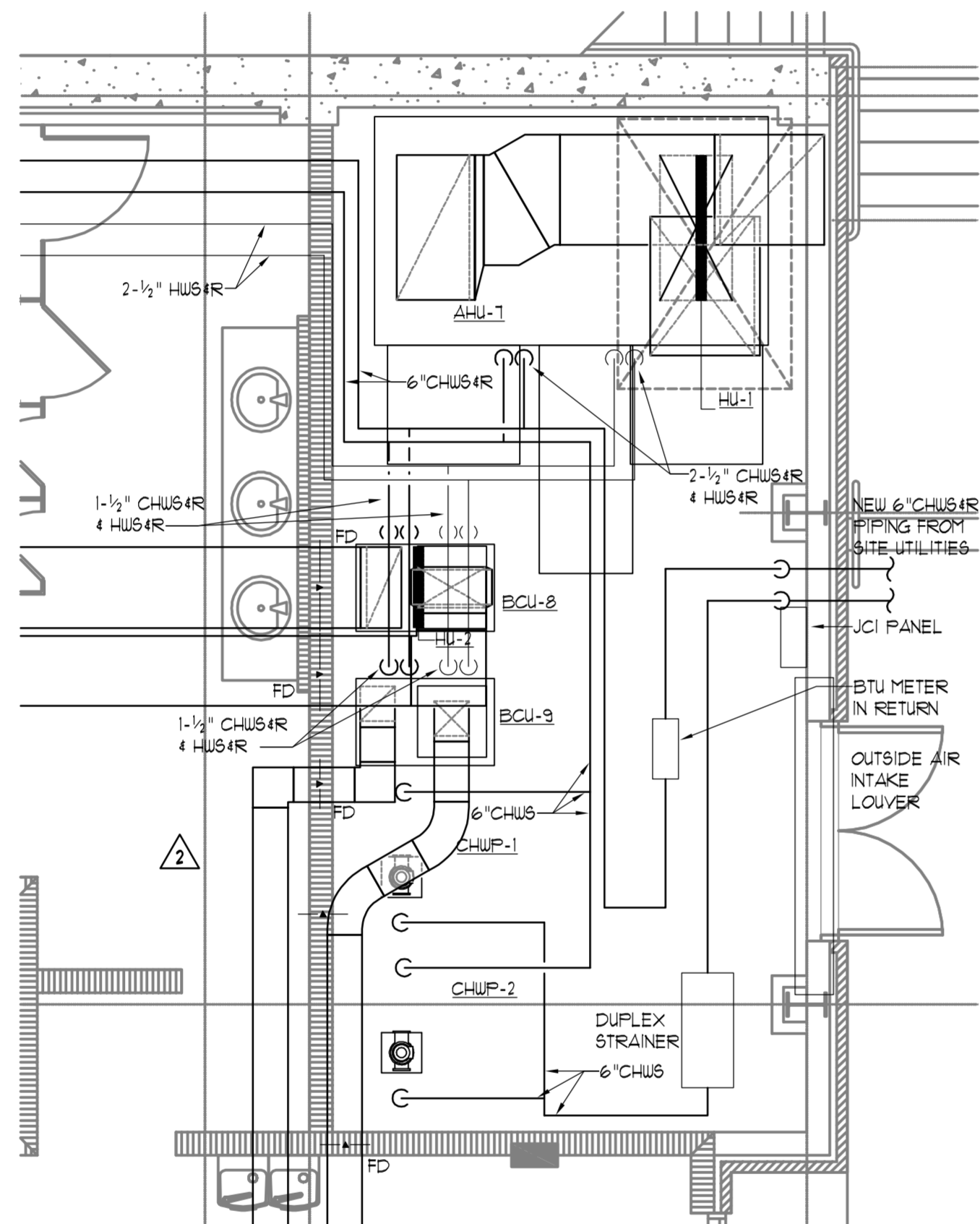
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SECTIONS AND DETAILS

DRAWN BY:
Casey
CHECKED BY:
JWD
DATE:
6-14-2017
FILE NUMBER:
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PROJECT NUMBER:
16-111
SHEET NUMBER:

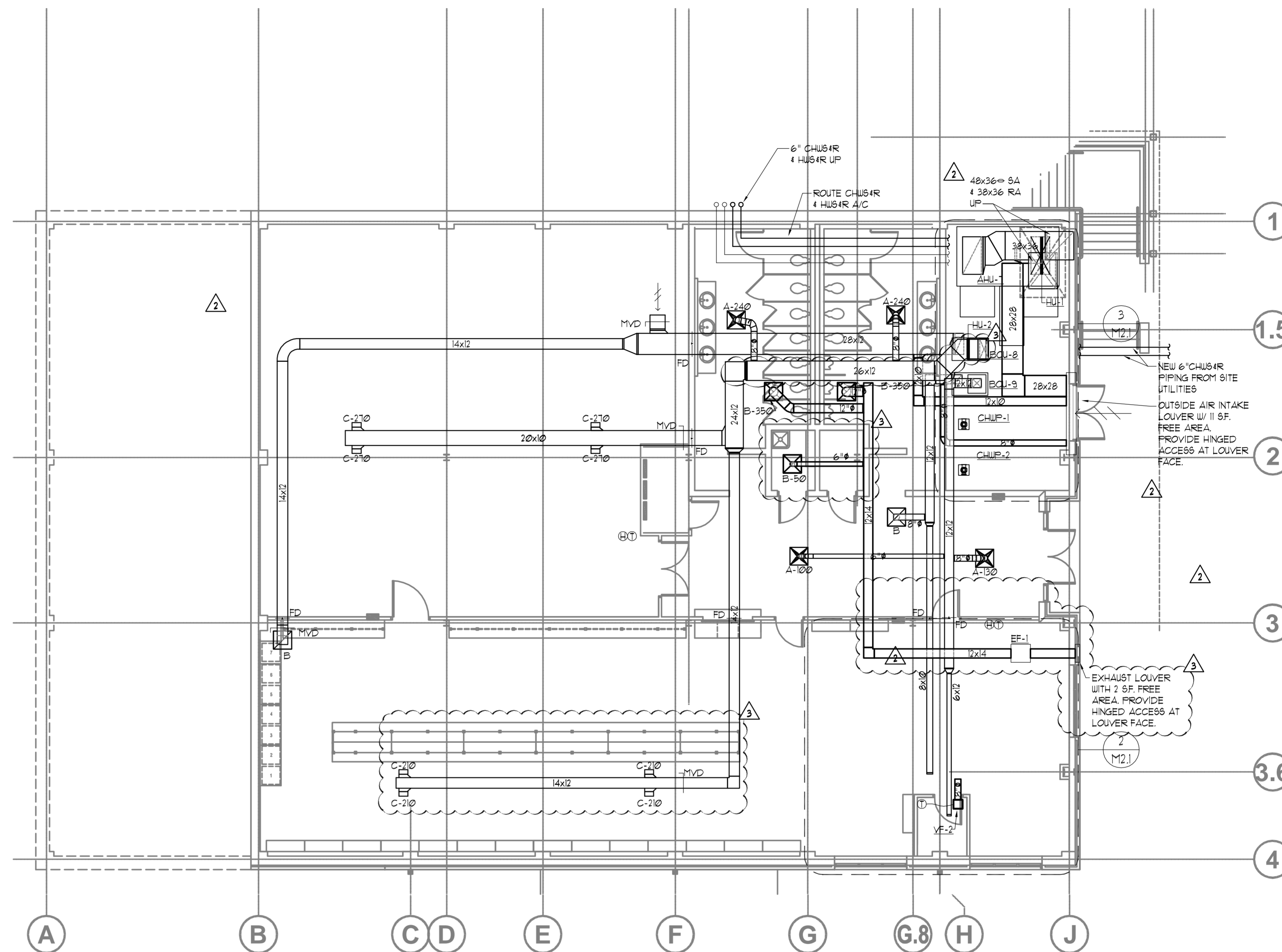
S2.2
XX



2 LOWER LEVEL FLOOR PLAN - MECHANICAL - ALTERNATE #3
SCALE: 1/8" = 1'-0"



3 ENLARGED PLAN - MECHANICAL ROOM
SCALE: 1/8" = 1'-0"

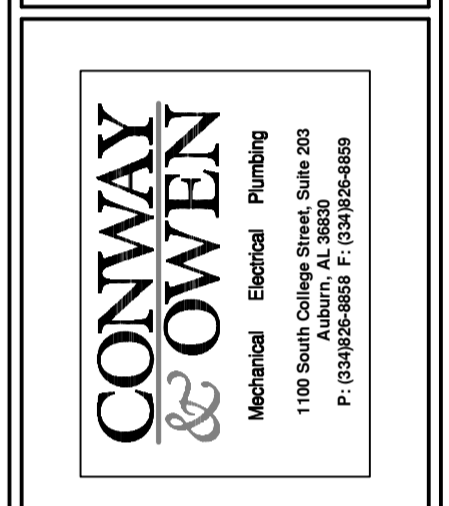
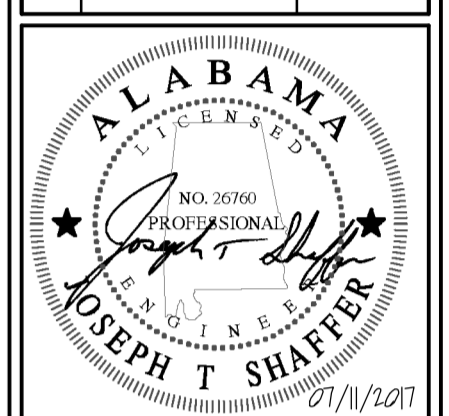


1 LOWER LEVEL FLOOR PLAN - MECHANICAL
SCALE: 1/8" = 1'-0"



MECHANICAL GENERAL NOTES:
1. SEE M01-M04 FOR LEGEND, NOTES, SCHEDULES, & DETAILS.
2. DETAILS ARE APPLICABLE EVEN IF NOT DIRECTLY REFERENCED.

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/13/2017
3	Addendum 3	07/20/2017



**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

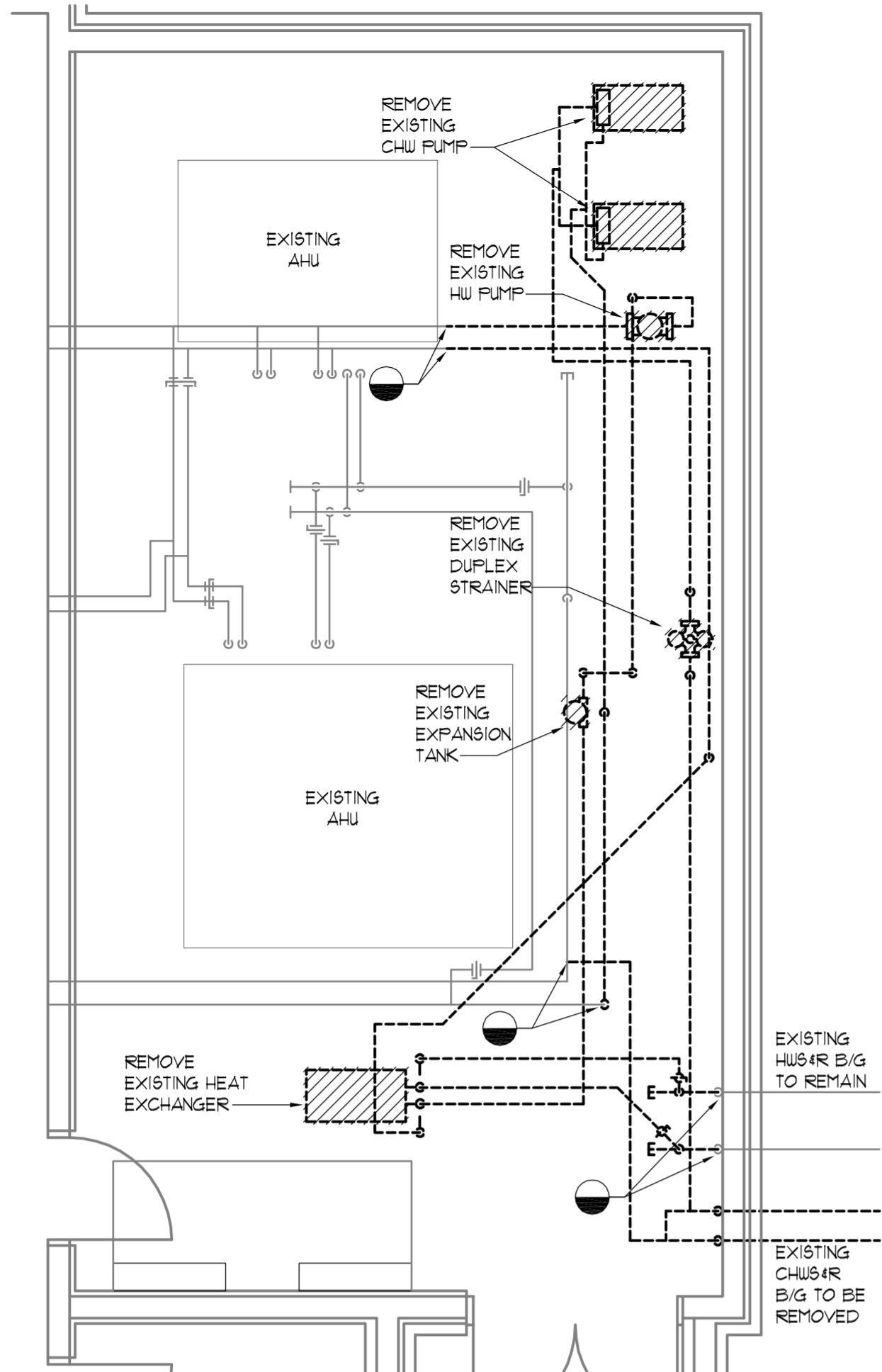
SHEET TITLE:
LOWER LEVEL FLOOR
PLANS - MECHANICAL

DRAWN BY:
MJL
CHECKED BY:
JTS

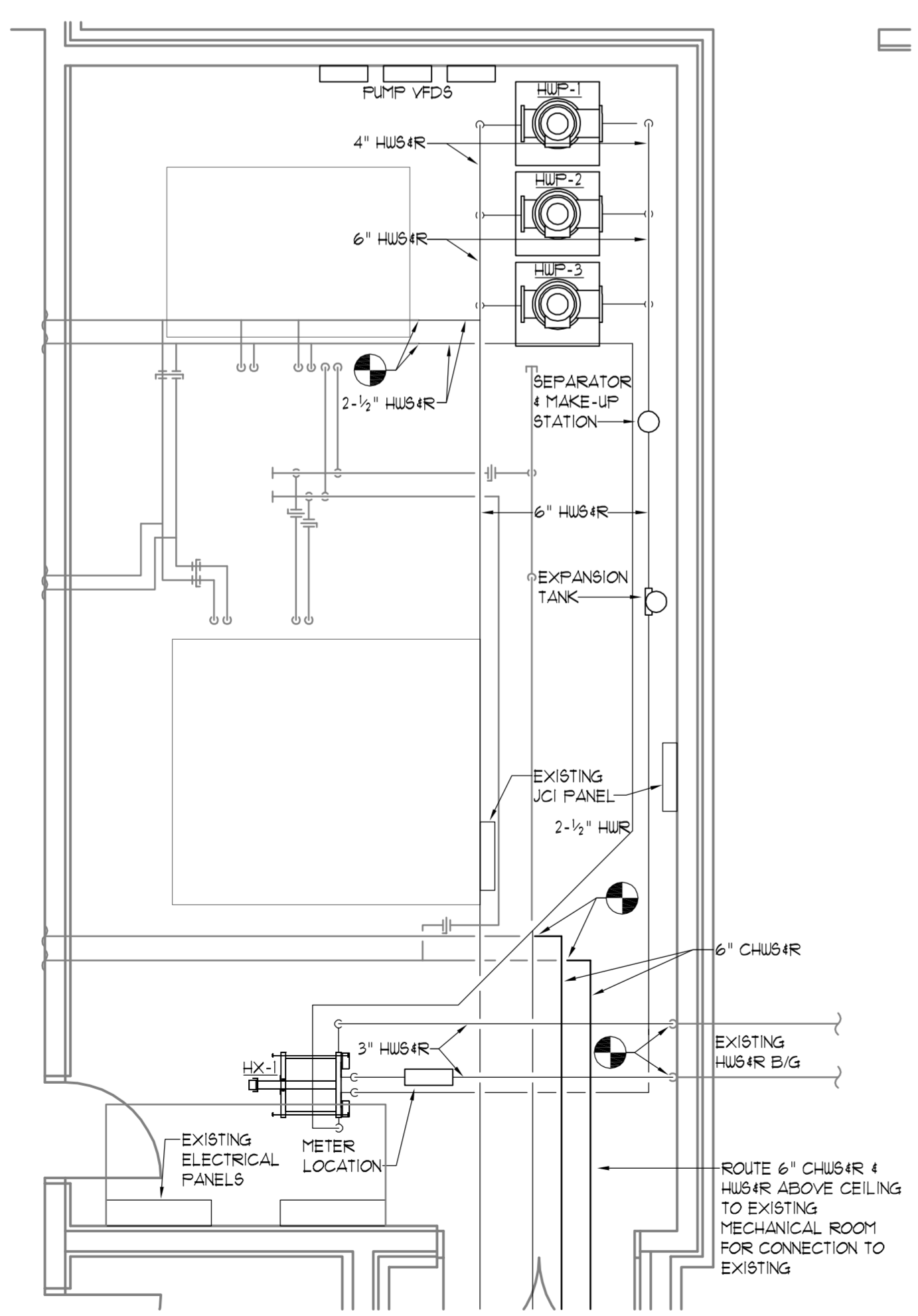
DATE:
6-14-2017
FILE NUMBER:
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PROJECT NUMBER:
15-255

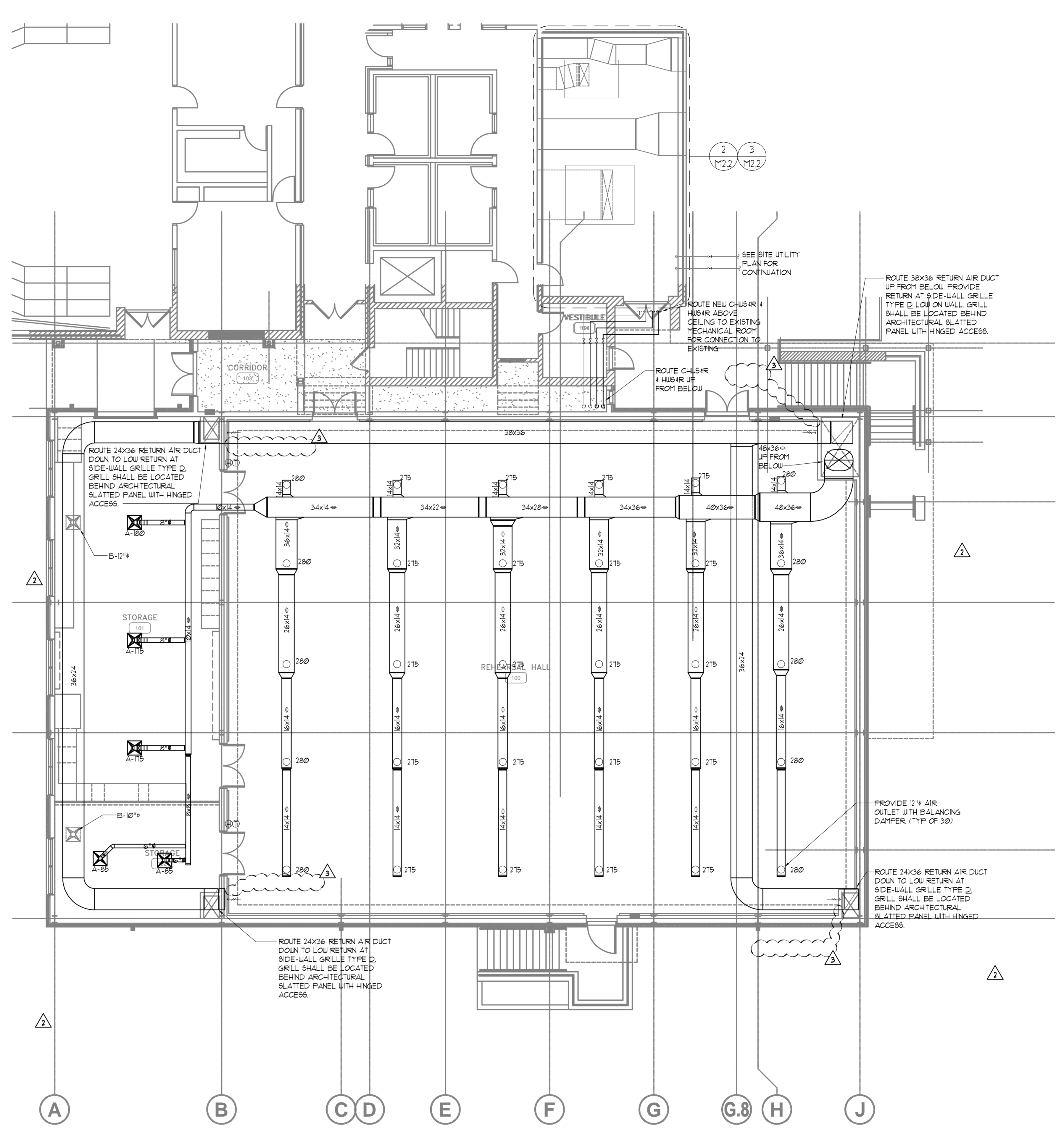
SHEET NUMBER:
M2.1
XX OF XX



2 ENLARGED DEMO PLAN - MECHANICAL ROOM
SCALE: 1/4" = 1'-0"



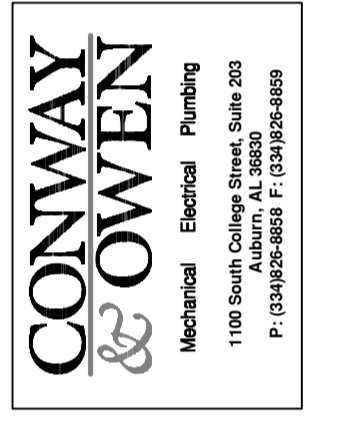
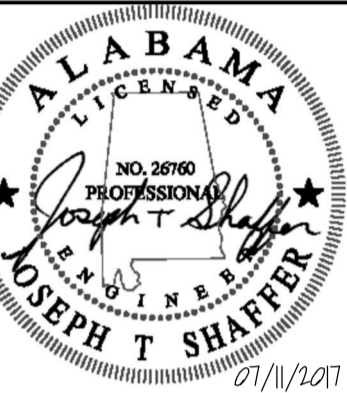
3 ENLARGED PLAN - MECHANICAL ROOM
SCALE: 1/4" = 1'-0"



1 UPPER LEVEL FLOOR PLAN - MECHANICAL
SCALE: 1/8" = 1'-0"

MECHANICAL GENERAL NOTES:
1. SEE M01-M04 FOR LEGEND, NOTES, SCHEDULES & DETAILS.
2. DETAILS ARE APPLICABLE EVEN IF NOT DIRECTLY REFERENCED.
3. ALL SUPPLY & RETURN DUCT LOCATED IN THE REHEARSAL ROOM SHALL BE INTERNALLY LINED FOR NOISE REDUCTION. SUPPLY DUCT SHALL BE DOUBLE WALL WITH PERFORATED INSIDE LAYER.

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/13/2017
3	Addendum 3	07/20/2017



**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:

UPPER LEVEL FLOOR
PLANS - MECHANICAL

DRAWN BY:
MJL

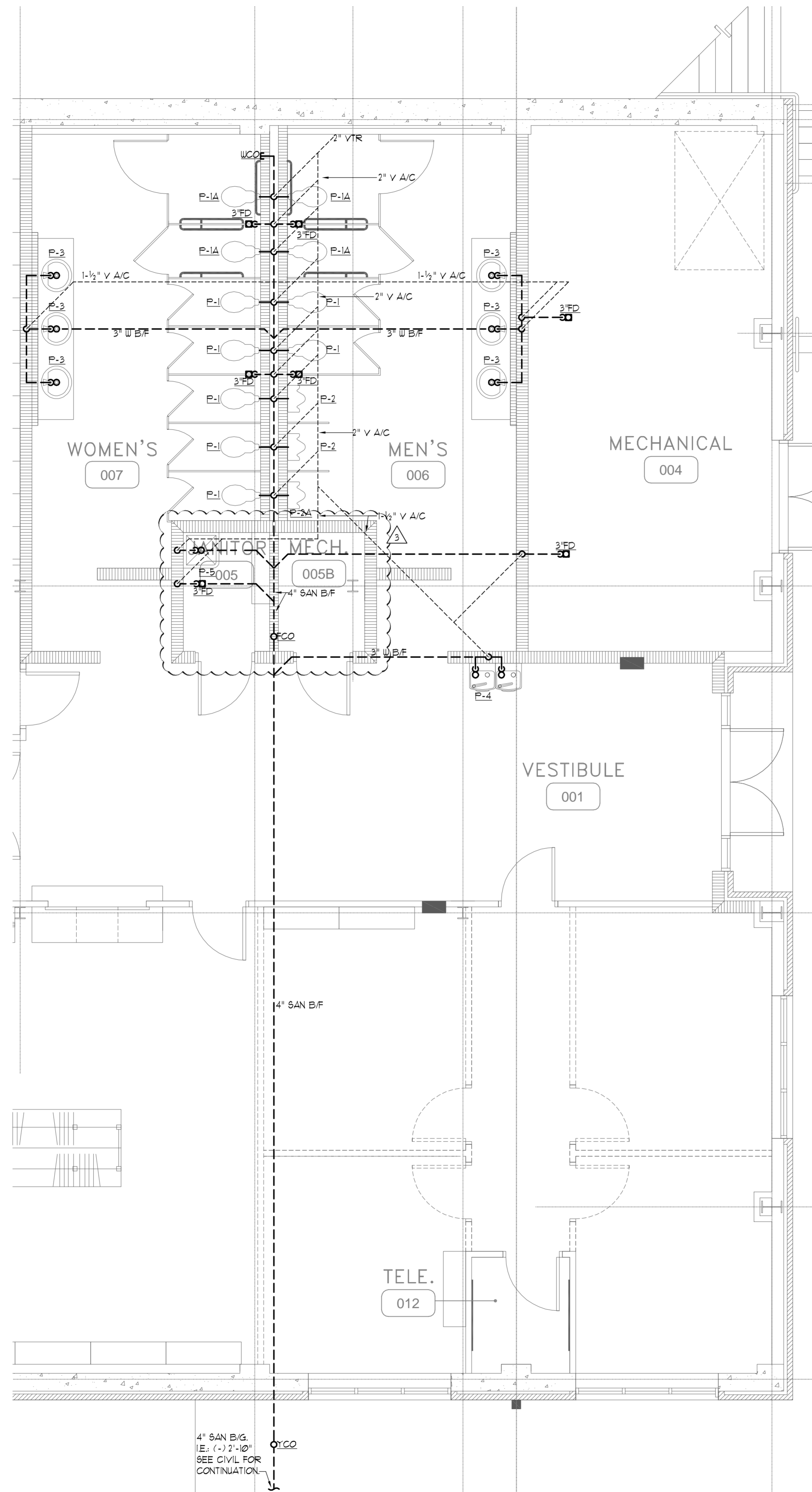
CHECKED BY:
JTS

DATE:
6-14-2017

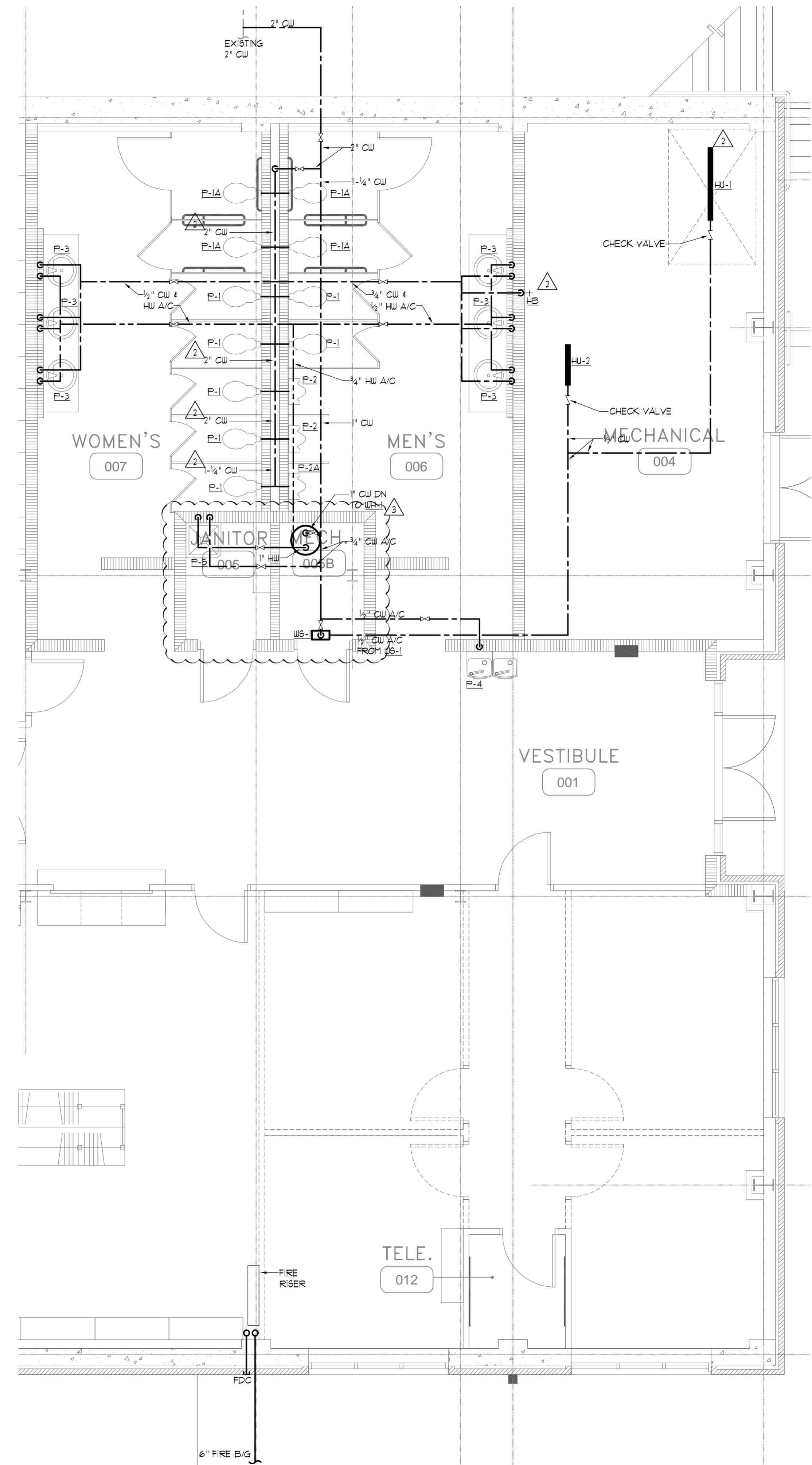
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PROJECT NUMBER:
15-255

SHEET NUMBER:
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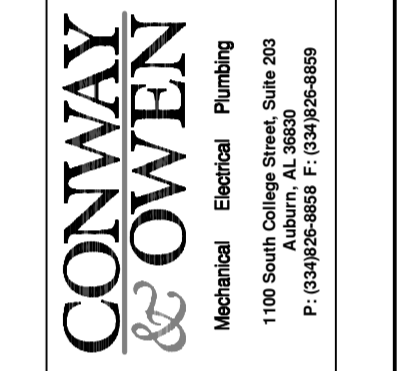
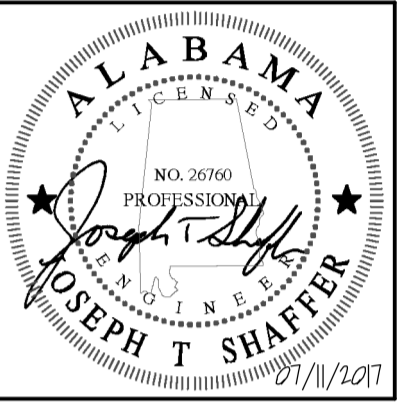
2 LOWER LEVEL FLOOR PLAN - WASTE & VENT
 SCALE: 1/4" = 1'-0"
 NORTH



1 LOWER LEVEL FLOOR PLAN - DOMESTIC WATER
 SCALE: 1/4" = 1'-0"
 NORTH

PLUMBING GENERAL NOTES:
 1. SEE SHEET P201 FOR LEGEND, NOTES, SCHEDULES & DETAILS.
 2. DETAILS ARE APPLICABLE EVEN IF NOT DIRECTLY REFERENCED.

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/13/2017
3	Addendum 3	07/20/2017



**GOODWIN HALL - RENOVATION
 AND
 BAND REHEARSAL HALL ADDITION**
 Project Number 15-255

SHEET TITLE:
 LOWER LEVEL FLOOR
 PLANS - PLUMBING
 DRAWN BY:
 MJL
 CHECKED BY:
 JTS
 DATE:
 6-14-2017
 FILE NUMBER:
 -
 PROJECT NUMBER:
 15-255
 SHEET NUMBER:

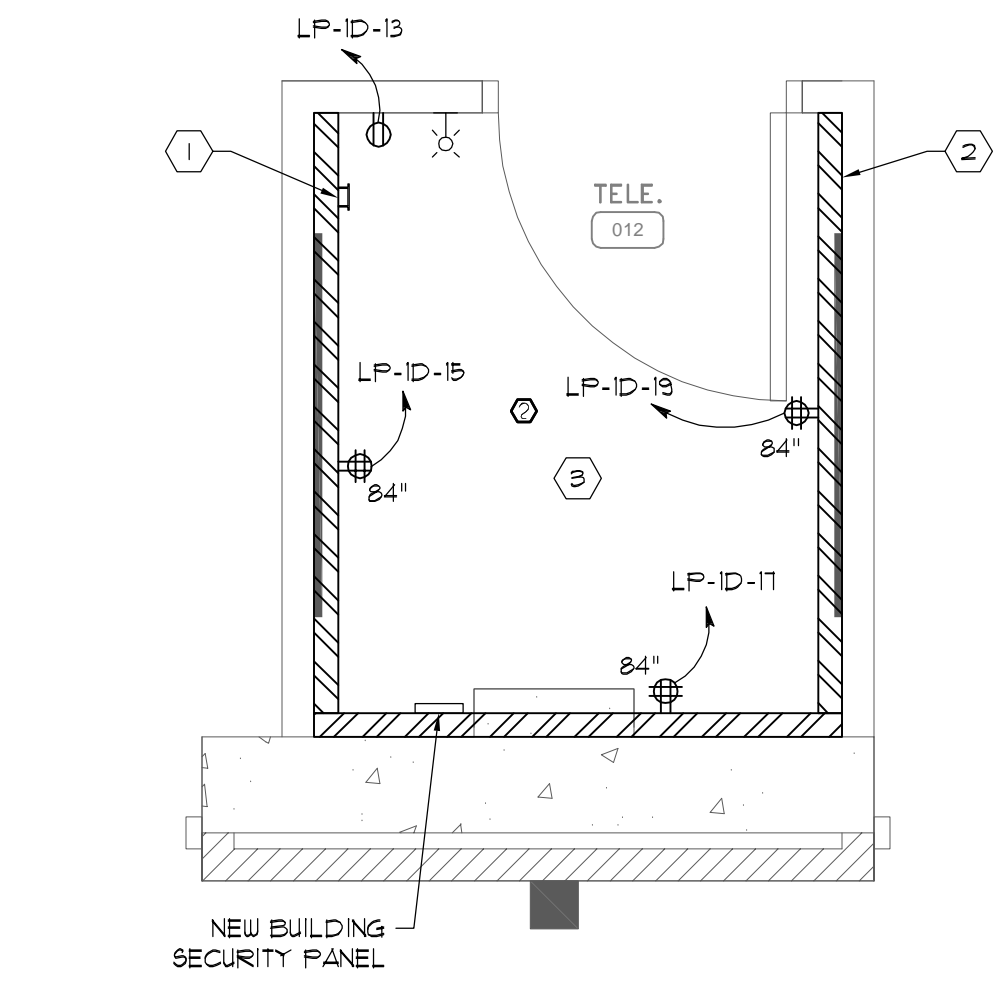
P2.1

GENERAL NOTES: (APPLY TO THIS SHEET ONLY)

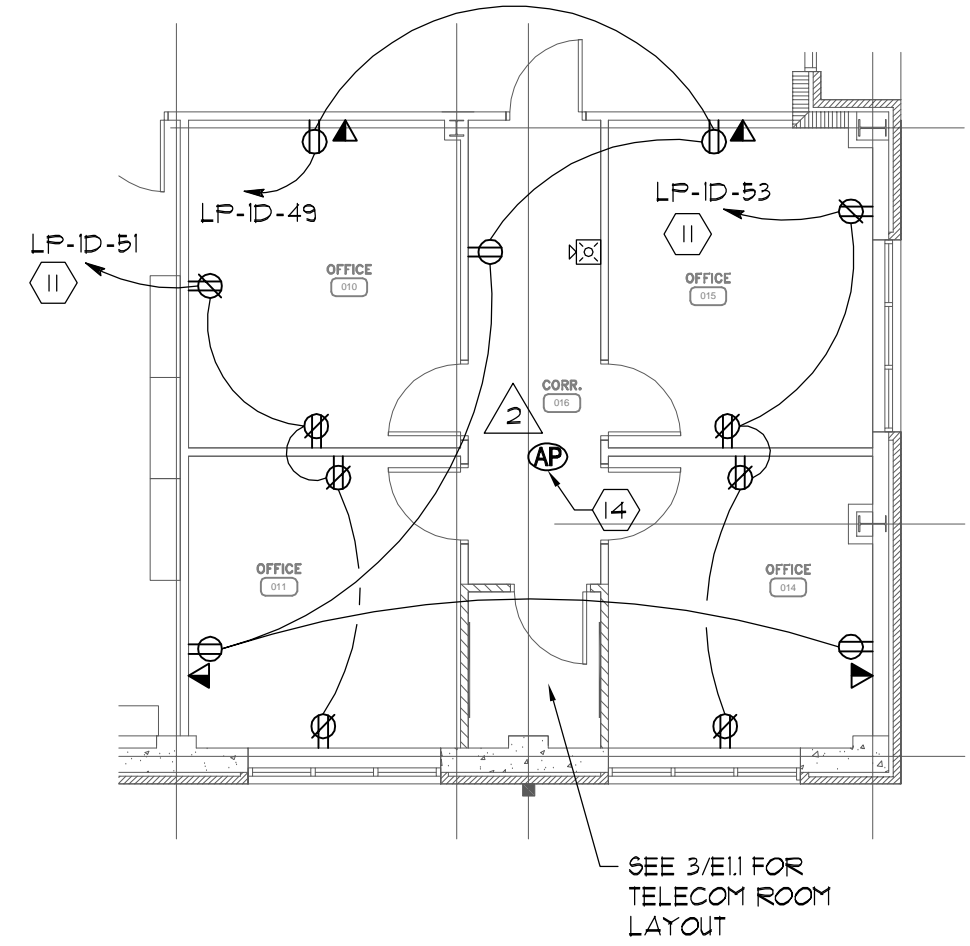
1. IN AREAS OTHER THAN THE TELECOMMUNICATIONS ROOM, COORDINATE THE EXACT LOCATION OF ALL DEVICES (RECEPTACLES, LOW VOLTAGE, FIRE ALARM, ETC.) WITH ARCHITECT PRIOR TO ROUGH-IN IN ORDER TO COORDINATE WITH CASEWORK AND OTHER ITEMS.
2. LABEL PANELBOARD SCHEDULES PER NEC 408.4. CONTRACTOR SHALL IDENTIFY ALL SPARE BREAKERS AND MOVE THEM TO THE "OFF" POSITION.
3. DO NOT MOUNT OUTLETS BACK TO BACK, OFFSET TO NEXT STUD SPACE.
4. ALL BRANCH CIRCUITS SHALL BE WIRED 1/2" C. 2-#12, 1-#10 MINIMUM, UNLESS OTHERWISE NOTED ON THE PLANS. ALL HOMERUNS SHALL BE A MINIMUM 3/4" CONDUIT. PROVIDE ADDITIONAL GROUND OF EQUAL SIZE FOR ISOLATED GROUND CIRCUITS.
5. WHERE ELECTRONIC DOOR HARDWARE IS INSTALLED, COORDINATE EXACT CONNECTION REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO ROUGH-IN. CONTRACTOR SHALL PROVIDE RELAY AND ASSOCIATED WIRING TO CONNECT ELECTRONIC DOOR HARDWARE INTO FIRE ALARM SYSTEM SO THAT UPON ACTIVATION OF THE FIRE ALARM SYSTEM, DOOR LOCKS WILL RELEASE FOR EMERGENCY EGRESS.

KEY NOTES (APPLY TO THIS SHEET ONLY)

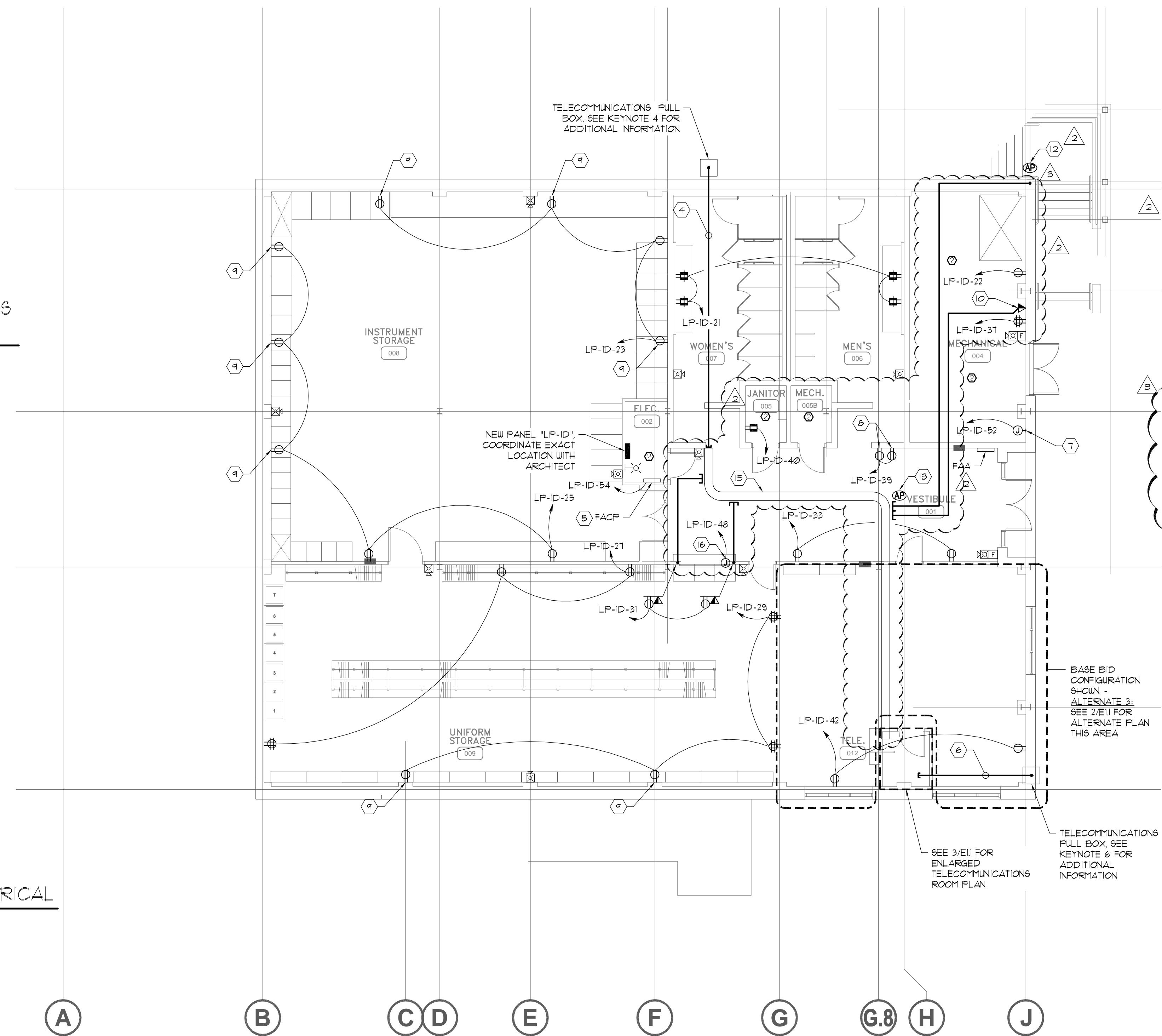
1. PROVIDE AND INSTALL 1/4" X 2" X 12" COPPER BUSBAR WITH STAND-OFF BUSHINGS (ERICO #EGBA142EE OR EQUAL) WITH #6 3/4" C. TO EXISTING BUILDING GROUND. COORDINATE EXACT TERMINATION LOCATION WITH AU OIT PRIOR TO ROUGH-IN.
2. IN TELECOMMUNICATIONS ROOM, PROVIDE AND INSTALL TELECOM BACKBOARD MOUNTED TO ALL WALLS. TELECOM BACKBOARD SHALL BE CONSTRUCTED OF 3/4" AC-GRADE PLYWOOD PAINTED ON ALL SIDES. THE BACKBOARD SHALL BE OF EITHER FIRE-RETARDANT PLYWOOD OR PAINTED WITH TWO COATS OF FIRE-RESISTANT PAINT. THE PLYWOOD SHOULD BE MOUNTED VERTICALLY TO ALL WALLS IN THE TELECOMMUNICATIONS ROOM WITH TOGGLE OR BUTTERFLY BOLTS.
3. PROVIDE AND INSTALL A WIRE BASKET-TYPE CABLE TRAY AT THE TOP OF THE TELECOM BACKBOARD. ANY CONDUITS THAT ENTER THE ROOM SHALL BE CONNECTED TO THE CABLE TRAY BY A DIRECT MECHANICAL CONNECTION. CABLE TRAY TO BE MINIMUM 4" X 12" CABLOFIL #CF105 OR EXACT EQUIVALENT WIRE BASKET TRAY.
4. PROVIDE AND INSTALL (1) 4" CONDUIT WITH FULL-STRING FROM MAIN BUILDING TELECOMMUNICATIONS ROOM. PROPOSED ROUTING SHOWN. SEE SHEET E12 FOR CONTINUATION. COORDINATE EXACT LOCATION AND ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN. COORDINATE INSTALLATION WITH AU OIT. PROVIDE FULL-BOXES AS REQUIRED.
5. PROVIDE AND INSTALL 3/4" C. WITH FULL-STRING FROM FIRE ALARM CONTROL PANEL TO TELECOMMUNICATIONS ROOM. COORDINATE EXACT LOCATION AND ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN. CONNECT TO GOODWIN EXISTING BUILDING FIRE ALARM CONTROL PANEL.
6. PROVIDE AND INSTALL (2) 1" CONDUIT WITH FULL-STRING FROM TELECOMMUNICATIONS ROOM TO ANY CABINET ON FIRST FLOOR. PROPOSED ROUTING SHOWN. SEE SHEET E12 FOR CONTINUATION. COORDINATE EXACT LOCATION AND ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN. COORDINATE INSTALLATION WITH AU OIT. PROVIDE FULL-BOXES AS REQUIRED.
7. PROVIDE AND INSTALL JUNCTION BOX FOR CONNECTION TO IRRIGATION SYSTEM POWER. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
8. PROVIDE AND INSTALL RECEPTACLES TO SERVE ELECTRIC DRINKING FOUNTAIN. INSTALL RECEPTACLES IN LOCATIONS INDICATED ON DRINKING FOUNTAIN SHOP DRAWINGS CONCEALED BEHIND ADA COVER. RECEPTACLES SHALL BE PROTECTED BY A GFCI BREAKER.
9. RECEPTACLES TO BE MOUNTED IN BASEBOARD TO COORDINATE WITH CASEWORK. COORDINATE EXACT LOCATION WITH ARCHITECT PRIOR TO ROUGH-IN.
10. PROVIDE AND INSTALL DATA CONNECTION FOR BUILDING AUTOMATION SYSTEM CONTROL PANEL. CONDUIT SHALL BE CONNECTED DIRECTLY TO THE CONTROL PANEL BOX. COORDINATE EXACT LOCATION WITH ARCHITECT PRIOR TO ROUGH-IN.
11. ALTERNATE 3: CIRCUIT TO BE ROUTED THROUGH LIGHTING CONTROL PANEL FOR TIME CONTROL. COORDINATE TIME SETTINGS WITH OWNER. SEE SHEET E01 FOR LIGHTING CONTROL PANEL DETAILS. ALL CONTROLLED RECEPTACLES SHALL BE PERMANENTLY MARKED TO VISUALLY DIFFERENTIATE THEM FROM UNCONTROLLED RECEPTACLES.
12. PROVIDE AND INSTALL WALL-MOUNTED JUNCTION BOX FOR CONNECTION TO OUTDOOR WIRELESS ACCESS POINT. PROVIDE AND INSTALL A 1" CONDUIT WITH FULL-STRING TO LOWER LEVEL TELECOMMUNICATIONS ROOM. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH AU OIT PRIOR TO ROUGH-IN.
13. IN BASE BID (DO NOT INSTALL IF ALTERNATE 3 IS ACCEPTED) PROVIDE AND INSTALL CEILING-MOUNTED JUNCTION BOX FOR CONNECTION TO WIRELESS ACCESS POINT. PROVIDE AND INSTALL A 1" CONDUIT WITH FULL-STRING TO LOWER LEVEL TELECOMMUNICATIONS ROOM. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH AU OIT PRIOR TO ROUGH-IN.
14. ALTERNATE 3: PROVIDE AND INSTALL CEILING-MOUNTED JUNCTION BOX FOR CONNECTION TO WIRELESS ACCESS POINT. PROVIDE AND INSTALL A 1" CONDUIT WITH FULL-STRING TO LOWER LEVEL TELECOMMUNICATIONS ROOM. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH AU OIT PRIOR TO ROUGH-IN.
15. PROVIDE AND INSTALL 4" X 12" CABLE TRAY EQUAL TO CABLOFIL #CF105. PROVIDE A METALLIC DIVIDER IN CENTER OF TRAY FOR SEPARATION OF COMMUNICATIONS CABLES AND CURRENT-CARRYING CONDUCTORS. COORDINATE EXACT ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN. CONTRACTOR SHALL COORDINATE INSTALLATION OF THE CABLE TRAY WITH OTHER TRADES SUCH THAT 6" ACCESS ABOVE AND TO ONE SIDE OF THE TRAY IS MAINTAINED.
16. PROVIDE AND INSTALL JUNCTION BOX FOR CONNECTION TO MOTORIZED ROLL-UP DOOR. COORDINATE EXACT LOCATION, CONNECTION AND CONTROL REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN. PROVIDE INTERFACE WITH FIRE ALARM SYSTEM SO THAT DOOR WILL CLOSE UPON ACTIVATION OF THE FIRE ALARM SYSTEM.



ENLARGED TELECOMMUNICATIONS ROOM PLAN - ELECTRICAL
SCALE: 1/2" = 1'-0"
NORTH



PARTIAL FLOOR PLAN - ALTERNATE 3 - ELECTRICAL
SCALE: 1/8" = 1'-0"
NORTH



NEW BUILDING LOWER FLOOR PLAN - ELECTRICAL
SCALE: 1/8" = 1'-0"
NORTH

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*Safety is our first priority.
Think Safety. Act Safely.*

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/12/2017
3	Addendum 3	07/20/2017



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GOODWIN HALL - RENOVATION AND BAND REHEARSAL HALL ADDITION
Project Number 15-255

SHEET TITLE:
LOWER FLOOR PLAN - ELECTRICAL

DRAWN BY:
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CHECKED BY:
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DATE:
6-14-2017
FILE NUMBER:
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PROJECT NUMBER:
15-255
SHEET NUMBER:

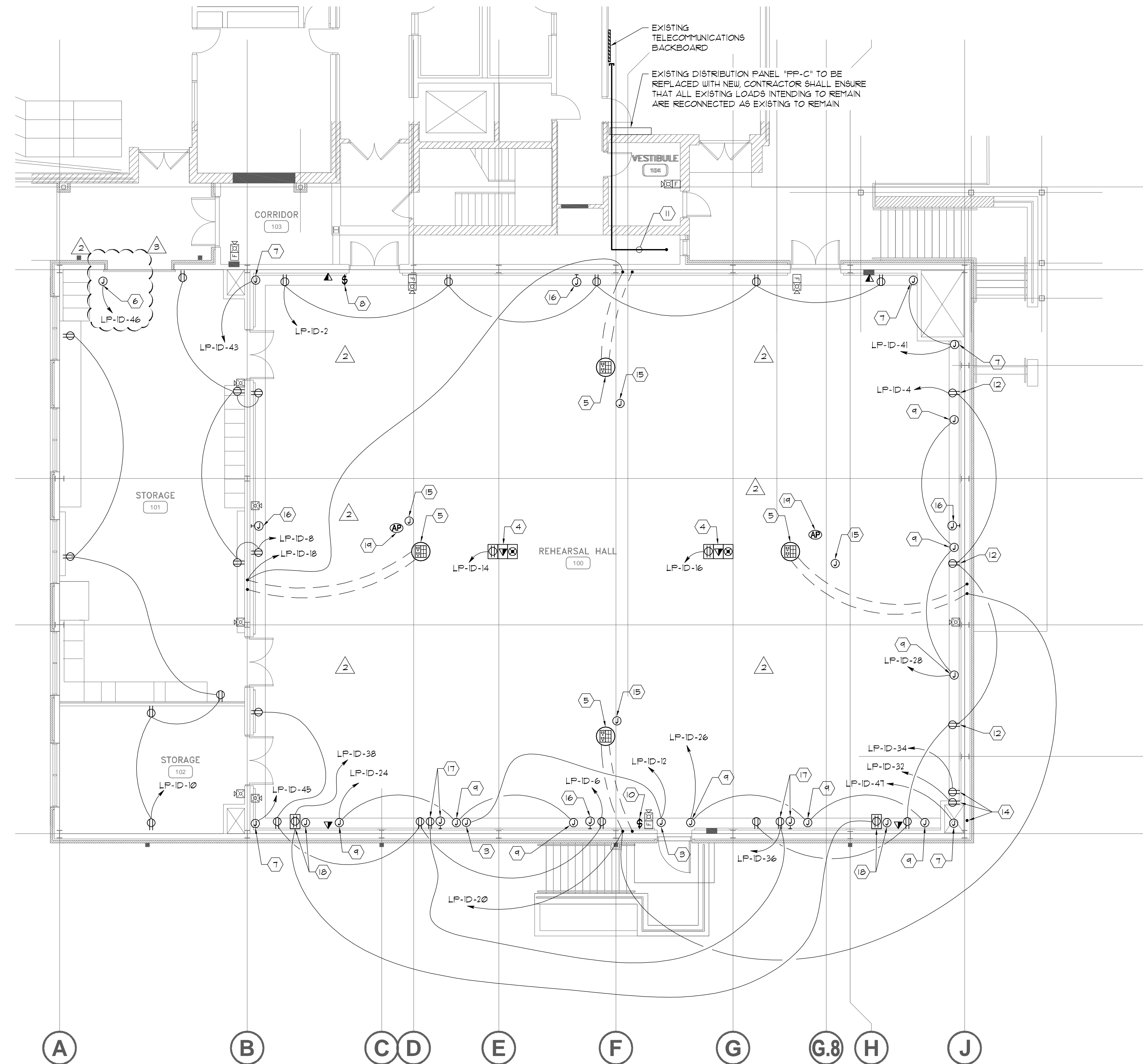
E1.1

GENERAL NOTES: (APPLY TO THIS SHEET ONLY)

- COORDINATE EXACT LOCATION OF ALL DEVICES WITH CASEWORK AND WALL TYPES WITH ARCHITECT PRIOR TO ROUGH-IN. PROVIDE ELECTRICAL BOX EXTENDERS AS REQUIRED.
- LABEL PANELBOARD SCHEDULES PER NEC 408.4. CONTRACTOR SHALL IDENTIFY ALL SPARE BREAKERS AND MOVE THEM TO THE "OFF" POSITION.
- DO NOT MOUNT OUTLETS BACK TO BACK OFFSET TO NEXT STUD SPACE.
- ALL BRANCH CIRCUITS SHALL BE WIRED 3/4" C, 2-#2, 1-#12G MINIMUM, UNLESS OTHERWISE NOTED ON THE PLANS. ALL HOMERUNS SHALL BE A MINIMUM 3/4" CONDUIT. PROVIDE ADDITIONAL GROUND OF EQUAL SIZE FOR ISOLATED GROUND CIRCUITS.
- WHERE ELECTRONIC DOOR HARDWARE IS INSTALLED, COORDINATE EXACT CONNECTION REQUIREMENTS WITH EQUIPMENT MANUFACTURER PRIOR TO ROUGH-IN. CONTRACTOR SHALL PROVIDE RELAY AND ASSOCIATED WIRING TO CONNECT ELECTRONIC DOOR HARDWARE INTO FIRE ALARM SYSTEM SO THAT UPON ACTIVATION OF THE FIRE ALARM SYSTEM, DOOR LOCKS WILL RELEASE FOR EMERGENCY EGRESS.

KEY NOTES: (APPLY TO THIS SHEET ONLY)

- NOT USED.
- NOT USED.
- PROVIDE AND INSTALL CEILING MOUNTED JUNCTION BOX FOR MOTORIZED PROJECTOR SCREEN. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL CEILING MOUNTED JUNCTION BOX FOR POWER/DATA CONNECTION TO PROJECTOR. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING ROUTED BACK TO LOWER LEVEL TELECOMMUNICATIONS ROOM FOR LOW VOLTAGE CONNECTIONS. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL WIREMOLD POKE THROUGH RC40ATCBK OR APPROVED EQUAL FLOOR BOX TO HAVE A MINIMUM OF 1 QUADRIplex POWER AND 4 DATA PORTS. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING ROUTED BACK TO LOWER LEVEL TELECOMMUNICATIONS ROOM FOR LOW VOLTAGE CONNECTIONS. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT QUANTITY AND LOCATION WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL JUNCTION BOX FOR CONNECTION TO MOTORIZED ROLL-UP DOOR. COORDINATE EXACT LOCATION, CONNECTION, AND CONTROL REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN. PROVIDE INTERFACE WITH FIRE ALARM SYSTEM SO THAT DOOR WILL CLOSE UPON ACTIVATION OF THE FIRE ALARM SYSTEM.
- ALTERNATE 2: PROVIDE AND INSTALL JUNCTION BOX FOR CONNECTION TO MOTORIZED CURTAINS. COORDINATE EXACT LOCATION, QUANTITY, CONNECTION, AND CONTROL REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- ALTERNATE 2: PROVIDE AND INSTALL (4) CONTROL SWITCHES FOR MOTORIZED CURTAINS INDICATED IN KEYNOTE 1. COORDINATE EXACT QUANTITY, LOCATION, AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL JUNCTION BOX FOR CONNECTION TO MOTORIZED SHADES. COORDINATE EXACT LOCATION, QUANTITY, CONNECTION, AND CONTROL REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL (2) CONTROL SWITCHES FOR MOTORIZED SHADES INDICATED IN KEYNOTE 3. COORDINATE EXACT QUANTITY, LOCATION, AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- TELECOMMUNICATIONS CONDUIT, PROPOSED ROUTING SHOWN. SEE SHEET E11 FOR CONTINUATION AND ADDITIONAL INFORMATION. COORDINATE EXACT LOCATION AND ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN.
- RECEPTACLES TO BE MOUNTED IN BASEBOARD TO COORDINATE WITH WALL-MOUNTED MIRROR. COORDINATE EXACT LOCATION WITH ARCHITECT PRIOR TO ROUGH-IN.
- NOT USED.
- A/V RACK LOCATION, PROPOSED CONDUIT ROUTING SHOWN. SEE SHEET E11 FOR CONTINUATION AND ADDITIONAL INFORMATION. PROVIDE AND INSTALL (2) DEDICATED RECEPTACLES ON ADJACENT WALL FOR A/V RACK POWER. COORDINATE EXACT LOCATION AND ROUTING WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL CEILING-MOUNTED JUNCTION BOX FOR CONNECTION TO A/V MICROPHONE. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL JUNCTION BOX AT 96" AFF FOR CONNECTION TO A/V CAMERA. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL JUNCTION BOX AND RECEPTACLE AT 120" AFF FOR CONNECTION TO A/V SPEAKER. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL CEILING-MOUNTED JUNCTION BOX AND RECEPTACLE FOR CONNECTION TO A/V SUB. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO A/V RACK LOCATION (KEYNOTE 14). COORDINATE EXACT LOCATION, CONNECTION REQUIREMENTS, AND MOUNTING REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.
- PROVIDE AND INSTALL CEILING-MOUNTED JUNCTION BOX FOR CONNECTION TO WIRELESS ACCESS POINT. PROVIDE AND INSTALL 1" CONDUIT WITH FULL-STRING TO LOWER LEVEL TELECOMMUNICATIONS ROOM. COORDINATE EXACT LOCATION AND CONNECTION REQUIREMENTS WITH ARCHITECT PRIOR TO ROUGH-IN.



FIRST FLOOR PLAN - ELECTRICAL
SCALE: 1/8" = 1'-0"
NORTH

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/12/2017
3	Addendum 3	07/20/2017



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GOODWIN HALL - RENOVATION AND BAND REHEARSAL HALL ADDITION
Project Number 15-255

SHEET TITLE:
FIRST FLOOR PLAN - ELECTRICAL

DRAWN BY:
ATS

CHECKED BY:
CC

DATE:
6-14-2017

FILE NUMBER:
-

PROJECT NUMBER:
15-255

SHEET NUMBER:

E1.2

GENERAL NOTES: (APPLY TO THIS SHEET ONLY)

1. LABEL PANELBOARD SCHEDULES PER NEC 408.4. CONTRACTOR SHALL IDENTIFY ALL SPARE BREAKERS AND MOVE THEM TO THE "OFF" POSITION.
2. ALL BRANCH CIRCUITS SHALL BE WIRED ¾" C, 2-#12, 1-#12G MINIMUM, UNLESS OTHERWISE NOTED ON THE PLANS. ALL HOMERUNS SHALL BE A MINIMUM ¾" CONDUIT. PROVIDE ADDITIONAL GROUND OF EQUAL SIZE FOR ISOLATED GROUND CIRCUITS.

LIGHTING CONTROL KEY NOTES (APPLY TO THIS SHEET ONLY)

1. ROOM CONTROLLER WITH 0-10V DIMMING OUTPUTS, WATTSTOPPER *LMRC-213 OR APPROVED EQUIVALENT
2. THREE BUTTON LOW VOLTAGE ROOM CONTROLLER SWITCH, LMSU-103 OR APPROVED EQUIVALENT, BUTTONS AS FOLLOWS:
 - RAISE ALL
 - LOWER ALL
 - ALL TOGGLE ON/OFF
3. LOW VOLTAGE CEILING-MOUNTED DUAL TECHNOLOGY VACANCY SENSOR WATTSTOPPER *MDC-100 OR APPROVED EQUIVALENT

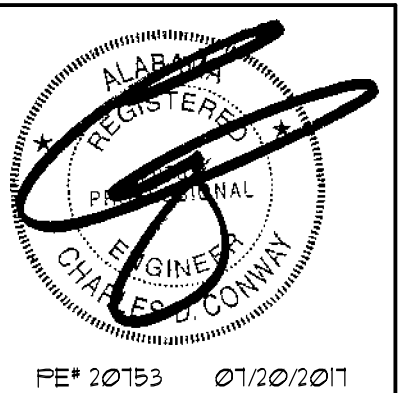
KEY NOTES (APPLY TO THIS SHEET ONLY)

1. EMERGENCY NIGHTLIGHT FIXTURE, CONTRACTOR SHALL CONNECT TO UN-SWITCHED "HOT" IN LIGHTING CIRCUIT.
2. EMERGENCY EGRESS LIGHTING FIXTURE, CONNECT TO SWITCHED "HOT" FOR NORMAL OPERATION AND CONNECT UN-SWITCHED "HOT" TO THE BATTERY PACK IN FIXTURE FOR CHARGING SO THAT IN THE EVENT POWER IS LOST, FIXTURE WILL TURN ON FOR EMERGENCY EGRESS LIGHTING.
3. ROUTE CIRCUIT THROUGH LIGHTING CONTROL PANEL, CONTRACTOR SHALL ROUTE UN-SWITCHED "HOT" AROUND LIGHTING CONTROL PANEL FOR EMERGENCY EGRESS LIGHTING FIXTURES SO THAT IN THE EVENT POWER IS LOST FIXTURES WILL TURN ON.
4. CONNECT TO NEAREST CORRIDOR LIGHTING CIRCUIT CONTROLLED BY LIGHTING CONTROL PANEL.
5. CONNECT TO NEAREST LIGHTING CIRCUIT WITH LOCAL OCCUPANCY SENSOR CONTROLS (TELECOM ROOM).
6. CONTRACTOR SHALL PROVIDE OVERRIDE SWITCH FOR LIGHTING CONTROL SYSTEM. SWITCH SHALL TURN LIGHTS ON/OFF DURING NORMAL BUSINESS HOURS AND OPERATE AS AN OVERRIDE SWITCH AFTER BUSINESS HOURS. REFER TO LIGHTING CONTROL PANEL ON SHEET E01 FOR ADDITIONAL INFORMATION.



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Auburn University, AL 36849
Phone: (334) 844-4810
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*Safety is our first priority.
Think Safety. Act Safely.*

No.	Revision	Date
1	ABC Comments	07/11/2017
2	Addendum 2	07/12/2017
3	Addendum 3	07/20/2017



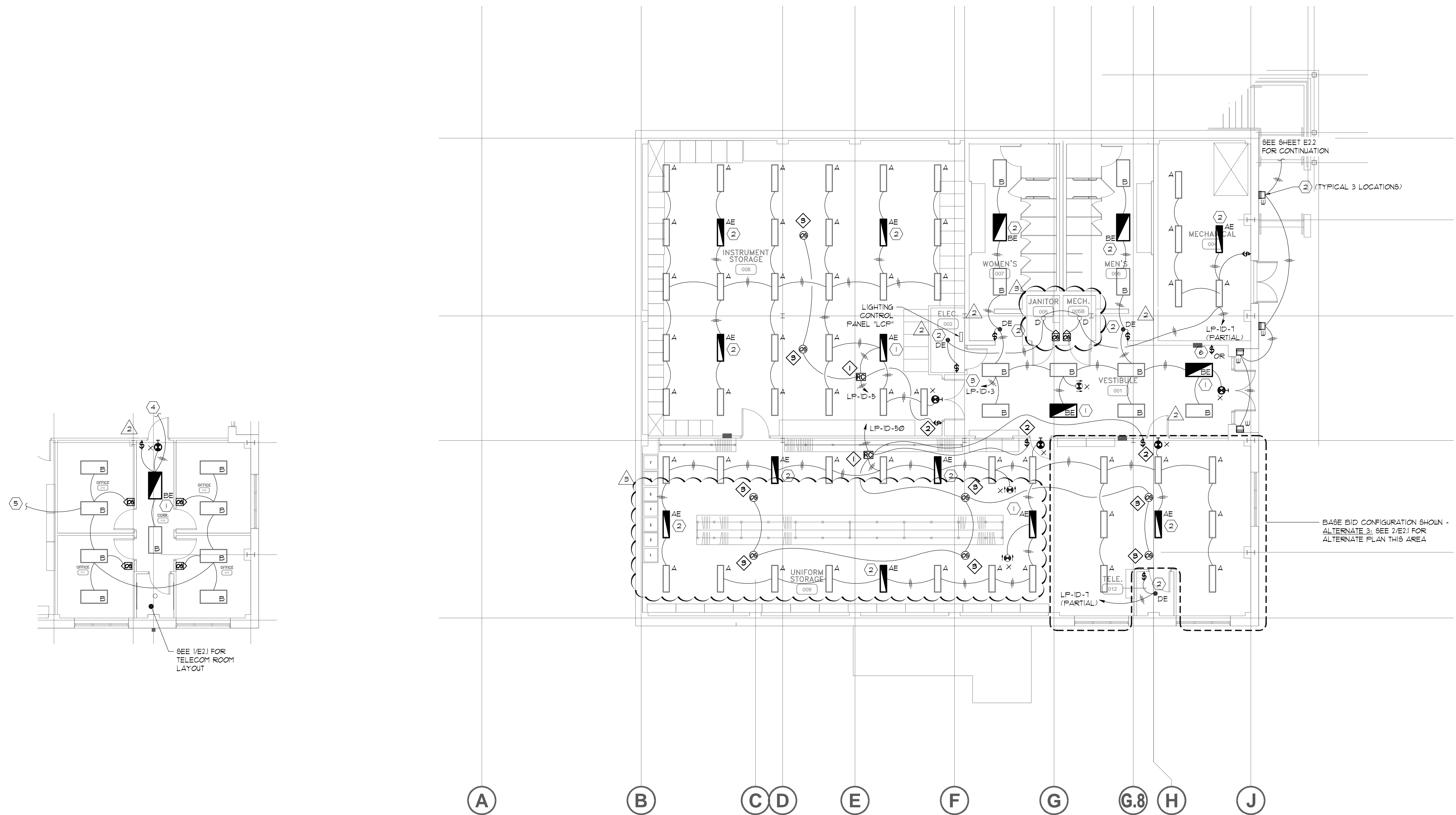
CONWAY & OWEN
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**GOODWIN HALL - RENOVATION
AND
BAND REHEARSAL HALL ADDITION**
Project Number 15-255

SHEET TITLE:
LOWER FLOOR
PLAN - LIGHTING

DRAWN BY:
ATS
CHECKED BY:
CC
DATE:
6-14-2017
FILE NUMBER:
-
PROJECT NUMBER:
15-255
SHEET NUMBER:

E2.1



2 PARTIAL FLOOR PLAN - ALTERNATE 3 - LIGHTING
SCALE: 1/8" = 1'-0"
NORTH

1 NEW BUILDING LOWER FLOOR PLAN - LIGHTING
SCALE: 1/8" = 1'-0"
NORTH

