

ADDENDUM 1

Date: July 10, 2026.

Owner: Charleston Area Regional Transportation Authority (CARTA).
Project: Shipwatch Square Transit and Workforce Development Center

Engineer: HDR Engineering of the Carolinas, Inc.
— 4400 Leeds Avenue
Suite 450
North Charleston, SC 29405

Project Architect: David Sheppard, AIA
Dave.Sheppard@hdrinc.com
(763) 591.5389

NOTICE:

This Addendum is issued to known individuals, firms or corporations holding Bidding Documents and Contract Documents for above listed project.

This Addendum is hereby made a portion of Bidding Documents and Contract Documents. Bidders are required to acknowledge receipt of Addendum in appropriate space on Bid Form.

1.1 CLARIFICATIONS

- A. Following are answers to questions received from bidders. Questions are in *italics*, responses are in **boldface**.
1. For answers to questions asked at the Prebid meeting, as well as general information provided at that meeting, please refer to the meeting minutes of June 24, 2026, attached to this Addendum.
 2. *There are no insurance coverage limits listed in the Project Manual. Article 11.1.1 of the General Conditions references the insurance requirements but does not specify the required monetary limits. Could you please request this information from the Owner so we can submit it for insurance review?*
The Owner-required coverage limit is \$1,000,000.
 3. *Please locate specific locations of the thermal breaks on the structural drawings.*
Thermal breaks are not typically shown on the structural drawings. The thermal break / expansion joint at the roof is shown on plan and details.
 4. *Keynote 6 on S-103 locates vertical angles for partition supports. What is the purpose of the note located on B3/S-103 at the stair; is there a partition here?*
The key note tag 6 located on B3/S-103 should be key note 2.
 5. *Keynote 1 on S-103 at grid line 4 and F calls out a thermal break (see standard details) however no standard detail exists for the expansion joist at this location.)*
Refer to standard details on sheet S-994.
 6. *The vertical bracing and columns at grid line 4 are interior and exposed to view; should this framing be AECS cleaned.*
Yes.
 7. *Loose lintel shown as typical on C1/A-501 is different from the loose lintels show on the structural lintel schedule C4/S-993.*
Detail C1/A-501 has been corrected as noted below in "Changes to Drawings."
 8. *The Bus Canopies ref. S-050 S-051 and S-052 are not noted as AECS please confirm.*
These are AECS.

9. *G-100 shows 0 hour fire rating of structure, however; beams near the elevator on A-451 shows spray on fireproofing and a fireproofing specification was included. Please advise. The 0-hour rating is listed in 6.0 for structure, but not in 6.1 for shaft enclosures, which maintain a 1 hour rating. The details in question occur where steel structure interrupts the one-hour shaft wall construction.*
10. *No shop primer (other than S.W. Pro-Cryl for exterior AECS steel) has been specified; please specify other primers for other applications if required (interior or exterior non-AECS).*
See clarifications in "Change to Project Manual" below. This product is intended as the default shop-applied primer for steel.
11. *Please verify the cleaning and shop priming of the following:*
 - a. *Bus Canopies exposed to view and the elements – SP3 and primed with S.W. Pro-Cryl per specifications* **Correct.**
 - b. *Interior framing exposed to view but not exposed to the elements (rooms 111, 118, 213, 205, and 204) – SP3 cleaned and primed with standard shop primer.* **Correct.**
 - c. *Interior framing not exposed to view – SP3 cleaned and primed with standard shop primer.* **Correct.**
 - d. *Roof parapet framing (ref. C3/A-501) partially exposed – SP3 cleaned and shop primed with S.W Pro-Cryl.* **Correct.**
 - e. *Mechanical roof screen posts/columns exposed non-AECS- SP3 cleaned and shop primed with S.W Pro-Cryl.* **Correct.**
 - f. *Tube framing at outdoor seating - AECS cleaned as noted and primed with S.W. Pro-Cryl.* **Correct.**
12. *Please clarify which mix matrix/style needs to be utilized. The CIP and Concrete, Materials and Proportioning indicate different styles of mixes.*
Provide 4,000 psi concrete per sheet S-990.
13. *There are two specification sections for the operable partition Scope (102239 and 102241) but only one operable partition. The models specified are completely different. Please clarify which is required - the single panel Acousti-Seal system from 102239 or the Acousti-Clear glass system from 102241.*
There are two operable partitions, and yes, they are very different. The two specification sections correlate with them: 10 22 41 is located in the first floor between 111 Transit Waiting and 118 Conference, shown on A-403, whereas 10 22 39 (Single Panels) refers to the single-panel, manually operated partition on the second floor separating 204 Training and 205 Training (see A-102.) We include in this Addendum an enlarged plan dimensioning the closet the panels stack in.
14. *Section 102239 has two different finishes specified: 2.3-C2 states wall covering fabric, while 2.3-C3 states wood veneer over MDF board. The project currently specifies the recommended panel build using steel skinned panels, but these would not be recommended to be supplied with Wood Veneer as the Steel Skin will not allow us to attach the softer wood veneer. Fabric is typically used in this instance. Please clarify.*
We will delete the erroneous reference to wood veneer. We will select a fabric once the vendor is chosen.
15. *Section 102239 specifies in 2.3 D that we are to use RT100 track with right angle intersections. Our recommendation is steel #17 track with smooth switches and curves to provide a pre-programmed an easier to use layout. Plus, it's significantly more durable, and less expensive from Modernfold than RT100 track. Can we change the spec to Modernfold steel #17 track with smooth switches and curves? The system will perform much better long term.*
The specification cannot be proprietary; we have no issue with this change, although this may require a wider soffit between the rooms. Note that in this Addendum we provide a wider soffit to accommodate such systems.
16. *Section 102241 specifies under 2.4 a motorized system only used with the Acousti-Seal product (chain driven motor). The Acousti-Clear uses #17 G track like the specified, but the motors on the Acousti-Clear motorized are small motors only used in the seals and final*

closure to deploy both. The only other fully automated option for Acousti-Clear motorized is to use the Comfortdrive system which is totally different than what 2.4 describes. Please clarify system.

Paragraph 2.4 reflects draws upon our standard, nonproprietary specification language for power-operated folding partitions.

1.2 CHANGES TO PROJECT MANUAL

A. The following Sections have changed:

1. Section 01 41 31 "Bid Form."
 - a. Section revised to include Bid Form Schedule.
 - b. Revised to change the paragraph titled "Completion Time" to "Anticipated Project Schedule." The Bidder may propose a construction duration that in its judgement offers the Owner the best value.²
 - c. Specification reprinted in full as an attachment to this Addendum.
2. Section 05 51 00 "Metal Stairs and Railings."
 - a. Add subparagraph 2.1 A.2, as follows: "Contractor's Option: Provide factory manufactured stair system in lieu of fabricated stairs, subject to review by Architect."
3. Section 07 42 66 "Perforated Metal Screen Wall Panels."
 - a. Revise paragraph 2.1 MANUFACTURERS to read as follows:

A, Perforated Metal Screen Wall Panels:

 1. A. Zahner Company.
 2. LUHA Building Systems.
 3. AMICO Inc.
 4. Other manufacturers desiring approval comply with Section 01 61 00.
5. Section 09 91 13 "Exterior Painting"
 - a. Paint system for Architectural Structural Steel, paragraph 3.5 B.1, revised for clarity. Reference to Section 05 12 13 corrected to Section 05 12 00. Shop primer for Structural Steel is Sherwin Williams Pro-Cryl Universal Acrylic Primer unless otherwise noted.
6. Section 09 91 23 "Interior Painting."
 - a. Paragraph 2.1 C, the reference for Structural Steel Paint primer is changed from 05 12 00 to 09 91 13 "Exterior Painting."
7. Section 10 32 99, "Operable Walls – Single Panels"
 - a. Paragraph 2.2 A.1 changed to read "Minimum Sound Transmission Class (STC): 48."
 - b. Paragraph 2.2 C.7, referring to wood veneer, is deleted.
8. Section 23 31 00, "HVAC - Ductwork."
 - a. Revised to delete aluminum ductwork and replace with galvanized steel ductwork throughout the Project.
 - b. Specification reprinted in full as an attachment to this Addendum.

9. Section 23 80 00 "HVAC - Equipment."
 - a. Revised list of manufacturers in section 2.1.
 - b. Specification reprinted in full as an attachment to this Addendum.
10. Section 23 81 29, "Variable Refrigerant Flow Heat Pump Systems."
 - a. Revised list of manufacturers in section 2.1.
 - b. Specification reprinted in full as an attachment to this Addendum.

1.3 CHANGES TO DRAWINGS

- A. Drawings listed in this section are reprinted at full size as an attachment to this Addendum.
- B. Sheet C-401:
 1. Revisions to water service at the direction of Charleston Water.
- C. Sheet C-403:
 1. Revisions to water service at the direction of Charleston Water.
- D. Sheet C-506:
 1. Revisions to water service at the direction of Charleston Water.
- E. Sheet A-102:
 1. Callout added for new enlarged plan B6/A-405 showing stacking of manually operated partition.
- F. Sheet A-151:
 1. Reflected ceiling plan revised to indicate 1'-0" wide gypsum soffit to accommodate track for manually operated partition.
- G. Sheet A-405:
 1. New plan detail B6 added, showing pocket of manually operated partition.
- H. Sheet A-501:
 1. Revisions to detail C1 correcting lintel type in conformance with Structural drawings and providing aluminum closure trim at window head.

1.4 ATTACHMENTS

- A. The following documents are attached to this Addendum and incorporated into it:
 1. Minutes of the June 24, 2026 Prebid meeting.
 2. Specification sections as identified in Section 1.2, above.
 3. Drawings as identified in Section 1.3, above.

END OF SECTION



Shipwatch Square Transit & Workforce Center Pre-Bid Meeting
BCDCOG, 5790 Casper Padgett Way, North Charleston, SC 29406
June 24, 2026 @ 3:00 PM

Agenda

I. Welcome and Introductions

All attendees signed in. Introductions began with Sharon Hollis, Jason McGarry, Jeff Carper, Elissa Smith, Contractors (see sign in sheet attached), Ruth Krieger and Dave Sheppard. Sharon began with an agenda review. Jason mentioned that responses to any questions asked will be issued in an addendum.

II. Project Overview

*Sharon reviewed the project slides with an overview and a virtual walk through of the property at 3655 Rivers Avenue.
Jeff Carper highlighted the existing utilities, one grand tree that will require protection during construction.*

III. Key Dates

Jason reviewed the key dates for the project. Specific questions are to be emailed to Jason by July 6th; responses will be given by noon on July 10th; bids due at BCDCOG on July 15th for public bid opening.

IV. Federal Requirements

- a. Buy America Build America
- b. DBE
- c. Davis Bacon
- d. EEO

FTA funded project; Jason highlighted requirements listed above.

Contractor question: No DBE goal – always encourage use of DBE but no specific project goal.

V. Special Provisions

Fiber connection to LCRT Project (100% plans for LCRT show where the projects meet)

Dave also mentioned that this project includes hurricane rated glass.

VI. Construction Schedule

Award of contract August 19, 2026

Contractor Question regarding calendar days included – contractor free to propose schedule that fits their budget.

VII. Other Items to Note

Jason to send out contact information

Contractor Question: no bid alternates – correct.

Contractor Question: Owner will be CARTA? - correct

Contractor Question: Can we get Geotech whenever it is available? Yes

Contractor Question: Is this pre-bid mandatory? – no

Contractor Question: No expectation of phasing? – no

Contractor Question: Voluntary cleanup project? – Jeff Carper responded that we can provide a copy.

VIII. Adjournment

SECTION 00 41 13
BID FORM

DATE: _____

Bidder, _____, a * _____ organized and existing under
the laws of the State of South Carolina, does business as ** _____.

* Insert corporation, partnership, or individual, as applicable.

** Insert trade or business name.

TO: Charleston Area Regional Transportation Authority
Hereinafter referred to as Owner

Gentlemen:

The Bidder, in compliance with your invitation for bids for construction of: the Shipwatch Square Transit and Workforce Development Center, having examined the Bidding Documents prepared by HDR Engineering Inc of the Carolinas, and other related documents and being familiar with site of proposed Work, and with all conditions surrounding construction of proposed Project including availability of materials and labor, hereby propose to furnish all labor, materials, tools, equipment, machinery, equipment rental, transportation, superintendence, perform all Work, provide all services, and to construct all Work in accordance with Bidding Documents, within time and amounts stated herein. These amounts are to cover all expenses incurred in performing Work required under Bidding Documents, of which this Bid is a part.

Bidder, if awarded contract, hereby agrees to commence Work under this contract on or before a date to be specified in Contract Agreement or written "Notice to Proceed" from Owner and to obtain Substantial Completion of Project within _____ (Bidder to fill in) consecutive calendar days thereafter.

Bid amount shall be expressed in words and in figures. In case of discrepancy, amount shown in words will govern. Bidders shall complete the Bid Form Schedule below.

BID FORM SCHEDULE

BASE BID - FOR CONTRACT: Bidder agrees to perform all Work as described in Bidding Documents, for Lump Sum of _____ dollars (Bidder to fill in) (\$_____).

CSI Division No.	Division Title	Material Cost	Labor Cost	Total Cost
00	Procurement and Contracting Requirements	\$	\$	\$
01	General Requirements	\$	\$	\$
03	Concrete	\$	\$	\$

04	Masonry	\$	\$	\$
05	Metals	\$	\$	\$
06	Wood, Plastics, and Composites	\$	\$	\$
07	Thermal and Moisture Protection	\$	\$	\$
08	Openings	\$	\$	\$
09	Finishes	\$	\$	\$
10	Specialties	\$	\$	\$
11	Equipment	\$	\$	\$
12	Furnishings	\$	\$	\$
14	Conveying Equipment	\$	\$	\$
21	Fire Suppression	\$	\$	\$
22	Plumbing	\$	\$	\$
23	Heating, Ventilating, and Air Conditioning	\$	\$	\$
25	Integrated Automation	\$	\$	\$
26	Electrical	\$	\$	\$
27	Communications	\$	\$	\$
28	Electronic Safety and Security	\$	\$	\$
31	Earthwork	\$	\$	\$

32	Exterior Improvements	\$	\$	\$
33	Utilities	\$	\$	\$
Base Bid subtotal				\$
<i>Contractor O&P</i>				\$
<i>Bonds and Insurance</i>				\$
Bid total				\$

Bidder agrees that this Bid shall be good and will not be withdrawn for period of 60 calendar days after date for opening of bid.

Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities or irregularities therein.

ANTICIPATED PROJECT SCHEDULE:

The undersigned agrees to commence actual physical work at the site, with an adequate force and equipment, per the schedule outlined below, unless otherwise mutually agreed upon with the Owner. The schedule below reflects the expectations of the Owner. The Bidder shall propose a schedule which they feel provides the best value to the Owner.

Milestone Dates:

1. Wednesday, August 19, 2026 - Award of Contract
2. Monday, September 14, 2026- Start Construction
3. Monday, February 14, 2028 - Substantial Completion
4. Monday, February 28, 2028 - Final Completion/ Closeout Approval by
CARTA

Bid Security attached in sum of _____ (\$ _____), as required by Instructions to Bidders, becomes property of Owner in event contract agreement is not executed and Performance Bond, and Labor and Material Payment Bonds are not delivered within time set forth.

Upon notice of award of this Bid, bidder and Owner will execute Contract Agreement prior to start of Work, but not later than 15 days after Notice to Proceed.

Use of American Institute of Architects document: A101 Standard Form of Agreement Between Owner and Contractor, 2007 edition, is hereby made a requirement of the Contract Documents.

If awarded a contract, Contractor shall furnish Performance Bond, and Labor and Material Payment Bond within three days following date agreement is entered into, and prior to commencement of Work. The bidder's Surety for Performance and Payment Bonds will be: _____.

Bidder acknowledges receipt of following addenda:

_____.
_____.
_____.

Respectfully submitted,

Contractor License Number: _____

Expiration Date: _____

Signature if an Individual: _____

Doing Business as: _____

Business Address: _____

If a Partnership: _____

By: _____

Member of Firm

Member of Firm

Business Address: _____

If a Corporation _____

By: _____ Title: _____

Business Address: _____

Telephone Number: _____

END OF SECTION

SECTION 23 31 00

HVAC - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. HVAC ductwork and accessories.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 07 62 00 - Flashing and Sheet Metal.
 - 2. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
 - 3. ASTM International (ASTM):
 - a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 4. National Fire Protection Association (NFPA).
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Ducted Electric Heat Guide for Air Handling Systems.
 - b. HVAC Duct Construction Standards - Metal and Flexible.
- B. Qualifications:
 - 1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three years.
 - 2. Installers: Firm with at least five years installation experience on products similar to that required for this Project.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 61 03.
 - 2. Efficiency ratings per ASHRAE 52 for factory built and assembled filter units.
 - 3. Scaled ductwork drawings (1/4 IN equals 1 FT) showing duct and accessory layout and support.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Miscellaneous Submittal:
 - 1. Documentation of qualifications for fabricators and installers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Transverse joints (factory fabricated aluminum):
 - a. Ductmate Industries, Inc.
 2. Flat oval and round spiral ductwork:
 - a. United McGill.
 - b. Spiral Pipe of Texas.
 - c. Eastern Sheet Metal.
 3. Flexible ducts:
 - a. Thermaflex.
 - b. Condu-flex.
 - c. Glass-flex.
 4. Turning vanes:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne.
 - c. SEMCO Incorporated.
 - d. Ward Industries, Inc.
 5. Flexible duct connections:
 - a. Vent Fabrics.
 - b. Duro Dyne.
 6. Access doors in ductwork:
 - a. Vent Fabrics.
 - b. American Warming.
 7. Backdraft dampers:
 - a. Air Balance.
 - b. Ruskin.
 - c. American Warming.
 8. Ceiling diffusers:
 - a. Price.
 - b. Anemostat.
 - c. Carnes.
 - d. Titus.
 9. Grilles and registers:
 - a. Price.
 - b. Anemostat.
 - c. Carnes.
 - d. Titus.
 10. Manual (volume) dampers:
 - a. Air Balance.
 - b. Ruskin.
 - c. American Warming.
 11. Duct sealers:
 - a. Durkee-Atwood.
 - b. Unitec McGill.
 - c. Benjamin Foster.
 - d. Design Polymerics.
 12. Louvers:
 - a. Greenheck.
 - b. Ruskin.
 - c. Air Balance.
 - d. American Warming.

2.2 COMPONENTS

A. Duct and Fittings (Metallic):

1. Materials:
 - a. 3003 H-14 aluminum alloy:
 - 1) Comply with ASTM B209.
 - b. G90 galvanized steel:
 - 1) Comply with ASTM A653 and ASTM A90.
2. Fabrication (galvanized steel):
 - a. Minimum Sheet Metal Thickness:
 - 1) Per SMACNA for 2 IN WC pressure class.
 - a) Heavier gage sheet material may be used with associated reinforcement as an alternate to minimum thickness specified.
 - b) Lighter gage sheet material with associated reinforcement shall not be used as an alternate to minimum thickness specified.
 - b. Longitudinal Seams:
 - 1) Pittsburgh lock seam.
 - 2) Continuously Welded.
 - c. Transverse Seams:
 - 1) SMACNA T-22 or T-24 companion flange.
 - 2) Factory fabricated flanged duct connection system:
 - a) Ductmate 25/35.
 - b) Angles and Cleates: Galvanized.
 - c) Snap cleats: Galvanized.
 - d) Gaskets: Close cell neoprene.
 - e) Bolts and screws: Stainless.
 - d. Sealing:
 - 1) Per SMACNA for Seal Class A.

B. Flat oval and round spiral ductwork:

1. Flat oval or round as indicated on drawings.
2. Spiral lockseam construction.
3. Reinforcing corrugations.
4. Removable labels.
5. No mill or shop markings on outside.
6. Material:
 - a. Painted:
 - 1) G90 hot dipped galvanized steel
 - 2) Color: as selected by Architect.
 - b. Exposed:
 - 1) Aluminum alloy.
7. Material thickness:
 - a. Straight runs: per SMACNA.
 - b. Fittings: at least two gages heavier than straight runs.
8. Fittings:
 - a. All seams continuously welded.
 - b. All divide flow fittings discreet and separate, i.e. no tap collars.
9. Double wall where indicated on drawings:
 - a. Outer wall: solid.
 - b. Inner wall: aluminum alloy, perforated.
 - c. Insulation: 1 IN fiberglass minimum.
 - 1) Minimum 'k-value': 0.27 BTU/ h-FT²-DEGF.

C. Supports and Hangers:

1. Materials (for aluminum duct):
 - a. Support angles: Aluminum or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.

- b. Hanger rods: Stainless steel.
 - c. Anchors: Stainless steel wedge type.
 - 2. Materials (for galvanized duct):
 - a. Support angles: Galvanized or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
 - b. Hanger rods: Galvanized or Stainless steel.
 - c. Anchors: Stainless steel wedge type.
 - 3. Fabrication: Trapeze type units.
 - 4. Strap hangers are not allowed.
- D. Turning Vanes:
- 1. Materials: Same as duct.
 - 2. Fabrication:
 - a. Fabricate double vane units.
 - b. Pressure drop through elbows: Maximum 20% of velocity pressure.
- E. Flexible Connections:
- 1. Materials: Hypalon, double coated closely woven glass fabric.
 - 2. Fabrication: Withstand 4.5 IN water column, positive and negative pressure.
- F. Access Doors:
- 1. Materials:
 - a. Inner panel, out panel and frame: Same as duct.
 - b. Gaskets: Closed cell neoprene.
 - c. Insulation: 1 LB density fiberglass.
 - d. Hinges: Stainless steel.
 - e. Latches:
 - 1) Aluminum-zinc alloy.
 - 2) Outside lever handle.
 - 3) Adjustable spacer.
 - 4) Beveled inside flange.
 - 5) Studs:
 - a) Minimum 3/8 IN DIA stud for doors up to 24 IN wide x 48 IN high.
 - b) Minimum 1/2 IN DIA stud for doors larger than 24 x 48 IN.
 - 2. Fabrication:
 - a. Provide four-side continuous gaskets.
 - b. Utilize continuous piano hinges.
 - c. Latches required:
 - 1) 12 IN in any direction: One.
 - 2) Up to 18 x 18 IN: Two.
 - 3) Up to 24 x 48 IN: Two with inside handles.
 - 4) Up to 24 x 72 IN: Three with inside handles.
 - 5) Minimum door size: 12 x 12 IN.
- G. Flexible Duct:
- 1. Material: Continuous steel supporting spiral covered with 100% continuous filament fiberglass with nonporous fiberglass/vinyl liner and reinforced Mylar/neoprene outer cover.
 - 2. UL listed, Class 1 with flame spread of 25 or less and smoke development rating not to exceed 50.
 - 3. Runouts to diffusers, registers, and grilles:
 - a. Maximum flexible duct length: 4 FT.
- H. Backdraft Dampers:
- 1. Material:
 - a. 6063 T5 aluminum.
 - b. Blade edge seals: Extruded vinyl.
 - 2. Fabrication:
 - a. Frame thickness: 0.125 IN minimum.

- b. Blade thickness: 0.070 IN minimum.
 - c. Linkage: 1/2 IN tie bars.
 - d. Bearings: Synthetic.
- I. Diffusers:
 - 1. Materials:
 - a. Body: Extruded aluminum.
 - b. Ceiling diffuser gaskets: Sponge rubber.
 - 2. Fabrication:
 - a. Type: Square or rectangular with removable core.
 - b. Key operated opposed blade damper mounted in neck except where indicated on Drawings to be omitted.
 - 1) Dampers to be housed in round to square adapters.
 - c. Linear supply diffusers:
 - 1) Internal pattern control vanes which also function as volume control dampers, adjustable through slots.
 - 2) Mounting: Hanger inside ductwork.
 - 3) Length: As indicated on Drawings.
 - 4) Number of slots, size, location, and throw: See Drawings.
 - d. Finish:
 - 1) Circular diffusers: Clear satin anodized.
 - 2) Interior of perforated supply and return diffusers: Flat black paint.
- J. Volume Dampers and Flow Equalizers for Round Neck Diffusers:
 - 1. Material: Aluminum.
 - 2. Fabrication:
 - a. Design for neck velocity: 2500 FT/MIN.
 - b. Center rod operator accessible through diffuser without removing diffuser.
 - c. Furnish with screws, duct collars, transitions and air pattern deflectors as required.
- K. Air Grille and Register Assembly:
 - 1. Materials:
 - a. Assembly: Extruded aluminum.
 - b. Gaskets: Sponge rubber.
 - 2. Fabrication:
 - a. Supply registers: Two sets individually adjustable louvers.
 - b. Exhaust and return registers: 45 DEG deflection front blades.
 - c. Dampers: Key-operated opposed blade.
 - d. Screws, duct collars, and transitions as required.
 - e. Finish:
 - 1) Manufacturer's standard factory applied finish.
 - 2) Color: White.
- L. Automatic and Manually (Volume) Operated Dampers:
 - 1. Material:
 - a. Body: 6063 T5 aluminum.
 - b. Seal blade edge: Extruded vinyl.
 - 2. Fabrication:
 - a. Frame thickness: 0.125 IN minimum.
 - b. Provide flanged connections.
 - c. Blades:
 - 1) Two-position damper: Parallel blade.
 - 2) Mixing and volume damper: Opposed blade.
 - 3) Airfoil shape.
 - 4) Maximum 6 IN width.
 - d. Linkage: Concealed in frame.
 - e. Axles: 1/2 IN plated steel hex.

- f. Bearings: Molded synthetic.
 - g. Seals:
 - 1) Jamb: Flexible compression type.
 - h. Control shaft: Removable, 1/2 IN DIA.
 - i. Air leakage (4 FT SQ damper) at 4 IN WG pressure: 99 CFM maximum.
 - j. Motors for motor operated damper: See Specification Section 23 09 00.
 - k. Provide outboard support for operator linkage where damper motor is to be installed outside of duct.
 - l. Provide stainless steel locking quadrants for manual (volume) dampers.
 - m. Provide fold out operator mounting bracket where damper motor is to be installed on face of damper or inside duct.
 - n. Finish: 215 R1 anodized.
- M. Duct sealer:
- 1. NFPA rating of "Non-Combustible".
 - 2. Flame spread rating: 25 or lower, in dry condition.
 - 3. Smoke developed rating: 50 or lower, in dry condition.
 - 4. Resistant to water and water vapors.
 - 5. Comply with UL 181.
 - 6. Pressure rupture rating: 16 IN WG, minimum.
- N. Louvers: See Specification Section 08 90 00.
- O. Louvers:
- 1. Drainable.
 - 2. Continuous blade appearance.
 - 3. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
 - 4. Minimum free area: As scheduled.
 - 5. Maximum pressure drop: As scheduled.
 - 6. Bird screen:
 - a. 1/2 IN SQ mesh.
 - b. 16 GA aluminum.
 - c. Install in standard, folded frame.
 - 7. Anchors, fasteners, reinforcing: Aluminum or stainless steel.
 - 8. Finish:
 - a. Meet requirements of AAMA 2605.
 - 1) PCDF coating with minimum 70% resin content.
 - 2) Color: To be selected by Architect.

2.3 MAINTENANCE MATERIALS

- A. Extra Materials:
- 1. Furnish Owner with the following extra materials:
 - a. 1 complete filter media change(s) for each filter unit.
 - b. Filter media used during construction is in addition to this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 01 61 03.
- B. Metal Ductwork:
- 1. Install with longitudinal seams sealed for zero leakage.
 - a. For welded seams, submit sample for approval by Engineer.
 - 2. Install gaskets at each transverse joint and fasten sections together with bolts.
 - a. Tighten for zero leakage.

3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
 4. Install turning vanes in square elbows:
 - a. Unsupported vane length not to exceed 48 IN.
 - b. Position vanes at proper angle to meet specified pressure drop.
 5. Install flexible connections at fans:
 - a. Locate as close as possible to fan.
 - b. Allow 1 IN of slack to prevent vibration transmission.
 - c. Install thrust restraints across connectors.
- C. Flexible Ductwork:
1. Install in concealed areas between: low velocity duct work and diffusers, return air grilles or exhaust outlets and ducts.
 2. Use low loss fittings for connection to duct.
 3. Connect to metal duct collars by means of non-combustible synthetic rubber sealing compound and stainless steel drawband.
 4. Install with maximum length of 3 FT and no change in direction.
- D. Diffusers:
1. Install where shown on Drawings of size and capacities scheduled on Drawings.
 2. Install painted lay-in type in lay-in ceilings.
 3. Install prime painted diffusers in areas where duct work is concealed.
 4. Install anodized diffusers in exposed duct work.
- E. Air Grille and Register Assemblies:
1. Install where shown on Drawings of size and capacities scheduled on Drawings.
 2. Install prime painted grilles and registers in areas where duct work is concealed.
 - a. Field paint to match adjacent surface finish.
- F. Louvers:
1. Install in accordance with manufacturer's instructions.
 - a. Provide anchoring and bracing accessories as required.
 - b. Seal around perimeter on exterior and interior.
 - c. Provide aluminum flashing at sill to match louver.

END OF SECTION

SECTION 23 80 00

HVAC - EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Heating, ventilating, and cooling equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 01 61 03 - Equipment - Basic Requirements.
 - 2. Section 23 05 93 - HVAC Systems - Balancing and Testing.
 - 3. Section 25 10 00 - Building Management System (BMS).
 - 4. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA).
 - 2. Air Conditioning and Refrigeration Institute (ARI).
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
 - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 4. Canadian Standards Association (CSA).
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 7. National Roofing Contractors Association (NRCA).
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 507, Standard for Electric Fans.
- B. Miscellaneous:
 - 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
 - 2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Fabrication and/or layout drawings.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Wiring diagrams.
 - d. Control diagrams.
 - e. Manufacturer's catalog cuts and technical data.
 - f. Corrosion-protection information.
 - g. Fan curves.
 - h. Sound data.
 - i. Vibration isolation.
 - j. Control description.
 - k. Performance data on all equipment.

3. Certifications:
 - a. Provide certification of thickness of corrosion-protection coating.
- B. Contract Closeout Information:
 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Dedicated outside air systems:
 - a. Daikin Applied:
 - b. AAON.
 - c. Carrier.
 - d. Trane.
 - e. Greenheck.
 2. Unit heater - electric:
 - a. Reznor.
 - b. Chromalox.
 - c. QMark.
 3. Unit heaters - gas:
 - a. Hastings.
 - b. Modine Manufacturing Co.
 4. Low-Intensity Radiant:
 - a. Co-Ray-Vac.
 - b. Detroit Radiant Products Company.
 5. Infrared gas heaters:
 - a. Detroit Radiant Products Company.
 - b. Schwank.
 6. Unit heaters - water-steam:
 - a. Modine Manufacturing Co.
 - b. Armstrong-Hunt Inc.
 7. Cabinet heaters - water:
 - a. Daikin Applied.
 - b. Trane.
 8. Cabinet heaters - electric:
 - a. McQuay.
 - b. Chromalox.
 9. Duct heaters - gas:
 - a. Hastings.
 - b. Reznor.
 10. Duct furnace - gas, direct fired:
 - a. Hastings.
 - b. Reznor.
 11. Duct heaters - electric:
 - a. Brasch.
 - b. Industrial Engineering and Equipment Co.
 12. Make-up air units - gas:
 - a. Hastings.
 - b. Titan.
 - c. AAON.
 13. Make-up air units, direct fired, gas:

- a. Hastings.
- b. Titan.
- c. AAON.
- 14. Make-up air units, electric or water:
 - a. Hastings.
 - b. Daikin Applied.
 - c. AAON.
 - d. Carrier.
- 15. Energy recovery units - coil type:
 - a. Q-Dot.
 - b. Gamewell.
- 16. Energy recovery units - fixed plate type:
 - a. Temp-X-Changer.
 - b. Exothermic.
- 17. :
 - a. Carrier.
 - b. Daikin.
 - c. Mitsubishi.
 - d. Trane.
 - e. LG.

2.2 GENERAL

- A. All Manufactured Units:
 - 1. Comply with Specification Section 01 61 03.
 - 2. Factory wired and assembled.
 - 3. Use fasteners made of same material as unit.
 - 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
 - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.
- B. All manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
 - 1. Type:
 - a. Corrosion-resistant materials:
 - 1) Aluminum.
 - 2) Stainless steel.
 - 3) FRP.
 - b. Corrosion-resistant coating:
 - 1) Phenolic-based coating:
 - a) 3 MIL minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
 - b) 5 MIL baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DEGF.
 - c) Factory applied.
 - d) Provide factory certification of application.

2.3 MANUFACTURED UNITS

- A. Unit Heater - Electric:
 - 1. Type: Horizontal and Vertical.
 - 2. UL listed for non-rated areas.
 - 3. Material:
 - a. Cabinet: 18 GA steel.
 - b. Heating elements: Copper-clad steel.
 - 4. Fan motors:
 - a. See Specification Section 01 61 03.
 - b. Built-in automatic reset overload protection.

5. Dynamically balanced fan.
 6. Built-in automatic reset cutout protection.
 7. Accessories:
 - a. Mounting bracket.
 - b. 40 to 90 DEGF, 5 DEGF differential wall-mounted thermostat.
 8. Electrical, fan motor, and airflow data as scheduled on Drawings.
- B. Dedicated Outdoor Air System:
1. Furnish as shown on Drawings.
 2. Configuration: Fabricate as detailed on Drawings:
 - a. Return plenum / economizer section
 - b. Filter section
 - c. Cooling coil section
 - d. Supply fan section
 - e. Condensing unit section
 3. The complete unit shall be cETLus listed.
 4. The unit shall be ASHRAE 90.1-2016 compliant and labeled.
 5. Each unit shall be specifically designed for outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with R-410 Refrigerant and oil.
 6. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.
 7. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.
 8. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.
 9. Warranty: The manufacturer shall provide 12-month parts only warranty. Defective parts shall be repaired or replaced during the warranty period at no charge. The warranty period shall commence at startup or six months after shipment, whichever occurs first.
 10. Cabinet, casing, and frame:
 - a. Panel construction shall be double-wall construction for all panels. All floor panels shall have a solid galvanized steel inner liner on the air stream side of the unit to protect insulation during service and maintenance. Insulation shall be a minimum of 1" thick with an R-value of 7.0 and shall be 2 part injected foam. Panel design shall include no exposed insulation edges. Unit cabinet shall be designed to operate at total static pressures up to 5.0 inches w.g.
 - b. Exterior surfaces shall be constructed of painted galvanized steel, for aesthetics and long-term durability. Paint finish will include a base primer with a high-quality polyester resin topcoat. Finished, unabraded panel surfaces shall be exposed to an ASTM B117 salt spray environment and exhibit no visible red rust at a minimum of 3,000 hours exposure. Finished, abraded surfaces shall be tested per ASTM D1654, having a mean scribe creepage not exceeding 1/16" at 1,000 hours minimum exposure to an ASTM B117 salt spray environment. Measurements of results shall be quantified using ASTM D1654 in conjunction with ASTM D610 and ASTM D714 to evaluate blister and rust ratings.
 - c. Service doors shall be provided on the fan section, filter section, control panel section, and heating vestibule in order to provide user access to unit components. All service access doors shall be mounted on multiple, stainless steel hinges and shall be secured by a latch system. Removable service panels secured by multiple mechanical fasteners are not acceptable.

- d. The unit base shall overhang the roof curb for positive water runoff and shall seat on the roof curb gasket to provide a positive, weathertight seal. Lifting brackets shall be provided on the unit base to accept cable or chain hooks for rigging the equipment.
11. Outdoor / return air section:
- a. Unit shall be provided with a 100% outdoor air hood. The 100% outdoor air hood shall allow outdoor air to enter from the back of the unit, at the draw-through filter section. The outdoor air hood shall be factory installed and constructed from galvanized steel finished with the same durable paint finish as the main unit. The hood shall include a bird screen to prevent infiltration of foreign materials and a rain lip to drain water away from the entering air stream.
 - b. Low leak dampers shall be provided. Damper blades shall be fully gasketed and side sealed and arranged vertically in the hood. Damper leakage shall be less than 1.5 CFM/Sq. Ft. of damper area at 1.0 inch static pressure differential. Leakage rate to be tested in accordance with AMCA Standard 500. Damper blades shall be operated from multiple sets of linkages mounted on the leaving face of the dampers. Control of the dampers shall be from a factory installed actuator.
 - c. Control of the outdoor dampers shall be by a factory installed actuator. Damper actuator shall be of the modulating type. Damper to open when supply fan starts, and close when supply fan stops.
12. Energy recovery:
- a. The rooftop unit shall be provided with an AHRI certified rotary wheel air-to-air heat exchanger in a cassette frame complete with seals, drive motor and drive belt. The energy recovery wheel shall be an integral part of the rooftop unit with unitary construction and does not require field assembly. Bolt-on energy recovery units that require field assembly and section to section gasketing and sealing are not acceptable.
 - b. The wheel capacity, air pressure drop and effectiveness shall be AHRI certified per AHRI Standard 1060. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Heat Exchangers For Energy Recovery Ventilation Equipment.
 - c. The rooftop unit shall be designed with a track so the entire energy recovery wheel cassette can slide out from the rooftop unit to facilitate cleaning.
 - d. The unit shall have 2" Merv 7 filters for the outdoor air before the wheel to help keep the wheel clean and reduce maintenance. Filter access shall be by a hinged access door with ¼ turn latches.
 - e. The matrix design shall have channels to reduce cross contamination between the outdoor air and the exhaust air. The layers shall be effectively captured in aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belt(s) of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
 - f. The total energy recovery wheel shall be coated with silica gel desiccant permanently bonded without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.
 - g. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning.
 - h. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel. Wheels shall be connected to the shaft by means of taper lock hubs.

- i. The exhaust air fan shall be a direct drive SWSI plenum fan. The exhaust fan shall be sized for the airflow requirements per the construction schedule. The unit controller shall control the exhaust fan to maintain building pressure. A VFD shall be provided for the exhaust fan motor or the exhaust fan motor shall be an ECM motor. The rooftop unit shall have single point electrical power connection and shall be ETL listed.
 - j. The control of the energy recovery wheel shall be an integral part of the rooftop unit's DDC controller. The DDC controller shall have visibility of the outdoor air temperature, leaving wheel temperature, return air temperature, and exhaust air temperature. These temperatures shall be displayed at the rooftop units DDC controller LCD display. All of these temperatures shall be made available through the BACnet interface.
 - k. The rooftop unit DDC controller shall provide frost control for the energy recovery wheel. When a frost condition is encountered the unit controller shall stop the wheel. When in the frost control mode the wheel shall be jogged periodically and not be allowed to stay in the stationary position.
13. Exhaust fan:
- a. Exhaust fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with aluminum fan blades that are continuously welded to the hub plate and end rim. The exhaust fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
 - b. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
 - c. The unit DDC controller shall provide building static pressure control. The unit controller shall provide proportional control of the exhaust fans from 25% to 100% of the supply air fan designed airflow to maintain the adjustable building pressure setpoint. The field shall mount the required sensing tubing from the building to the factory mounted building static pressure sensor.
14. Filters:
- a. Unit shall be provided with a draw-through filter section. The filter rack shall be designed to accept a 2" prefilter and a 4" final filter. The unit design shall have a hinged access door for the filter section. The manufacturer shall ship the rooftop unit with 2" MERV 8 and 4" MERV 14 filters.
15. Cooling coil:
- a. The indoor coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil and an ASHRAE 62.1 compliant double sloped drain pan.
 - b. The direct expansion (DX) cooling coils shall be fabricated of seamless high efficiency copper tubing that is mechanically expanded into high efficiency aluminum plate fins. Coils shall be a multi-row, staggered tube design with a minimum of 3 rows. All cooling coils shall have an interlaced coil circuiting that keeps the full coil face active at all load conditions. All coils shall be factory leak tested with high pressure air under water.
 - c. The cooling coil shall have an electronic controlled expansion valve. The unit controller shall control the expansion valve to maintain liquid subcooling and the superheat of the refrigerant system.
 - d. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors.
 - e. The drain pan shall be stainless steel and positively sloped. The slope of the drain pan shall be in two directions and comply with ASHRAE Standard 62.1. The drain pan shall have a minimum slope of 1/8" per foot to provide positive draining. The drain pan

shall extend beyond the leaving side of the coil. The drain pan shall have a threaded drain connection extending through the unit base.

16. Hot gas reheat:

- a. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser
- b. Hot gas reheat coil shall be a Micro Channel design. The aluminum tube shall be a micro channel design with high efficiency aluminum fins. Fins shall be brazed to the tubing for a direct bond. The capacity of the reheat coil shall allow for a 20°F temperature rise at all operating conditions.
- c. The modulating hot gas reheat systems shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2°F.
- d. Each coil shall be factory leak tested with high-pressure air under water.

17. Supply fan:

- a. A. Supply fan shall be a single width, single inlet (SWSI) airfoil centrifugal fan. The fan wheel shall be Class II construction with fan blades that are continuously welded to the hub plate and end rim. The supply fan shall be a direct drive fan mounted to the motor shaft. Belts and sheaves are not acceptable due to the additional maintenance.
- b. All fan assemblies shall be statically and dynamically balanced at the factory, including a final trim balance, prior to shipment.
- c. Supply fan and motor assembly combinations larger than 8 hp or 22" diameter shall be internally isolated on 1" deflection, spring isolators and include removable shipping tie downs.
- d. The fan motor shall be a totally enclosed EC motor that is speed controlled by the rooftop unit controller. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase. Motors shall be premium efficiency.
- e. The supply fan shall be capable of airflow modulation from 30% to 100% of the scheduled designed airflow. The fan shall not operate in a state of surge at any point within the modulation range.

18. Heating section:

- a. The rooftop unit shall include an electrical resistance heating coil section. Staged electric heating coil modules shall be factory installed downstream of the supply air fan in the heating section of the rooftop unit. Heating coils shall be constructed of a low watt density, nickel - chromium alloy resistance wire with intermediate supports that include ceramic bushings. The electrical contactors shall be of the full line-breaking type with all the electrical power legs being disconnected when the contactors are not energized. All electrical circuit wiring shall be designed with copper conductors, aluminum wires are not acceptable. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements. The power supply for the electric heater shall be factory wired into the units main power block or disconnect switch.
- b. The heating modules shall have an automatic reset, high temperature limit safety protection. A secondary high limit protection shall also be provided that requires a manual reset. An airflow switch shall be provided with the heating module to prevent the electric heater from operating in the event of no airflow.
- c. The electric heat elements shall be controlled by the factory installed DDC unit control system. The heater shall have proportional SCR control. The unit controller shall modulate the electric heater to maintain the discharge air temperature setpoint.
- d. Field installed heating modules shall require a field ETL certification. Duct heaters mounted within the rooftop unit in the field shall not be acceptable. The

manufacturer's rooftop unit ETL certification shall cover the complete unit including the electric heating modules

19. Heat pump heating:

- a. A. The evaporator coil, condenser coil, compressors and refrigerant circuit shall be designed for heatpump operation. The refrigerant circuit shall contain a 4 way reversing valve for the heatpump operation. The outdoor coil shall have an electronic expansion valve to control the refrigerant flow. The unit controller shall modulate the expansion valve to maintain compressor operation within the compressor operational envelope.
- b. The refrigerant system shall have a pump-down cycle.
- c. The unit shall have an electric resistance heating coil for auxiliary heating. When the heatpump operation cannot maintain the discharge air temperature setpoint the electric heating coil shall temper the airstream to the discharge air temperature setpoint.

20. Condensing section:

- a. Outdoor coils shall have seamless copper tubes, mechanically bonded into aluminum plate-type fins. The fins shall have full drawn collars to completely cover the tubes. A sub-cooling coil shall be an integral part of the main outdoor air coil. Each outdoor air coil shall be factory leak tested with high-pressure air under water.
- b. Fan motors shall be an ECM type motor for proportional control. The unit controller shall proportionally control the speed of the condenser fan motors to maintain the head pressure of the refrigerant circuit from ambient condition of 25~120°F. Mechanical cooling shall be provided to 25° F. The motor shall include thermal overload protection and protect the motor in the case of excessive motor temperatures. The motor shall have phase failure protection and prevent the motor from operation in the event of a loss of phase.
- c. The condenser fan shall be low noise blade design. Fan blade design shall be a dynamic profile for low tip speed. Fan blade shall be of a composite material.
- d. The unit shall have scroll compressors. One of the compressors shall be an inverter compressor providing proportional control. The unit controller shall control the speed of the compressor to maintain the discharge air temperature. The inverter compressor shall have a separate oil pump and an oil separator for each compressor that routes oil back to the compressor instead of through the discharge line.
- e. Pressure transducers shall be provided for the suction pressure and head pressure. Temperature sensor shall be provided for the suction temperature and the refrigerant discharge temperature of the compressors. All of the above devices shall be an input to the unit controller and the values be displayed at the unit controller.
- f. Refrigerant circuit shall have a bypass valve between the suction and discharge refrigerant lines for low head pressure compressor starting and increased compressor reliability. When there is a call for mechanical cooling the bypass valve shall open to equalizing the suction and discharge pressures. When pressures are equalized the bypass valve shall close and the compressor shall be allowed to start.
- g. Each circuit shall be dehydrated and factory charged with R-410A Refrigerant and oil.

21. Electrical:

- a. A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel. Unit shall have a single point power terminal block for main power connection. A terminal board shall be provided for low voltage control wiring. Branch short circuit protection, 115-volt control circuit transformer and fuse, system switches, and a high temperature sensor shall also be provided with the unit. Each compressor and condenser fan motor shall be furnished with contactors and inherent thermal overload protection. Supply fan motors shall have contactors and external overload protection. Knockouts shall be provided in the bottom of the main control panels for field wiring entrance.

- b. A single non-fused disconnect switch shall be provided for disconnecting electrical power at the unit. Disconnect switches shall be mounted internally to the control panel and operated by an externally mounted handle.
22. Controls:
- a. Provide a complete integrated microprocessor based Direct Digital Control (DDC) system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired and tested.
 - b. The stand-alone DDC controllers shall not be dependent on communications with any on-site or remote PC or master control panel for proper unit operation. The microprocessor shall maintain existing set points and operate stand alone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.
 - c. The DDC control system shall permit starting and stopping of the unit locally or remotely. The control system shall be capable of providing a remote alarm indication. The unit control system shall provide for outside air damper actuation, emergency shutdown, remote heat enable/disable, remote cool enable/disable, heat indication, cool indication, and fan operation.
 - d. All digital inputs and outputs shall be protected against damage from transients or incorrect voltages. All field wiring shall be terminated at a separate, clearly marked terminal strip.
 - e. The DDC controller shall have a built-in time schedule. The schedule shall be programmable from the unit keypad interface. The schedule shall be maintained in nonvolatile memory to insure that it is not lost during a power failure. There shall be one start/stop per day and a separate holiday schedule. The controller shall accept up to sixteen holidays each with up to a 5-day duration. Each unit shall also have the ability to accept a time schedule via BAS network communications.
 - f. The keypad interface shall allow convenient navigation and access to all control functions. The unit keypad/display character format shall be 4 lines x 20 characters. All control settings shall be password protected against unauthorized changes. For ease of service, the display format shall be English language readout. Coded formats with look-up tables will not be accepted. The user interaction with the display shall provide the following information as a minimum:
 - 1) Return air temperature.
 - 2) Discharge air temperature.
 - 3) Outdoor air temperature.
 - 4) Space air temperature.
 - 5) Outdoor enthalpy, high/low.
 - 6) Compressor suction temperature and pressure
 - 7) Compressor head pressure and temperature
 - 8) Expansion valve position
 - 9) Condenser fan speed
 - 10) Inverter compressor speed
 - 11) Dirty filter indication.
 - 12) Airflow verification.
 - 13) Cooling status.
 - 14) Control temperature (Changeover).
 - 15) VAV box output status.
 - 16) Cooling status/capacity.
 - 17) Unit status.
 - 18) All time schedules.

- 19) Active alarms with time and date.
- 20) Previous alarms with time and date.
- 21) Optimal start
- 22) Supply fan and exhaust fan speed.
- 23) System operating hours.
 - a) Fan
 - b) Exhaust fan
 - c) Cooling
 - d) Individual compressor
 - e) Heating
 - f) Economizer
 - g) Tenant override
- g. The user interaction with the keypad shall provide the following:
 - 1) Controls mode
 - a) Off manual
 - b) Auto
 - c) Heat/Cool
 - d) Cool only
 - e) Heat only
 - f) Fan only
 - 2) Occupancy mode
 - a) Auto
 - b) Occupied
 - c) Unoccupied
 - d) Tenant override
 - 3) Unit operation changeover control
 - a) Return air temperature
 - b) Space temperature
 - c) Network signal
 - 4) Cooling and heating change-over temperature with deadband
 - 5) Cooling discharge air temperature (DAT)
 - 6) Supply reset options
 - a) Return air temperature
 - b) Outdoor air temperature
 - c) Space temperature
 - d) Network signal
 - e) External (0-10 vdc)
 - f) External (0-20 mA)
 - 7) Temperature alarm limits
 - a) High supply air temperature
 - b) Low supply air temperature
 - c) High return air temperature
 - 8) Lockout control for compressors.
 - 9) Compressor interstage timers
 - 10) Night setback and setup space temperature.
 - 11) Building static pressure.
 - 12) Economizer changeover
 - a) Enthalpy
 - b) Drybulb temperature
 - 13) Currently time and date
 - 14) Tenant override time
 - 15) Occupied/unoccupied time schedule
 - 16) One event schedule
 - 17) Holiday dates and duration
 - 18) Adjustable set points

- 19) Service mode
 - a) Timers normal (all time delays normal)
 - b) Timers fast (all time delays 20 sec)
- h. If the unit is to be programmed with a night setback or setup function, an optional space sensor shall be provided. Space sensors shall be available to support field selectable features. Sensor options shall include:
 - 1) Zone sensor with tenant override switch
 - 2) Zone sensor with tenant override switch plus heating and cooling set point adjustment. (Space Comfort Control systems only)
- i. To increase the efficiency of the cooling system the DDC controller shall include a discharge air temperature reset program for part load operating conditions. The discharge air temperature shall be controlled between a minimum and a maximum discharge air temperature (DAT) based on one of the following inputs:
 - 1) Airflow
 - 2) Outside air temperature
 - 3) Space temperature
 - 4) Return air temperature
 - 5) External signal of 1-5 vdc
 - 6) External signal of 0-20 mA
 - 7) Network signal
- 23. Roof curb:
 - a. A prefabricated heavy gauge galvanized steel, mounting curb shall be provided for field assembly on the roof decking prior to unit shipment. The roof curb shall be a full perimeter type with complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 14" high and include a nominal 2" x 4" wood nailing strip. Gasket shall be provided for field mounting between the unit base and roof curb.

25 10 00

25 10 00

C. Split System Heat Pump:

- 1. Outdoor Unit:
 - a. Casing and frame:
 - 1) Material: Heavy gage galvanized steel, factory painted.
 - 2) Insulation: 1 IN thick neoprene-coated glass fiber.
 - 3) Installation: Base equipped with lifting brackets with lifting holes.
 - 4) Removable end panel for access to components and connections.
 - b. Compressors:
 - 1) Modulating Scroll type, with five-year non-prorated warranty.
 - 2) Suction and discharge service valves.
 - 3) Crankcase heater.
 - 4) Thermal overload protection.
 - c. Refrigeration circuit:
 - 1) Sight glass.
 - 2) Filter dryer.
 - 3) Manual shut-off valve.
 - 4) High pressure relief valve.
 - d. Compressor isolators.
 - e. Condenser coils:
 - 1) Nominal 3/8 IN OD seamless copper mechanically bonded to corrugated aluminum fins.
 - 2) Factory leak tested at 315 PSIG under water.
 - f. Condenser fans:
 - 1) Direct drive: See Specification Section 01 61 03.
 - 2) Propeller type.
 - g. Condenser fan motors:

- 1) Heavy duty, inherently protected, non-reversing.
- 2) Permanently lubricated bearings.
- 3) Integral rain shield.
- h. Defrost control: Defrost cycles at a preselected time interval when the outdoor coil is below a preset initiation temperature.
- i. Expansion valve: Designed and sized specifically for heat pump service.
- j. Reversing valve: Four-way interchange reversing valve, operates on pressure differential between the outdoor unit and indoor unit.
2. Non-ducted wall mount indoor unit:
 - a. General:
 - 1) Indoor unit shall be a fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation onto a wall or ceiling within a conditioned space.
 - 2) Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
 - b. Condensate drain pan:
 - 1) A mildew-proof, polystyrene condensate drain pan and resin net mold resistant filter shall be included as standard equipment.
 - c. Sound Pressure:
 - 1) Wall Mounted Unit:
 - a) The indoor units sound pressure shall range from 31 dB(A) to 40 dB(A) at low speed measured at 3.3 FT below and from the unit.
 - d. Indoor Unit:
 - 1) The indoor unit shall be completely factory assembled and tested.
 - a) Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 - b) The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops.
 - 2) Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 - 3) Both refrigerant lines shall be insulated from the outdoor unit.
 - 4) Return air shall be through a resin net mold resistant filter.
 - 5) The indoor units shall be equipped with a condensate pan.
 - 6) The indoor units shall be equipped with a return air thermistor.
 - e. Unit Cabinet:
 - 1) The cabinet shall be affixed to a factory supplied wall/ceiling hanging brackets and located in the conditioned space.
 - 2) The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
 - f. Fan:
 - 1) The fan shall be a direct-drive cross-flow fan, statically and dynamically balanced impeller with high and low fan speeds available.
 - 2) The fan motor shall operate on 208/230 V, 1 PH, 60 Hz.
 - 3) The airflow rate shall be available in high and low settings.
 - 4) The fan motor shall be thermally protected.
 - g. Coil:
 - 1) Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
 - 2) The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
 - 3) The coil shall be a 2-row (3-row floor console only) cross fin copper evaporator coil completely factory tested.
 - 4) The refrigerant connections shall be flare connections.

- 5) A thermistor will be located on the liquid and gas line.
- 6) A condensate pan shall be located in the unit.
- h. Electrical:
 - 1) A separate power supply will be required of 208/230 V, 1 PH, 60 Hz.
 - a) The acceptable voltage range shall be 187 to 253 V.
 - 2) Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 FT (total 6,560 FT).
 - 3) Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 FT.
- i. Control:
 - 1) The unit shall have on board controls perform input functions necessary to operate the system.
 - 2) The unit shall include all devices necessary to be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
- j. Optional Accessories Available:
 - 1) Remote “in-room” sensor kit.
 - 2) A condensate pump.
- k. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Specification Section 01 61 03.
- B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

3.2 FIELD QUALITY CONTROL

- A. Comply with Specification Section 23 05 93.

3.3 ADJUSTING

- A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION

SECTION 23 81 29

VARIABLE REFRIGERANT FLOW HEAT PUMP SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Air Cooled Condensing Unit:
 - a. Heat Recovery (heat and cool model).
 - b. Branch Selector (BS) Units for Heat Recovery systems.
 - c. Indoor Fan Coil Units:
 - 1) Non-ducted recessed ceiling cassette units.
 - 2) Ducted concealed ceiling fan coil units.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Section 01 61 03 - Equipment - Basic Requirements
 - 2. Section 23 05 93 - Testing, Adjusting and Balancing.
 - 3. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
 - 4. Section 25 10 00 - Building Management System (BMS)
 - 5. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA):
 - a. 99, Standards Handbook.
 - b. 210, Laboratory Methods of Testing Fans for Rating (Unit shall bear AMCA Certified Rating Seal).
 - c. 300, Reverberant Room Method for Sound Testing of Fans (Unit shall bear AMCA Certified Rating Seal).
 - d. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - e. 500, Test Method for Louvers, Dampers, and Shutters.
 - 2. American National Standards Institute (ANSI):
 - a. 9, Load Ratings and Fatigue Life for Ball Bearings.
 - b. 11, Load Ratings and Fatigue Life for Roller Bearings.
 - c. 900, Test Performance of Air Filter Units.
 - 3. Air-Conditioning Heating and Refrigeration Institute (AHRI):
 - a. 1230, Variable Refrigerant Flow Multi-split Air –conditioners and Heat Pumps.
 - 4. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 15, Safety Code for Mechanical Refrigeration.
 - 5. National Electrical Manufacturers Association (NEMA).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National electrical Code.
 - b. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - c. 90B, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 - 7. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA).
 - 8. Underwriters Laboratories, Inc. (UL): Electrical Laboratories (ETL).
- B. Manufacturer's Qualifications:
 - 1. Provide packaged units that are the standard product of an equipment manufacturer regularly engaged in the production of such units who issues complete catalog information on such products.
 - 2. Units shall not be fabricated by the Contractor.

1.3 SYSTEM DESCRIPTION

- A. Heat Recovery (Heat and Cool Model):
 - 1. The variable capacity heat pump air conditioning system shall be a VRV/VRF series heat and cool model.
 - a. The system shall consist of multiple evaporators, Branch Selector Units or Branch Circuit Terminals, heat recovery condensing unit with variable speed inverter driven compressors, and PID DDC (direct digital controls).
 - b. All zones are each capable of operating separately with individual temperature control.
 - 2. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously or all of the indoor units associated with each branch of the cool/heat selector box.
 - a. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an Intelligent Manager or a BMS interface.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. Applicator experience qualifications.
 - a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
 - 2. Product technical data including:
 - a. Submit manufacturer's technical product data for systems with air handler units, evaporator coils, and outdoor condensing units showing dimensions, weights, capacities, ratings, fan performance with operating point clearly indicated, motor electrical characteristics, finishes of materials, installation instructions, sound and vibration test report, and bearing life calculations.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver Products to Site under Provisions Of Division 01.
 - 1. Deliver units to the site in containers with manufacturer's stamp or label affixed.
- B. Store/Protect Products under Provisions of Division 01 and According to Manufacturer's Recommendation:
 - 1. Protect units against dirt, water, chemical, and mechanical damage.
 - 2. Do not install damaged units.
 - a. Remove from project site.

1.7 EXTENDED WARRANTY

- A. For compressors only, under normal use and maintenance for comfort cooling and conditioning applications, the products will be free from defects in material or workmanship for a six-year period.
 - 1. This extended warranty for compressors is limited in duration to six years from the earlier to occur of:
 - a. The date of original installation, whether or not actual use begins on that date, or;
 - b. 24 months from the date of shipment, and applies to the compressor and compressor parts only.

2. The effective date of this extended warranty shall be established as above.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Daikin VRV.
 2. Mitsubishi City Multi.
 3. Trane VRF.
 4. LG-Multi V.

2.2 CONDENSING UNIT

- A. General:
1. The outdoor unit shall be designed for used with an integrated variable refrigerant flow zone system.
 2. The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls.
 - a. The refrigeration circuit of the condensing unit shall consist of scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports and refrigerant regulator.
 3. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.
 4. Refrigerant lines (heat recovery only) from the outdoor unit to the BS or BC unit shall be individually insulated between the condensing and fan coil units.
 5. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
 6. The connection ratio of fan coil units to condensing unit shall be permitted up to 130% of outdoor rated capacity.
 7. Each condensing system shall be able to support maximum quantity of indoor units as scheduled on Drawings.
 8. The sound pressure level standard shall no greater than 65 dBA at 3 FT from the front of the unit.
 - a. The condensing unit shall be capable of operating automatically at further reduced noise during night time.
 9. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
 10. The unit shall incorporate an auto-charging feature.
 11. The condensing unit shall be modular in design and should allow for side-by-side installation with minimum spacing.
 12. The following safety devices shall be included on the condensing unit; high pressure sensor and switch, low pressure sensor, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
 13. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
 14. Each system shall maintain continuous heating during oil return operation.
 15. The condensing unit shall be capable of heating operation at 0 DEGF dry bulb ambient temperature without additional low ambient controls or an auxiliary heat source.
 16. The system (heat recovery only) shall continue to provide heat to the indoor units in heating operation while in the defrost mode.
 17. Except for motors, provide electrical components required as part of units, which have been listed and labeled by UL. This includes condensate pumps and other ancillary devices required for operation. The units shall be listed by ETL and bear the ETL label. See

Specification Section 01 61 03 - Equipment - Basic Requirements for additional requirements.

B. Unit Cabinet:

1. Air Cooled:

- a. The condensing unit shall be completely weatherproof and corrosion resistant.
- b. The unit shall be constructed from rust-proofed mild steel panels coated with a baked enamel finish.

C. Fan:

1. The condensing unit shall consist of one or more propeller type, direct-drive fan motors that have multiple speed operation via a DC (digitally commutating) inverter.
2. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 IN WG.
 - a. A field setting switch to a maximum 0.24 IN WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
3. The fan shall be a vertical discharge configuration.
4. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
5. The fan motor shall be provided with a fan guard to prevent contact with moving parts.
6. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature.

D. Condenser Coil:

1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.
3. The fins are to be covered with an anti-corrosion finish.

E. Compressor:

1. The inverter driven scroll hermetic compressors shall be variable speed controlled capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
 - a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read and calculated.
 - b. With each reading, the compressor capacity shall be controlled to eliminate deviation from target value.
2. The inverter driven compressor in each condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll type.
3. The capacity control range shall be as low as 4 to 100%.
4. Each non-inverter compressor shall also be of the hermetically sealed scroll type.
5. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
6. Oil separators shall be standard in the equipment together with an intelligent oil management system.
7. The compressor shall be spring mounted to avoid the transmission of vibration.

F. Electrical:

1. The power supply to the condensing unit shall be as scheduled on Drawings..
2. The control voltage between the indoor and condensing unit shall be 16 VDC non-shielded, stranded 2-conductor cable.

2.3 BRANCH SELECTOR (BS) BOX FOR HEAT RECOVERY SYSTEM

- A. General:
 - 1. Branch selector boxes/branch circuit controllers are designed specifically for use with heat recovery system components.
 - a. Selector boxes/circuit controllers shall be factory assembled, wired, piped and run tested at the factory.
 - b. Selector boxes/circuit controllers must be mounted indoors.
 - c. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.
- B. Unit Cabinet:
 - 1. These units shall have a galvanized steel plate casing.
 - 2. Each cabinet shall house multiple electronic expansion valves for refrigerant control per branch.
 - 3. The unit shall have sound absorption thermal insulation material made of flame and heat resistant foamed polyethylene.
- C. Refrigerant Valves:
 - 1. The refrigerant connections must be of the braze type.
 - 2. Multiple indoor units may be connected to a branch selector box / branch circuit controller.
- D. Condensate Removal:
 - 1. Provide integral condensate pan if required for condensate removal.
- E. Electrical:
 - 1. The unit electrical power shall be as scheduled on Drawings.
 - 2. The unit shall be capable of operation within the limits of 187 V to 228 V.
 - 3. The minimum circuit amps (MCA) shall be 0.1 and the maximum.
 - 4. The control voltage between the indoor and condensing unit shall be 16 VDC non-shielded 2 conductor cable.
 - 5. Provide electrical components required as part of units, which have been listed and labeled by UL. The units shall be listed by ETL and bear the ETL label. See Specification Section 01 61 03 - Equipment - Basic Requirements for additional requirements.

2.4 INDOOR FAN COIL UNITS

- A. Non-Ducted Recessed Ceiling Cassette Units:
 - 1. General:
 - a. Indoor unit shall be a ceiling cassette fan coil unit, operable with R-410A refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with an air panel grill.
 - b. It shall be a four-way air distribution type, white, impact resistant with a washable decoration panel.
 - c. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0 to 90 DEG.
 - d. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
 - e. The indoor units sound pressure shall range from 28 dB(A) to 34 dB(A) at low speed measured at 5 FT below the unit.
 - 2. Indoor Unit:
 - a. The indoor unit shall be completely factory assembled and tested.
 - 1) Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.

- b. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 - c. Both refrigerant lines shall be insulated from the outdoor unit.
 - d. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
 - e. Return air shall be through the concentric panel, which includes a resin net mold resistant filter.
 - f. The indoor units shall be equipped with a condensate pan and condensate pump.
 - 1) The condensate pump provides up to 21 IN of lift and has a built in safety shutoff and alarm.
 - g. The indoor units shall be equipped with a return air thermistor.
3. Unit Cabinet:
- a. The cabinet shall be space saving and shall be located into the ceiling.
 - b. Three auto-swing positions shall be available to choose, which include standard, draft prevention and ceiling stain prevention.
 - c. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
 - d. Fresh air intake shall be possible by way of optional fresh air intake kit (3 x 3 FT model only).
 - 1) Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet (2 x 2 FT model only).
 - e. A branch duct knockout shall exist for branch ducting supply air.
 - f. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
 - g. Optional high efficiency MERV 8 and 13 air filters are available for each model unit (3 x 3 FT model only).
4. Fan:
- a. The fan shall be direct-drive fan type with statically and dynamically balanced impeller with high and low fan speeds available.
 - b. The fan motor shall operate on 208/230 V, 1 PH, 60 Hz with a motor output range from 0.06 to 0.12 HP.
 - c. The airflow rate shall be available in high and low settings.
 - d. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the MERV 8 and 13 filter options (3 x 3 FT model only).
 - e. The fan motor shall be thermally protected.
5. Filter:
- a. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
 - b. Optional high efficiency disposable MERV 8 and 13 filters shall be available (3 x 3 FT model only).
6. Coil:
- a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
 - b. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
 - c. The coil shall be a 2-row cross fin copper evaporator coil completely factory tested.
 - d. The refrigerant connections shall be flare connections.
 - e. A condensate pan shall be located under the coil.
 - f. A condensate pump up to 21 IN lift shall be located below the coil in the condensate pan with a built in safety alarm.
 - g. A thermistor will be located on the liquid and gas line.
7. Electrical:
- a. A separate power supply will be required of 208/230 V, 1 PH, 60 Hz.
 - 1) The acceptable voltage range shall be 187 to 253 V.

- b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 FT (total 6,560 FT).
 - c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 FT.
 - 8. Control:
 - a. The unit shall have on board controls to perform input functions necessary to operate the system.
 - b. The unit shall include all devices necessary to be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
 - 9. Optional accessories available:
 - a. A high efficiency disposable MERV 8 air filter kit (3 x 3 FT).
 - b. A high efficiency disposable MERV 13 air filter kit (3 x 3 FT).
 - c. Fresh air intake kit.
 - d. Supply air branch duct connections.
 - e. Remote "in-room" sensor kit.
 - f. The wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature.
 - 1) The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).
- B. Ducted Concealed Ceiling Fan Coil Units:
- 1. General:
 - a. Indoor unit shall be a built-in ceiling concealed fan coil unit, operable with refrigerant R-410A, equipped with an electronic expansion valve, for installation in a ceiling cavity.
 - 1) It is constructed of a galvanized steel casing.
 - 2) It shall be a horizontal discharge air with horizontal return air configuration.
 - 3) Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
 - 4) Included as standard equipment, a condensate drain pan and drain pump kit that pumps up to 18-3/8 IN from the drain pipe opening.
 - b. All pressure drops, horsepower's and dimensions shown on Drawing schedules are maximum allowable.
 - 1) All capacities shown are minimum allowable.
 - 2) All units must have AMCA certified performance data for fans tested in the unit casings.
 - 3) Bare fan certification without casing is not acceptable.
 - c. Manufacturers unable to meet this criteria will only be considered as an alternate to specified and as a deduct to base bid.
 - 1) Manufacturers listed by name does not imply that their standard construction meets the Specifications nor that they are approved.
 - 2) All manufacturers are required to meet all details of this Specification Section without exception.
 - d. Sound levels shall be as follows:
 - 1) Large capacity, medium static units: 48 dB(A) at low speed measured 5 FT below the ducted unit.
 - 2) Small capacity, medium static units: 29 dB(A) to 40 dB(A) at low speed measured 5 FT below the ducted unit.
 - 3) Shallow depth fan coils: 29 dB(A) to 32 dB(A) at low speed and 33 dB(A) to 36 dB(A) at high speed 5 FT below the suction grille.
 - e. Ductwork shall comply with Section 23 31 00 - HVAC - Ductwork.
 - f. Where ductwork is outside the conditioned space, duct insulation shall be per Section 40 42 00 - Pipe, Duct and Equipment Insulation.
 - 1)

2. Indoor Unit:
 - a. The indoor unit shall be completely factory assembled and tested.
 - 1) Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
 - 2) The unit shall have an adjustable external static pressure switch (large models).
 - 3) The unit shall be equipped with automatically adjusting external static pressure logic selectable during commissioning.
 - 4) This adjusts the airflow based on the installed external static pressure (small models).
 - a) Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
 - b) Both refrigerant lines shall be insulated from the outdoor unit.
 - c) The indoor units shall be equipped with a return air thermistor.
 - d) The indoor units shall be equipped with a condensate pan and condensate pump.
 - (1) The condensate pump provides up to 18-3/8 IN of lift from the center of the drain outlet (small and slim model only).
 - e) Return air shall be through a resin net mold resistant filter (slim model only).
3. Unit Cabinet:
 - a. The cabinet shall be located within the ceiling and ducted to the supply and return openings.
 - b. The cabinet shall be constructed with minimum 1/2 IN 1.5 LB internal insulation.
 - 1) Insulation shall be attached with adhesive with all exposed edges coated to prevent erosion or of an insulation type not requiring protection.
4. Fan (Large models and slim duct):
 - a. The fan shall be direct-drive type fan, statically and dynamically balanced impeller with high and low fan speeds available.
 - b. The fan motor shall operate on 208/230 V, 1 PH, 60 Hz, with a motor output of 0.51 HP.
 - c. The airflow rate shall be available in high and low settings.
 - d. The fan motor shall be thermally protected.
 - e. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
5. Fan (small models):
 - a. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
 - b. The unit shall be equipment with automatically adjusting external static pressure logic selectable during commissioning.
 - c. The fan motor shall operate on 208/230 V, 1 PH, 60 Hz with a motor output range of 0.12 to 0.47 HP respectively.
 - d. The airflow rate shall be available in three settings.
 - e. The fan motor shall be thermally protected.
 - f. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings.
6. Coil:
 - a. Coils shall be ARI certified of the direct expansion type.
 - b. All coil casings shall be galvanized steel minimum or stainless steel.
 - c. Copper tubes shall be a minimum thickness of 0.020 IN and return bends of minimum 0.035 IN.
 - 1) Headers shall be non-ferrous seamless copper.
 - 2) Aluminum fins shall have a minimum thickness of 0.0080 IN and tubes shall be mechanically expanded into fin collars to provide permanent mechanical bond.
 - d. The coils shall be pressure tested at the factory.
 - e. The refrigerant connections shall be flare connections.

- f. A thermistor will be located on the liquid and gas line.
- g. A condensate pan shall be located under the coil.
- h. The condensate shall be capable of being gravity drained from the fan coil.
- i. Where scheduled, a condensate pump with an 18 IN minimum lift shall be located below the coil in the condensate pan with a built in safety alarm.
- 7. Electrical:
 - a. A separate power supply will be required of 208/230 V, 1 PH, 60 Hz.
 - 1) The acceptable voltage range shall be 187 to 253 Volts.
 - b. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 FT (total 6,560 FT).
 - c. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 FT.
- 8. Control:
 - a. The unit shall have on board controls to perform input functions necessary to operate the system.
 - b. The unit shall include all devices necessary to be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
- 9. Optional Accessories Available:
 - a. Remote "in-room" sensor kit (recommended).
 - b. The wall mounted, hard wired remote sensor kit is recommended for ceiling-embedded type fan coils, which often result in a difference between set temperature and actual temperature.
 - 1) The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

2.5 REFRIGERANT PIPING AND FITTINGS

- A. Refrigerant Piping:
 - 1. Copper tubing conforming to ASTM B280 and/or FS WW-T-799, dehydrated for refrigerant use, with high-temperature soldered joints and wrought copper (600 psig) fittings.
 - a. Type L.
- B. Piping Joints:
 - 1. Joints between copper tubing and fittings to be high temperature brazed (melting point not less than 1000 DegF, but less than that of the metal being joined) with phos-copper alloys.
 - 2. Joints between copper and brass, steel, etc., shall be silver soldered only.
 - a. Silver solder to be Handy Harmon "Easy-Flow 45."
 - 3. Nitrogen must be used during all brazing of fittings.
 - a. A pressure of 2-3 psi shall be used to prevent copper plate or oxidation formation.
- C. Precharged Line Sets: Size per manufacturer's recommendations.
- D. Field Assembled Units:
 - 1. Size refrigeration lines according to manufacturer's published tables using pressure or temperature drops as follows:
 - a. Suction lines: 2 DegF.
 - b. Liquid lines: 1 DegF or 2 psi.
 - c. Hot gas lines: 1 DegF or 3.6 psi.
 - d. Size discharge and hot gas risers for positive oil return to compressors.
- E. Hangers: As specified in Specification Section 22 05 29.

2.6 CONTROLS

- A. General:
 - 1. Provide control devices necessary to support a fully operating system including but not limited to
 - a. Local remote controllers.
 - b. Centralized/multi-zone controllers.

- c. Open protocol network devices that transmit information via the communication bus and graphical user workstations.
 - 2. The network shall have the capability to support:
 - a. Operation monitoring and scheduling.
 - b. Error email distribution.
 - c. General user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via BACnet or LonWorks interfaces.
 - 3. General Electrical Requirements:
 - a. The control wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to the branch circuit selector/controller (Heat Recovery System), then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit.
 - b. Wiring shall be non-shielded, 2-conductor sheathed vinyl core or cable, and 18 AWG stranded copper wire.
- B. Centralized/Multizone Controllers:
 - 1. The Centralized/Multizone controllers shall be capable of controlling up to 64 indoor unit groups and 128 indoor units connected to up to 10 outdoor units.
 - a. The Centralized/Multizone Controllers shall be complete with power supply.
 - b. The Centralized/Multizone Controllers can be used in conjunction with local remote controllers, BACnet and Lonworks interfaces to control the same indoor unit groups.
 - c. Centralized/Multizone controllers shall be available with the option of interconnection with a network PC via the internet or Local Area Network (LAN).
 - 2. Basic Operation:
 - a. The Centralized/Multizone controller shall control the following group operations:
 - 1) On/off, operation mode (cool, heat, fan, dry and Auto).
 - 2) Independent cooling and heating setpoints in the occupied mode.
 - 3) Independent cooling setup and heating setback setpoint in the unoccupied mode.
 - 4) Fan speed.
 - 5) Airflow direction.
 - 6) The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period.
 - 7) Remote controller permit/prohibit of ON/Off, Mode, and Setpoint.
 - 8) Lockout setting for touch display.
 - 9) Indoor unit Group/Zone assignment.
 - 3. Programmability:
 - a. Controller shall support weekly schedule settings.
 - b. Scheduling shall support unit On/Off.
 - c. The controller shall support multiple auto-changeover methods for both Heat Pump and Heat Recovery systems based upon the Zone configurations.
 - 1) This will allow for the optimal room temperature to be maintained by automatically switching the indoors unit's mode between cool and heat according to the room temperature and temperature setpoint.
 - d. Controller shall support Interlock for use with 3rd party equipment to automatically control groups or zones corresponding to the change of the operation states or On/Off states of any group.
 - e. Optional Digital Input/Output unit shall be available to allow On/Off based monitoring and control of 3rd party equipment.
 - f. The controller shall support force shutdown of associated indoor unit.
 - 4. Display Features:
 - a. Backlit LCD display.
 - b. Multi-language availability.
 - c. The controller shall display On/Off, Operations Mode, Setpoint, space Temperature, Louver Position, Fan Speed for Group/Zone.

- d. Date, day of week and time of day.
 - e. Daylight savings automatic adjustment.
 - f. Display update every 3 seconds.
 - g. System status icons shall display On/Off (color coded), Malfunction/Error (color coded), Forced Stop, Set Schedule/Setback/Auto-changeover, Filter, and Screen Lock.
 - h. The controller shall display the temperature setpoint in one degree increments with a range of 600 – 900 DEGF (160 – 320 DEGC).
 - i. Display shall reflect room temperature 0 DEGF – 176 DEGF (-180 DEGC – 800 DEGC) range in one degree increment.
 - j. Zone configuration shall display Setpoint Range Limitation, Setback Temperature setting, and Auto-changeover for each Zone.
 - k. Indoor units shall be capable of being displayed by Zone or Group.
 - l. Error status shall be displayed in the event of system abnormality/error with one of two color coded icons placed over the indoor unit icon.
5. Software Options:
- a. All PC's shall be field supplied:
 - 1) Web/Email software:
 - a) Each Controller shall be capable of monitoring, operating, and scheduling a maximum of 64 indoor unit groups (128 indoor unit groups with the addition of an option adapter) from a networked PC's web browser.
 - b) It shall also be capable of creating general user access and sending detailed error emails to a customized distribution list (up to three email addresses).
 - 2) Power Proportional Distribution (PPD):
 - a) The tenant billing option shall be capable of calculating VRV Controls Network equipment energy usage in kWh based on the energy consumption of the outdoor unit(s) divided among the associated indoor units.
 - b) This software is used in conjunction with the Watt Hour Meter (WHM).
 - c) A maximum of 3 Watt Hour Meters can be connected to the Controller.
 - d) The use of the optional adapter will add an additional 3 Watt Hour Meters.
 - 3) HTTP Interface:
 - a) This option shall be capable of creating a software interface between the VRV Controls Network and Home Automation control systems.
- C. System BMS Integration:
- 1. The VRV/VRF system shall support integration with Building Management Systems (BMS) via a BACnet® or LonWorks interface.
 - 2. BMS to have capability to monitor and control VRV indoor units.
 - 3. The VRV/VRF systems supplier shall cooperate fully with BMS supplier to enable them to map points into the BMS.
 - 4. The BMS supplier shall provide all labor and programming necessary to map VRF system points into BMS.
 - a. At a minimum, through the BMS, the operator shall be enabled to monitor space temperature of all zones change space temperature setpoint of all zones, monitor fan, heating and cooling status of all zones, monitor indoor fan coil alarm, monitor status and alarms of outdoor units and schedule each zone.
 - 5. Operation and monitoring points include but are not limited to:
 - a. On/Off (setting).
 - b. On/Off (status).
 - c. Alarm Sign.
 - d. Error Code.
 - e. Operation Mode (setting).
 - f. Operation Mode (status).
 - g. Fan Speed (setting).
 - h. Fan Speed (status).
 - i. Measured Room Temperature.

- j. Set Room Temperature.
- k. Filter Limit Sign.
- l. Filter Limit sign reset.
- m. Remote Control Operation (On/Off).
- n. Remote Control Operation (Operation Mode).
- o. Remote Control Operation (Set Temperature).
- p. Electrical Total Power.
- q. Communication Status.
- r. System Forced Off.
- s. Forced Thermostat off (setting).
- t. Forced Thermostat off (status).
- u. Compressor Status.
- v. Indoor Fan Status.
- w. Heater operation Status.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive work.
- B. Verify that proper power supply is available.

3.2 INSTALLATION

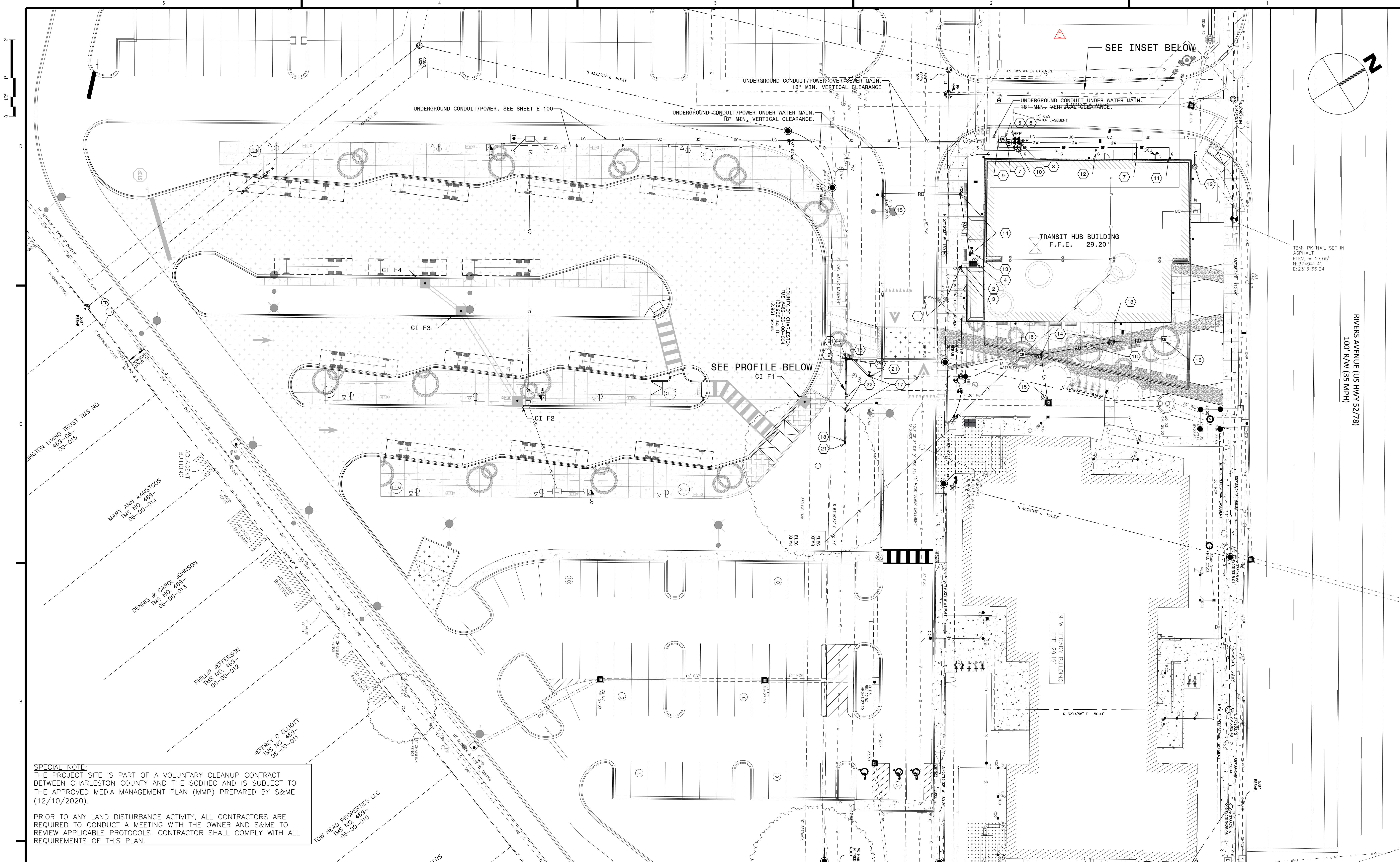
- A. Install in accordance with manufacturer's instructions.
- B. Provide Layout Drawings of units, locations and power requirements to electrical installer.
- C. Install air filters in unit during installation phase.
 - 1. Do not operate the unit without filters in place.
- D. In the case of suspended units, mount the fan coil units on springs or from spring hangers as required and as shown on Drawings.
 - 1. Provide Mason Number DNHS combination isolator hangers or equal to fully support horizontal units hung from building framing.
- E. Provide pre-fabricated metal equipment stand for the support of condensing unit on all sides.
 - 1. Attach condensing unit to pre-fabricated metal equipment stand per manufacturer's instructions.
- F. Install 2 IN flexible duct connection at inlets and outlets of ducted units.
- G. Install condensate drain piping and traps in accordance with manufacturer's instructions and as shown on the Drawings.
 - 1. Where drainage to gravity waste is not possible provide condensate pumps.
 - 2. Do not route condensate lines over electrical cabinets.
- H. Copper refrigerant piping shall be installed per the VRF system manufacturer's instructions. Copper tubing and brazing requirements shall be per Specification Section 23 74 36 - Refrigerant Piping Systems. Refrigerant piping shall be insulated per 40 42 00 - Pipe, Duct and Equipment Insulation
- I. Control Wiring:
 - 1. Communication wiring shall be terminated in a daisy chain design at the outdoor unit, which is then daisy chained to branch selector/controller (Heat Recovery system), then daisy chained to each indoor unit in the system and terminating at the farthest indoor unit.
 - 2. The termination of the wiring shall be non-polar.
 - 3. The remote control wiring shall run from the indoor unit control terminal block to the remote controller connected with that indoor unit.

4. Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.
- J. Install a new set of filters prior to final air balance and substantial completion.
- K. Provide support to BMS supplier for mapping of VRV/VRF systems points into the BMS.
- L. Flaring: flared tube ends should have a smooth, even round flare of sufficient length to fully engage the mating surface of the flare nut, without protruding into the threads. Use only "PVE" or "POE" refrigeration oil when making flares. Dedicated flare block and tool is recommended. Only use synthetic oil on the flare tool.
- M. Pressure testing:
 1. Tighten down stop valves before any pressure testing to prevent nitrogen from leaking back through condenser and contaminating refrigerant. Pressure testing shall be done in three (3) steps:
 - a. Step 1- leak check 3 minutes at 150 psi.
 - b. Step 2- leak check after 5 minutes at 325 psi.
 - c. Step 3- leak check after 24 hours at 550 psi.
 - d. (450 psi for systems with vertical Air Handlers)
 2. Check flare connections for leaks using bubble solution recommended by manufacturer.
- N. Leak testing and evacuation
 1. Evacuate the system to 4000 microns. Break the vacuum with nitrogen to a pressure of 2-3 psi and hold for 15 minutes.
 2. Evacuate system to 1500 microns and maintain for 20 minutes. Break the vacuum with nitrogen to a pressure of 2-3 psi and hold for 15 minutes.
 3. Evacuate system to below 500 microns and hold for 60 minutes.
 4. Evacuate system to below 300 microns and hold for 24 hours.
 - a. Final < 300 micron evacuation shall be witnessed, verified and documented by an independent 3rd party (general contractor or testing and balancing contractor) prior to charging the system with refrigerant.
 5. Vacuum pump check valve should be used to prevent mineral oil from being drawn into the system. Procedures must be adhered to, with written documented.
- O. Refrigerant charging:
 1. Record refrigerant line lengths or as build drawings. Calculate refrigerant charge based on actual field installed total line lengths plus lb/ft of refrigerant per pipe diameter. Weigh in additional refrigerant with digital scales. Check with each unit model for correct multiplier. After the amount of refrigerant to be added has been determined write it down on the label, on the back side of the front cover. After the vacuum/drying is complete, charge the additional refrigerant in its liquid state through the liquid stop valve service port.
 2. Make sure the installation tools used are exclusively for use on R410a installations to withstand the pressure and to prevent foreign material from mixing into the system.

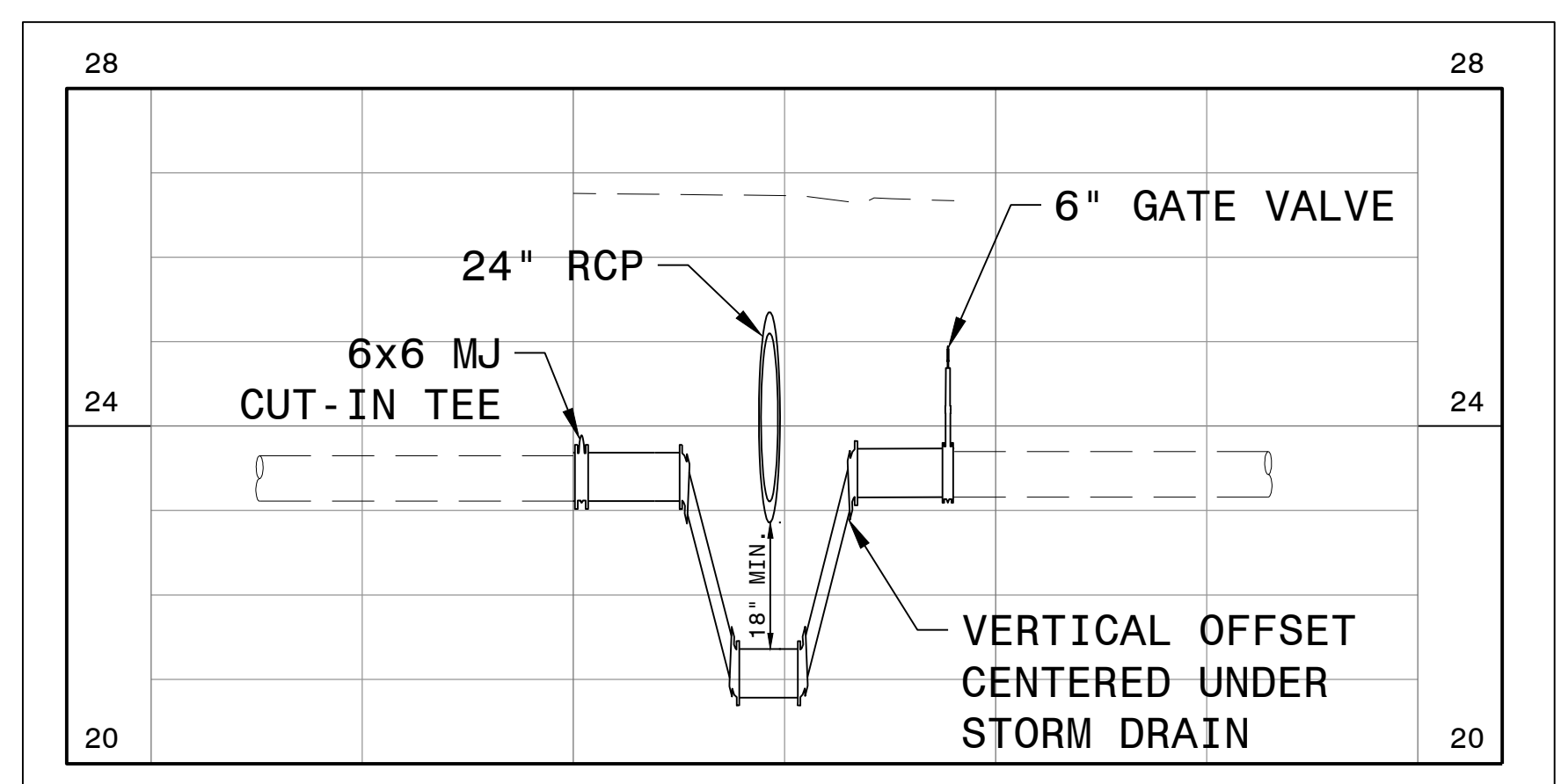
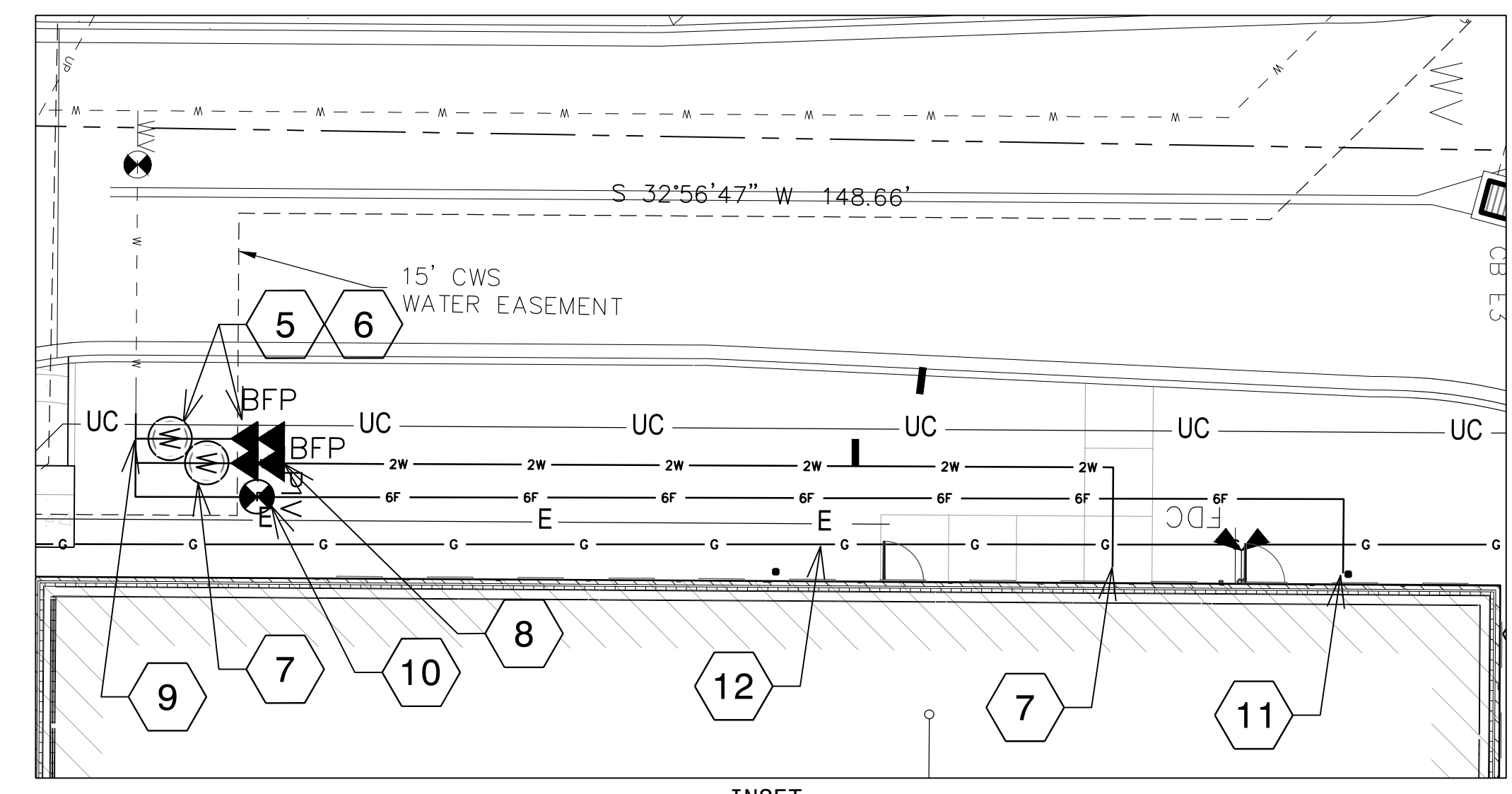
3.3 MANUFACTURER'S START-UP SERVICES

- A. The Manufacturer shall provide start-up service in the form of a factory trained Service Technician.
 1. The Service Technician shall verify correct installation, verify unit mounting, verify fan rotation, verify spring isolator adjustments, verify control wiring, verify power wiring, start-up the fans, and check for proper operation.
 2. The Service Technician shall provide final adjustments to meet the specified performance requirements.
 3. System shall be tested and balanced per Specification Section 23 05 93, Testing, Adjusting and Balancing.

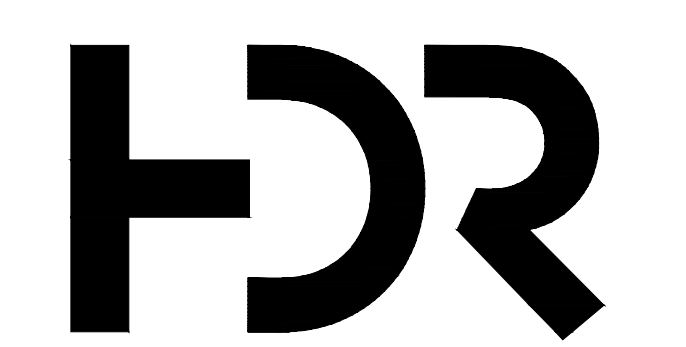
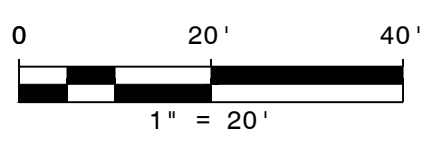
END OF SECTION



SPECIAL NOTE:
THE PROJECT SITE IS PART OF A VOLUNTARY CLEANUP CONTRACT BETWEEN CHARLESTON COUNTY AND THE SCDHEC AND IS SUBJECT TO THE APPROVED MEDIA MANAGEMENT PLAN (MMP) PREPARED BY S&M (12/10/2020).
PRIOR TO ANY LAND DISTURBANCE ACTIVITY, ALL CONTRACTORS ARE REQUIRED TO CONDUCT A MEETING WITH THE OWNER AND S&M TO REVIEW APPLICABLE PROTOCOLS. CONTRACTOR SHALL COMPLY WITH ALL REQUIREMENTS OF THIS PLAN.



- UTILITY KEYNOTES**
- 8"x6" SEWER WYE AND SERVICE STACK BY OTHERS. CONTRACTOR SHALL CONNECT TO EXISTING WYE AND PROVIDE 6" SDR 26 SEWER SERVICE.
 - PROVIDE 6" SDR 26 SEWER SERVICE LINE TO WITHIN 5' OF BUILDING. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE SEWER CLEANOUT, IAW DETAILS.
 - PROVIDE 4" SDR 26 SAN. SEWER SERVICE FROM ELEVATOR. INSTALL OIL/WATER SEPARATOR IAW DETAIL, SHEET C-505. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE 1-1/2" TAPPING SADDLE AND 1-1/2" IRRIGATION WATER METER IAW DETAIL W-24. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE 1-1/2" REDUCED PRESSURE PRINCIPLE ASSEMBLY BACKFLOW PREVENTER IAW CWS MIN. STANDARDS.
 - PROVIDE 2" TAPPING SADDLE AND 2" DOMESTIC WATER METER AND SERVICE IAW DETAIL W-24 TO WITHIN 5' OF BUILDING. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE 2" REDUCED PRESSURE PRINCIPLE ASSEMBLY BACKFLOW PREVENTER IAW CWS MIN. STANDARDS.
 - REMOVE TEMP. BLOWOFF AND PROVIDE 6" FIRE SERVICE TO FIRE SPRINKLER ROOM. COORDINATE LOCATION AND ELEVATION WITH ARCHITECTURAL AND PLUMBING DRAWINGS.
 - PROVIDE POST INDICATOR VALVE OUTSIDE CWS EASEMENT.
 - CONNECT TO DOUBLE CHECK VALVE ASSEMBLY WITHIN RISER ROOM. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE 2" GAS SERVICE LINE TO WITHIN 5' OF BUILDING. COORDINATE METER LOCATION WITH PLUMBING PLANS.
 - CONNECT TO BUILDING ROOF DRAIN AND TRANSITION TO 10" PVC ROOF DRAIN PIPE. COORDINATE LOCATION WITH PLUMBING PLANS.
 - PROVIDE ROOF DRAIN CLEANOUT IAW DETAIL.
 - CONNECT NEW ROOF DRAIN PIPE TO DRAINAGE STRUCTURE.
 - INSTALL 15" DRAIN BASIN IAW DETAIL, SHEET C-502.
 - WATER MAIN CONSTRUCTION ACTIVITIES SHALL BE COORDINATED SUCH THAT WORK IS COMPLETED AND EXIST. FIRE SERVICE IS RESTORED IN 1 DAY.
 - PROVIDE NEW 6" GATE VALVE AND BOX IAW DETAIL, SHEET C-503.
 - PROVIDE 6" MJ CUT-IN TEE.
 - PROVIDE 45deg BEND.
 - CONNECT TO EXISTING 6" MAIN.
 - PROVIDE VERTICAL OFFSET IAW DETAIL, SHEET C-503.



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**Charleston Area Regional
Transportation Authority
Shipwatch Transit and
Workforce Development
Center**

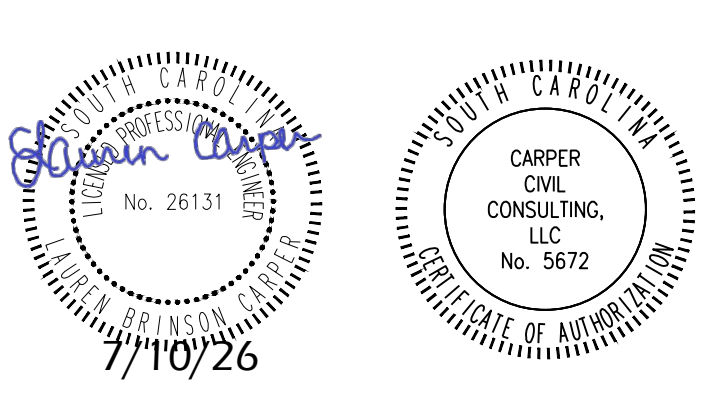
3655 Rivers Avenue
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Project Manager	Ruth Krieger
Project Designer	Nicole Peterson
Project Architect	Dave Sheppard
Landscape Architect	Bryant Sloves
Civil Engineer	Jeff Carper
Structural Engineer	Joshua Hooker
Mechanical Engineer	Chris Work
Electrical Engineer	Jesus Gonzalez
Plumbing Engineer	Chris Work
Interior Designer	Kristin Greeley
Fire Protection	Adam Sank

Sheet Reviewer	Author
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A 02/02/2026 ISSUED FOR BID
B 02/25/2026 CWS COMMENTS
C 07/10/2026 ADDENDUM 1

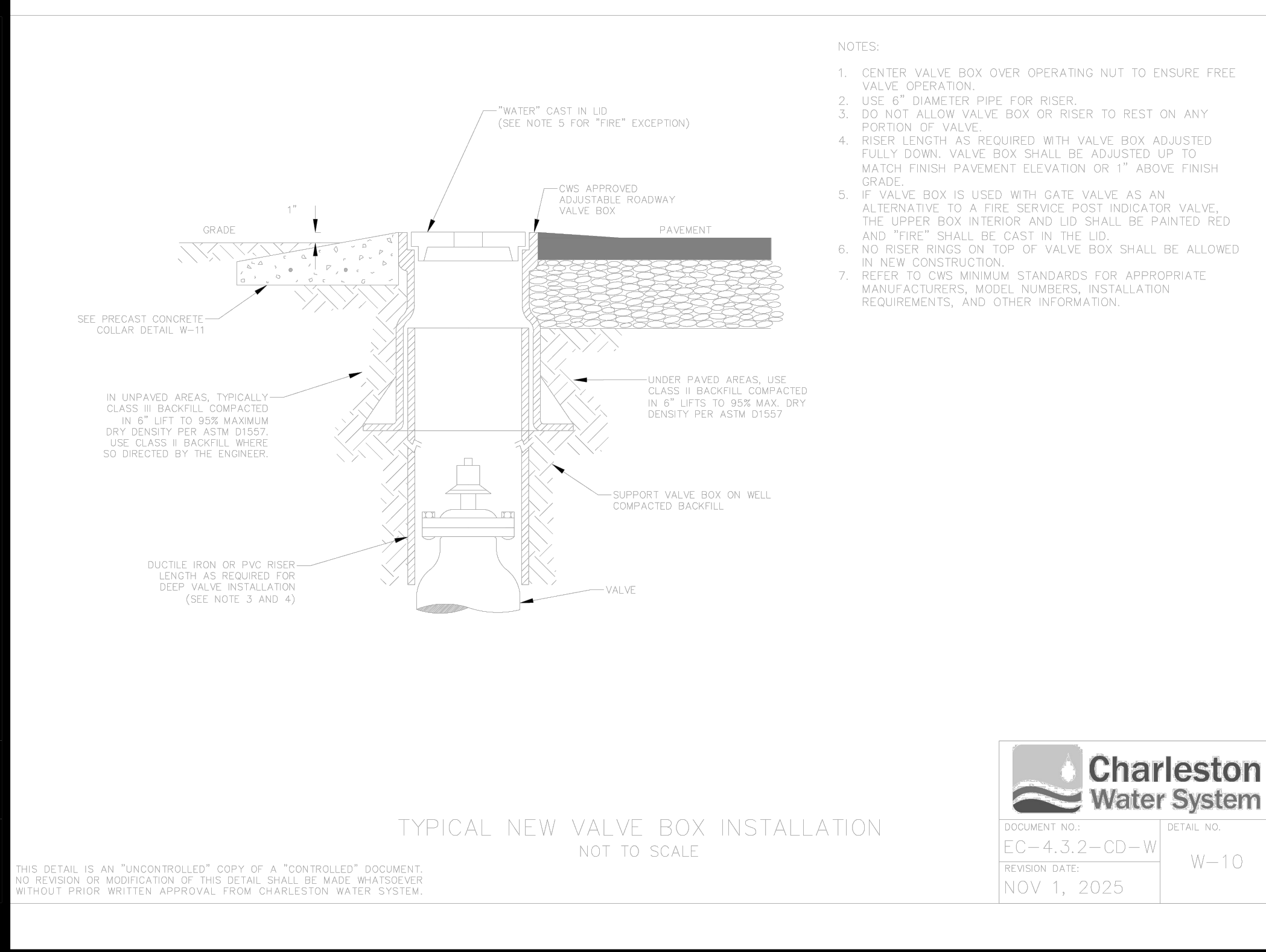
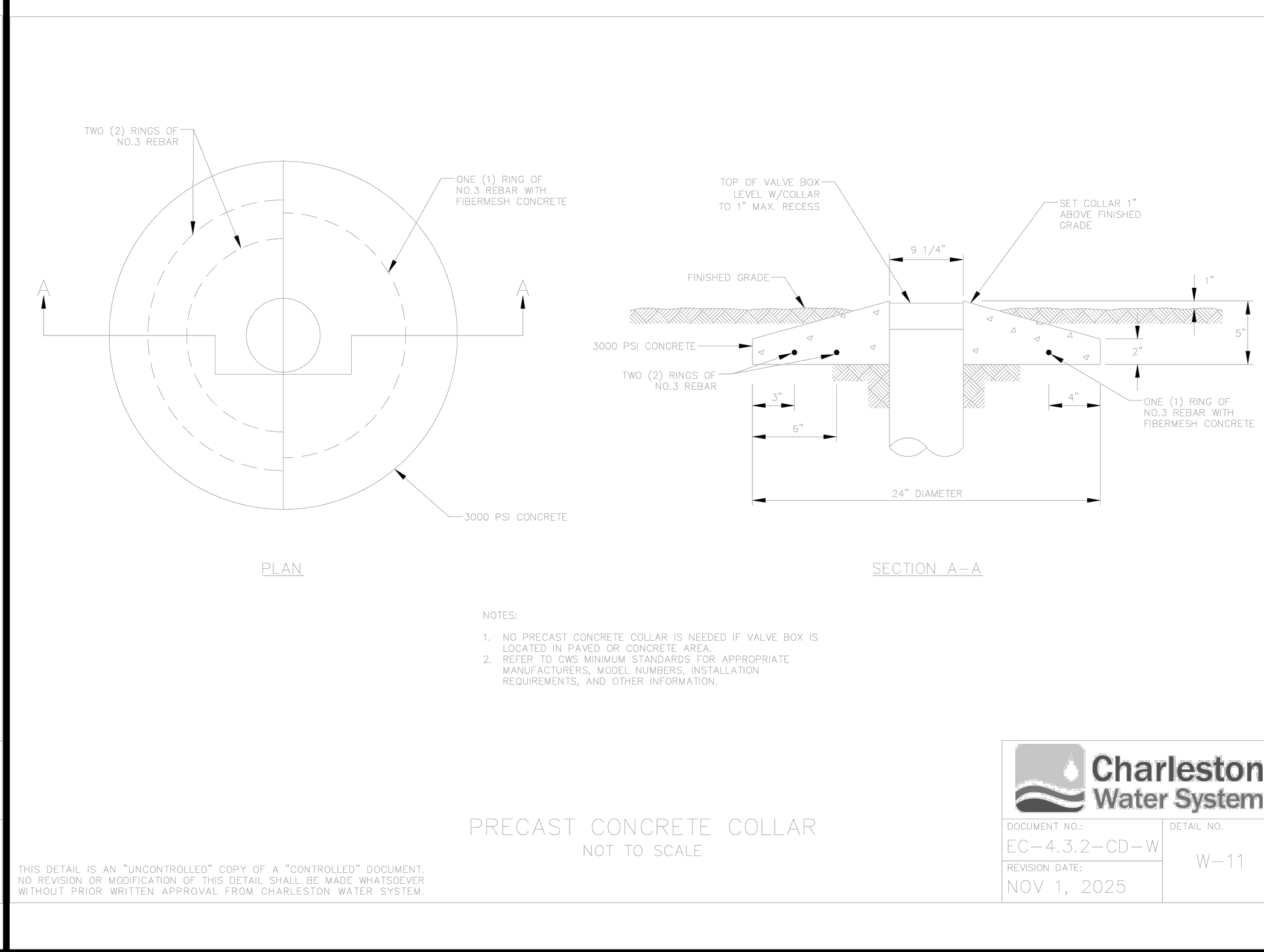
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Original Issue 02/02/2026

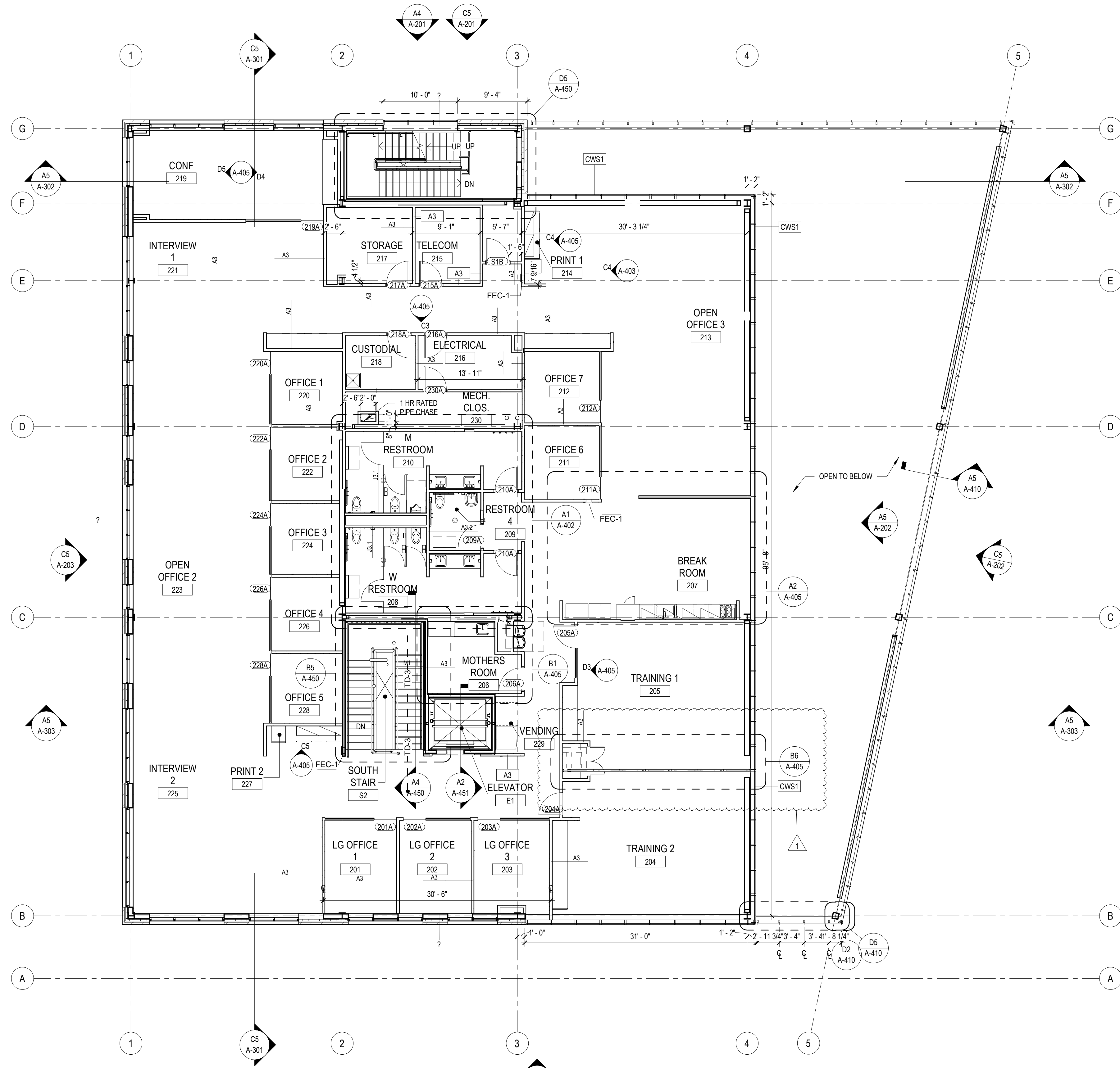


Sheet Name
SITE UTILITY PLAN

Sheet Number
C-401

Project Status
CONSTRUCTION DOCUMENTS



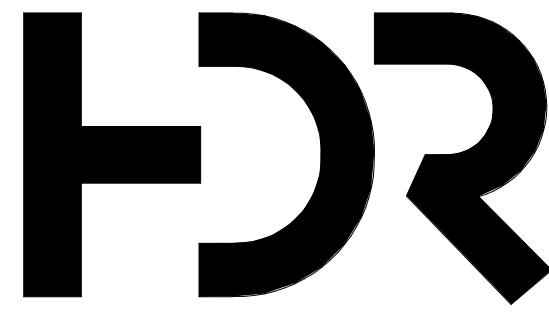


A5 FLOOR PLAN - LEVEL 2
1/8" = 1'-0"



FLOOR PLAN GENERAL NOTES

1. DRAWINGS & SPECIFICATIONS ARE COMPLEMENTARY COMPONENTS OF THE CONTRACT DOCUMENTS. REVIEW ALL DRAWINGS AND SPECIFICATIONS FOR THE COMPLETE SCOPE OF WORK. NOTIFY ARCHITECT IMMEDIATELY FOR CLARIFICATION IF INCONSISTENCIES, CONTRADICTIONS OR OMISSIONS ARE DISCOVERED.
2. DO NOT SCALE DRAWINGS. IF DIMENSIONAL INFORMATION IS REQUIRED & NOT FOUND, NOTIFY ARCHITECT IMMEDIATELY FOR CLARIFICATION.
3. ALL DIMENSIONS ARE TO COLUMN CENTERLINES OR FACE OF FINISHED WALLS OR SURFACES UNLESS NOTED OTHERWISE.
4. REFER TO DEMOLITION DRAWINGS, IF ANY, FOR WORK REQUIRED IN ADVANCE OF CONSTRUCTION AND COORDINATE ACCORDINGLY.
5. ALL DOOR FRAMES ARE TO BE INSTALLED 4" AWAY OF ADJACENT PERPENDICULAR WALLS UNLESS NOTED OTHERWISE.
6. REFER TO LIFE SAFETY DRAWINGS FOR ADDITIONAL FIRE / SMOKE RATING REQUIREMENTS.
7. REFER TO EQUIPMENT DRAWINGS FOR ADDITIONAL EQUIPMENT SPECIFIC INFORMATION.
8. REFER TO INTERIOR FINISH DRAWINGS FOR ADDITIONAL INTERIOR FINISH SPECIFIC INFORMATION.
9. REFER TO STRUCTURAL DRAWINGS FOR ADDITIONAL STRUCTURAL SPECIFIC INFORMATION.
10. REFER TO MEP DRAWINGS FOR ADDITIONAL MEP SPECIFIC INFORMATION.
11. ALL NON-LOAD BEARING INTERIOR WALLS ARE TYPE "A" UNLESS NOTED OTHERWISE.
12. HIGHER RATED FIRE WALLS TAKE PRECEDENCE OVER LOWER RATED WALLS & ARE TO CONTINUE THROUGH ALL SUCH INTERSECTIONS.
13. ALL SMOKE BARRIER WALLS ARE TO BE EXTENDED FROM BACK SIDE OF EXTERIOR WALL SHEATHING OR ANOTHER SMOKE BARRIER WALL.
14. REFER TO A-200 FOR EXTERIOR WALL TYPES AND ASSEMBLY DESCRIPTIONS.



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Project Architect	Dave Sheppard
Landscape Architect	Bryant Stowe
Civil Engineer	Jeff Carper
Structural Engineer	Joshua Hooker
Mechanical Engineer	Chris Work
Electrical Engineer	Jesus Gonzalez
Plumbing Engineer	Chris Work
Interior Designer	Kristin Greeley
Fire Protection	Adam Senk

MARK	DATE	DESCRIPTION
1	06/16/2026	ISSUED FOR BID
	07/10/2026	BID ADDENDUM 1

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Sheet Name

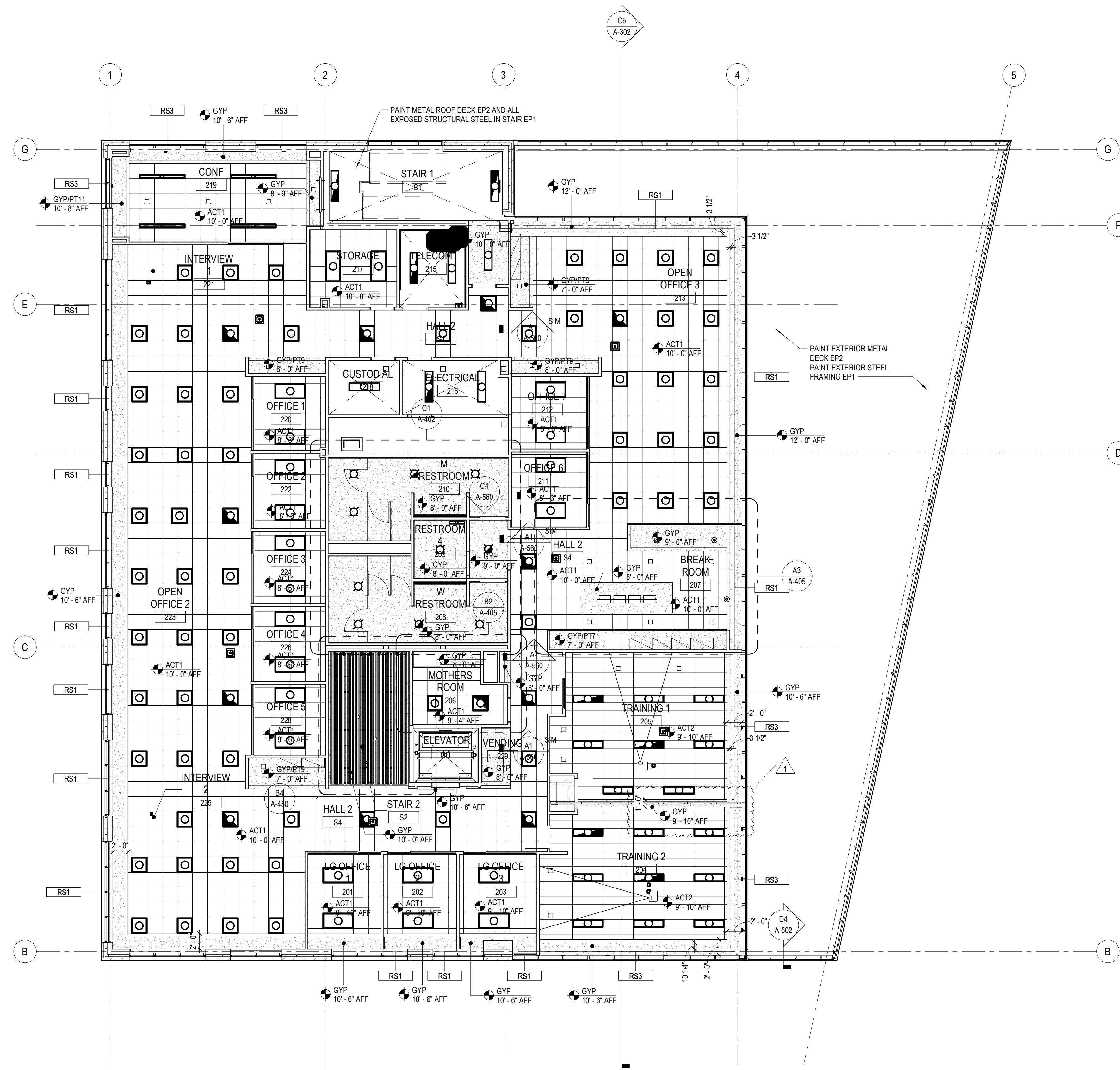
OVERALL BUILDING
PLAN - LEVEL 2

Sheet Number

A-102

Project Status

CONSTRUCTION DOCUMENTS



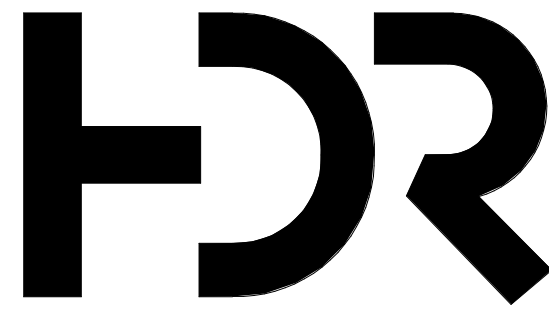
A5 REFLECTED CEILING PLAN - LEVEL 2
1/8" = 1'-0"

RCP LEGEND

- MULTIPURPOSE BOARD INSULATION MB1
- ACOUSTICAL CEILING TILE ACT1 (24" X 24" UON)
- GYPSUM BOARD CEILING PT4 UON
- WALL MOUNTED LED STRIP LIGHT
- SPEAKER
- SUPPLY DIFFUSER
- RETURN GRILLE
- SPRINKLER PENDENT
- EXIT SIGN
- 24" X 24" ACCESS PANEL UON
- 24" X 48" RECESSED TROFFER LIGHT
- 24" X 24" RECESSED TROFFER LIGHT
- 12" X 24" SUSPENDED LIGHT

RCP GENERAL NOTES

- MB1 TO WRAP ALL STRUCTURAL STEEL BEAMS AND FRAMING MEMBERS.
- ALL GYPSUM CEILINGS TO BE PAINTED WITH PT4 UON.
- REFER TO FIRE PROTECTION DRAWINGS FOR SPRINKLER INFORMATION.
- REFER TO LIGHTING PLAN DRAWINGS FOR LIGHTING FIXTURE TYPES.
- CENTER ALL CEILING HUNG DEVICES SUCH AS SPEAKERS, SMOKE DETECTORS, FIRE STROBES, FIRE SPRINKLER HEADS, ETC. IN CEILING TILE.
- SCRIBE CEILING MATERIAL FOR TIGHT FIT.
- ALL SHADES ARE RS-1, UON.
- COORDINATE REQUIRED ACCESS PANEL LOCATIONS IN GYP. CEILINGS WITH MECHANICAL AND ELECTRICAL CONTRACTOR.
- ELECTRICAL CONDUIT TO BE CONCEALED UNDER FLUTES AND ABOVE THE PLATES.



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Chris Work
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Chris Work
Kristin Greeley
Adam Senk

MARK	DATE	DESCRIPTION
1	06/16/2026	ISSUED FOR BID
1	07/10/2026	BID ADDENDUM 1

Project Number
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02/02/2026



Sheet Name

REFLECTED CEILING PLAN - LEVEL 02

Sheet Number

A-151

Project Status

CONSTRUCTION DOCUMENTS

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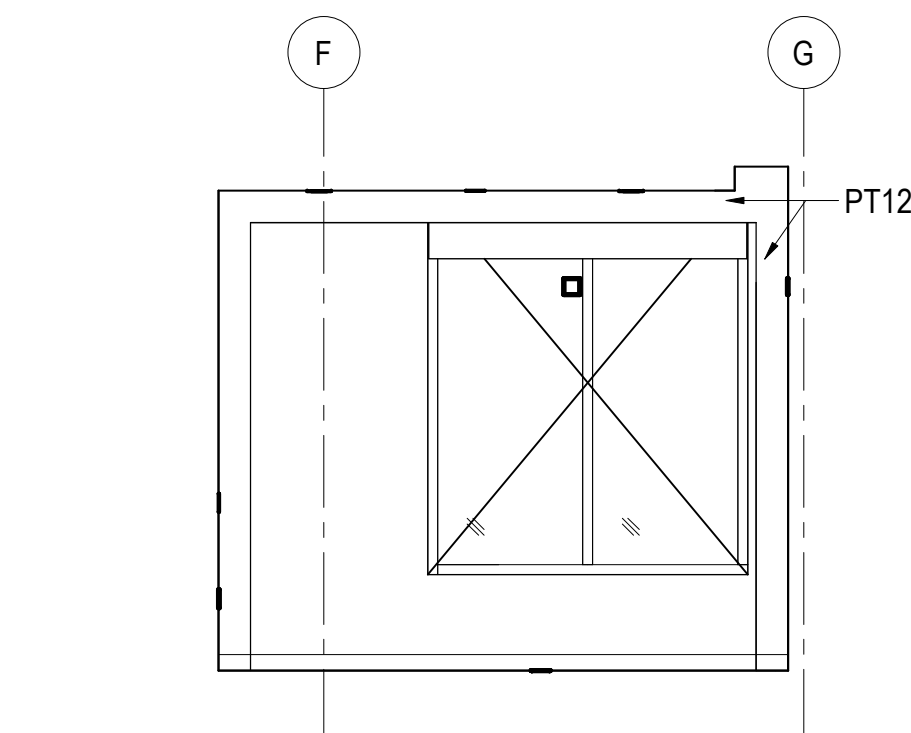
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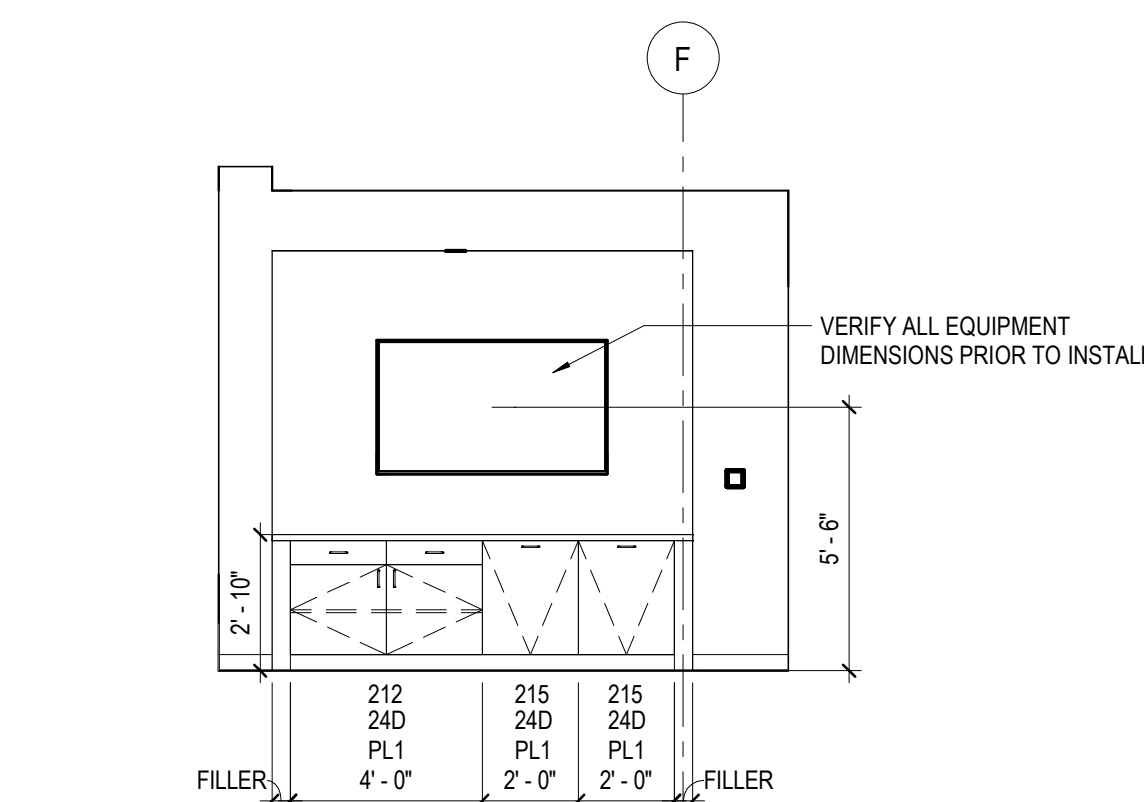
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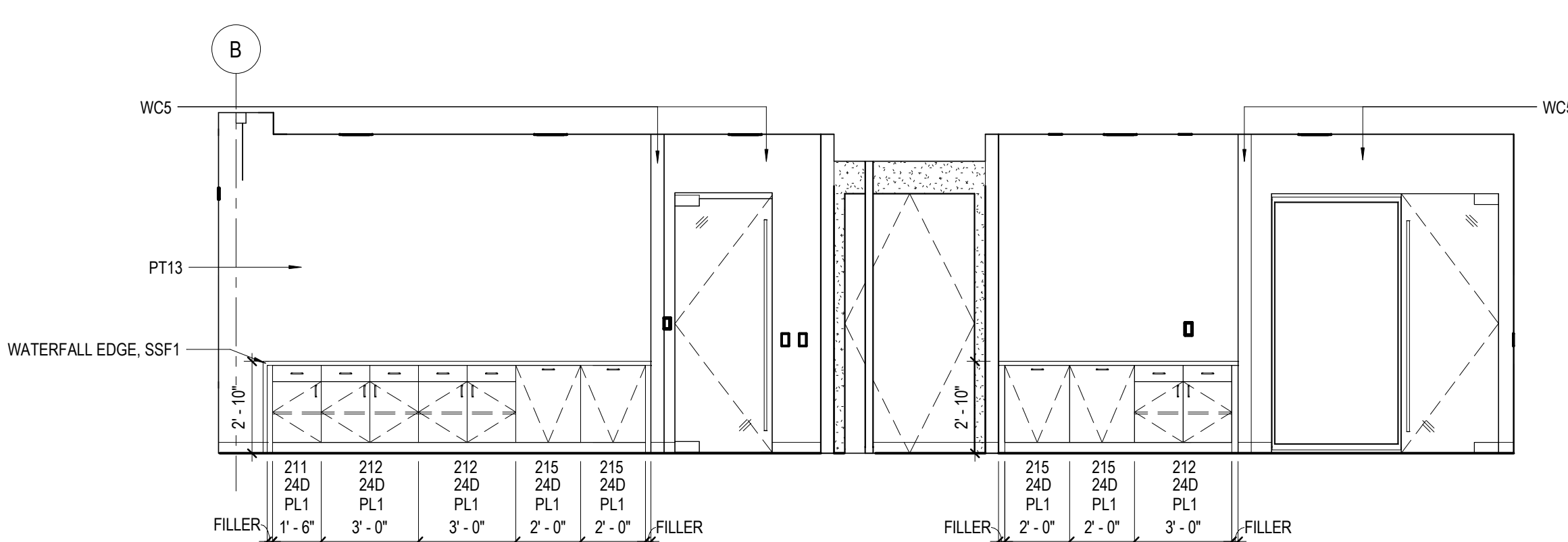
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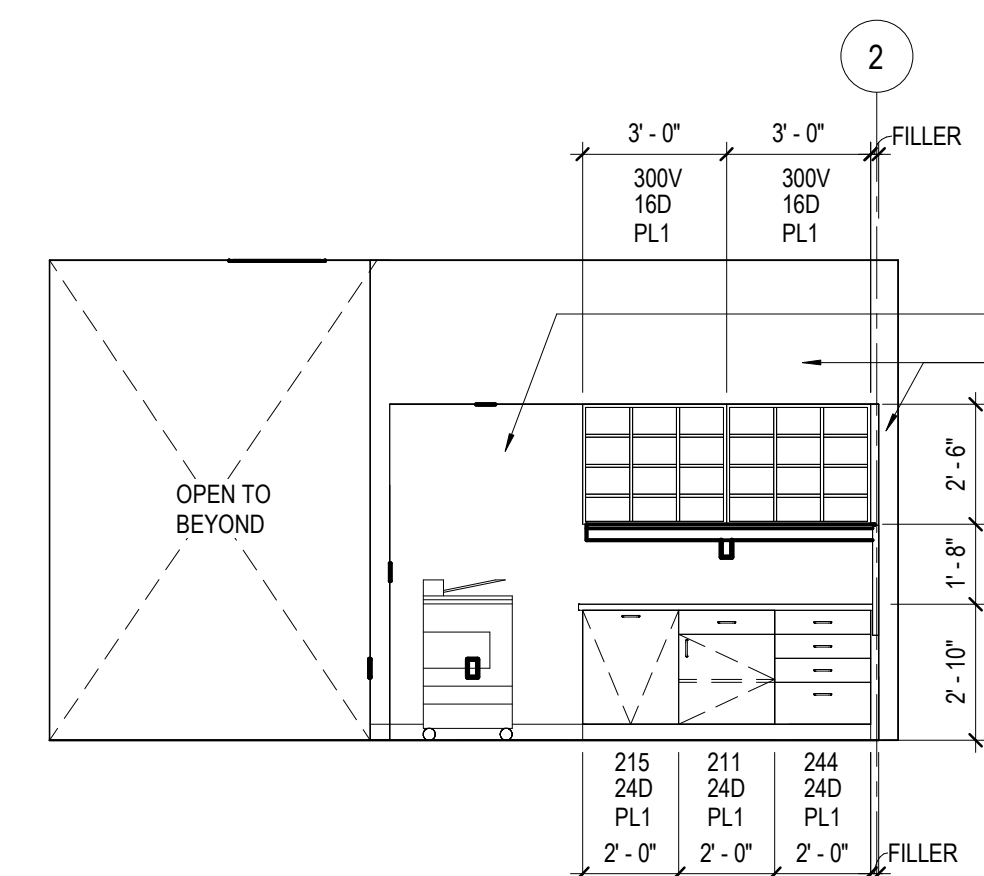
D5 SMALL CONFERENCE - WEST
1/4" = 1'-0"



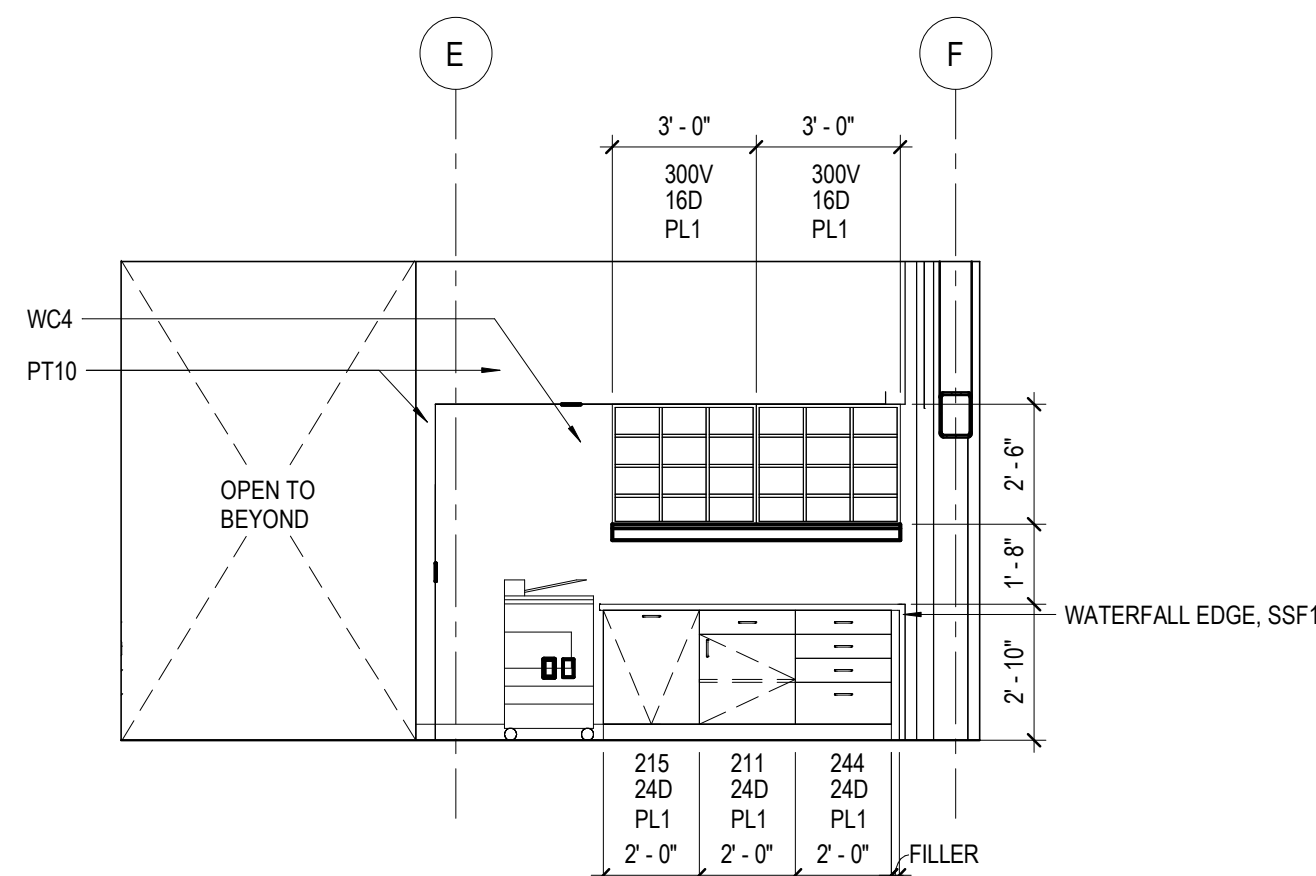
D4 SMALL CONFERENCE - EAST
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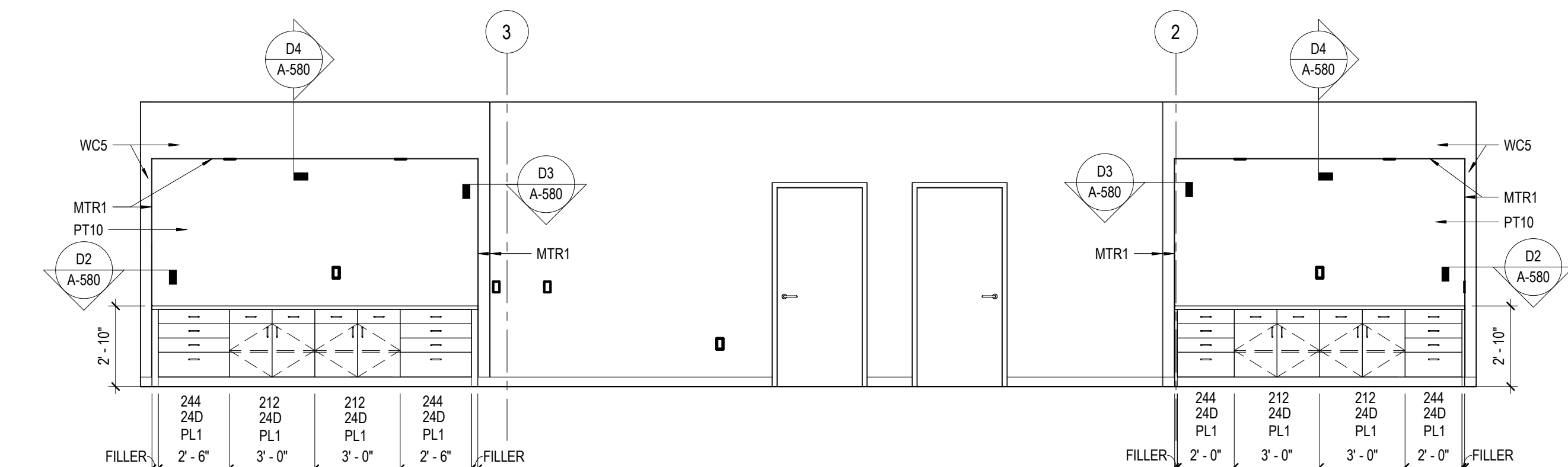
D3 TRAINING 1 & TRAINING 2 - WEST
1/4" = 1'-0"



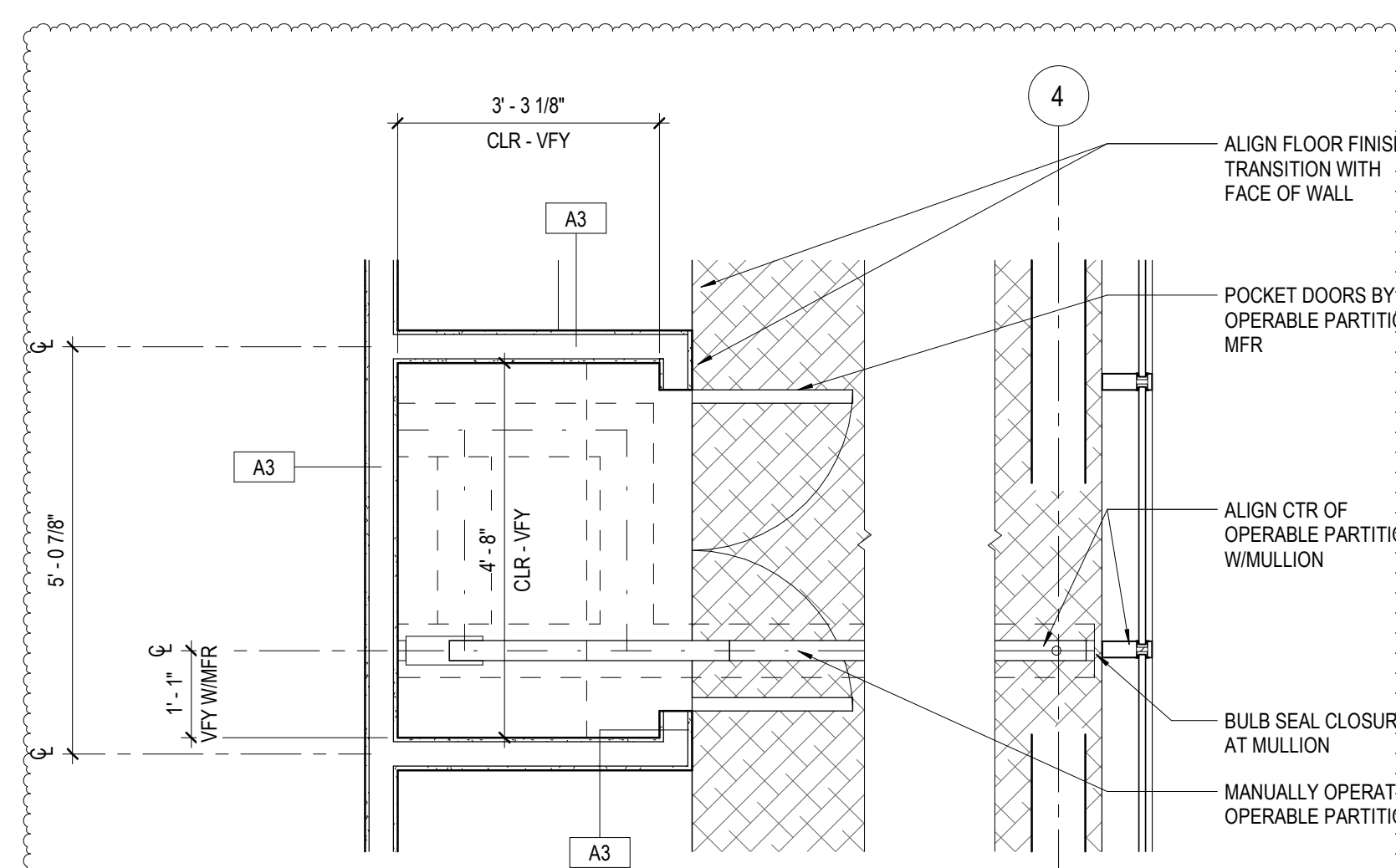
C5 PRINT 2
1/4" = 1'-0"



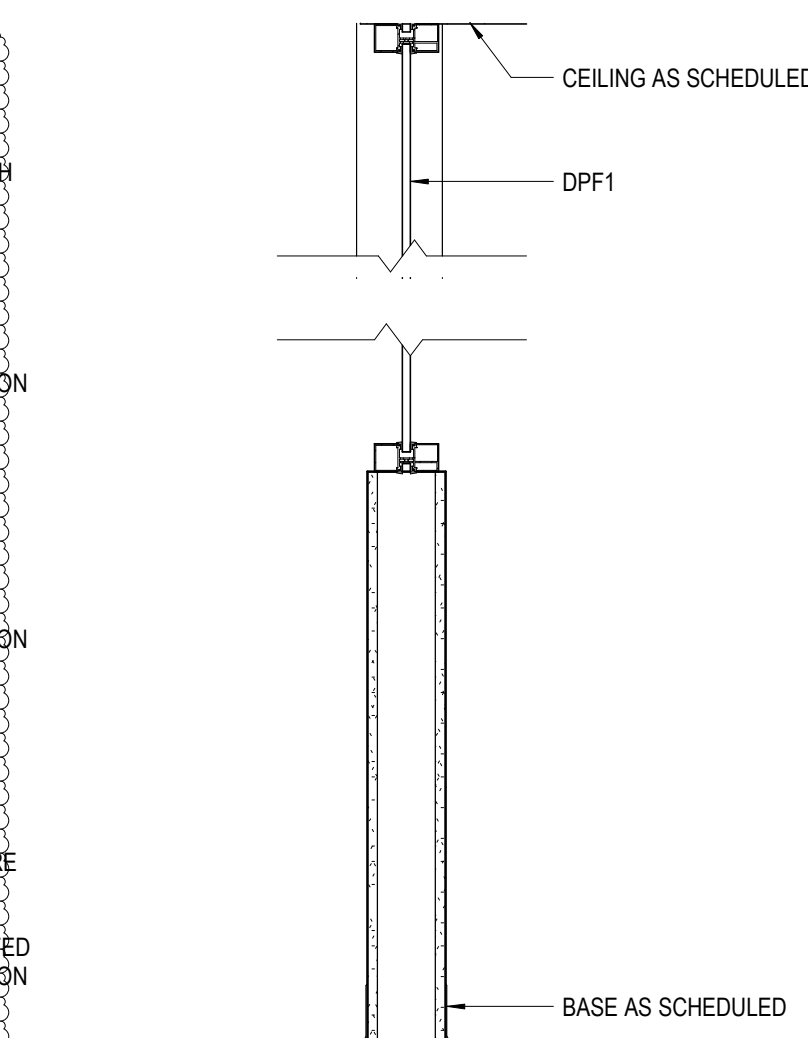
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1/4" = 1'-0"



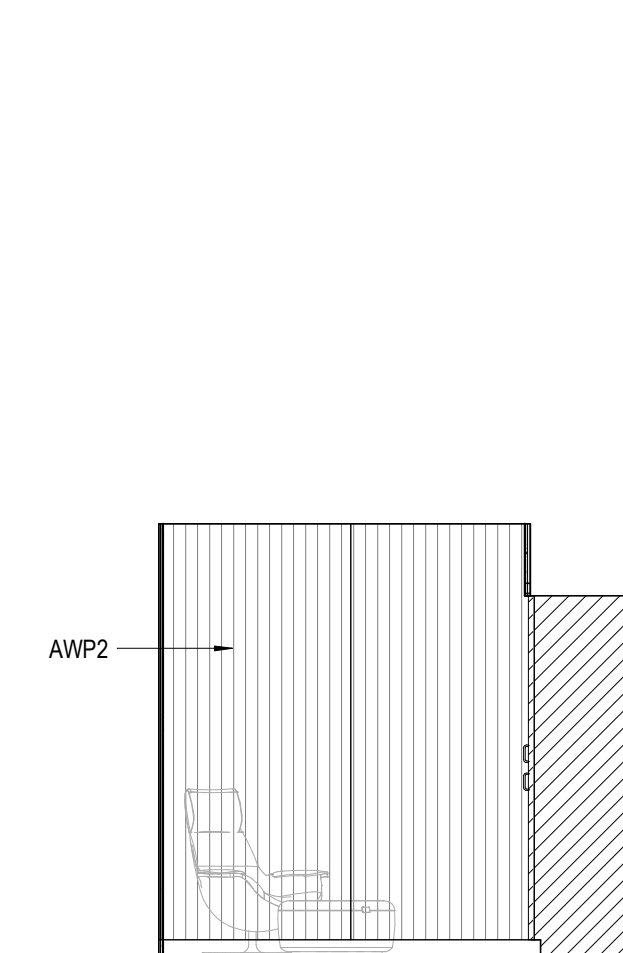
C3 HALL 2 - NORTH
1/4" = 1'-0"



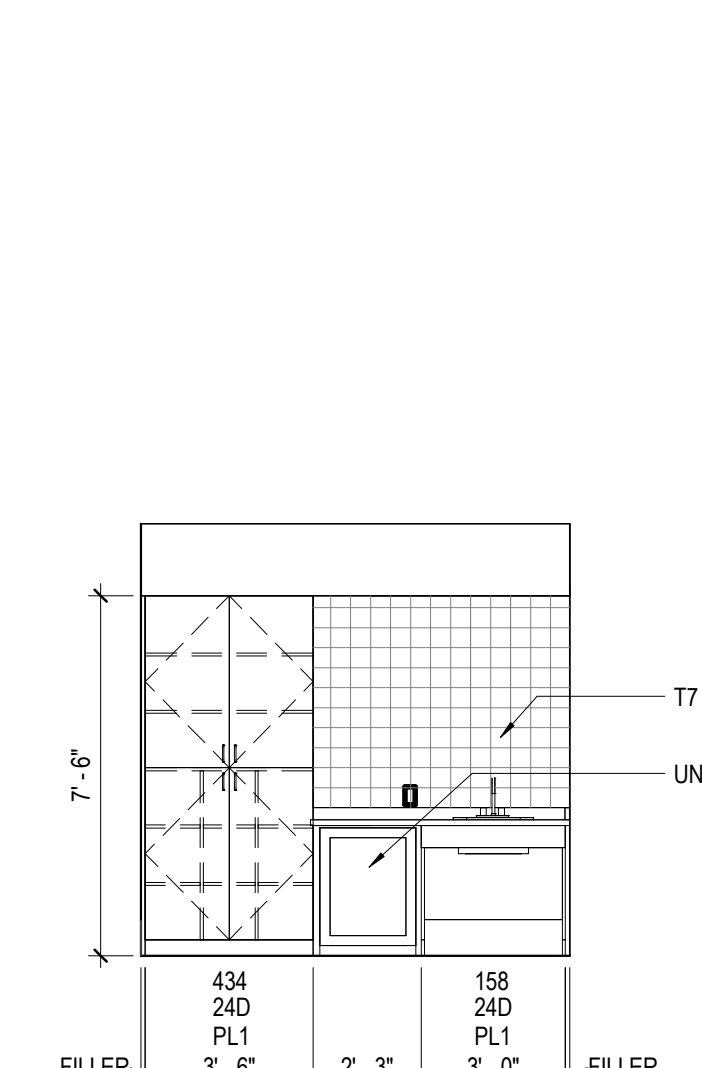
B6 PLAN @ SECOND FLOOR OPERABLE PARTITION
1/2" = 1'-0"



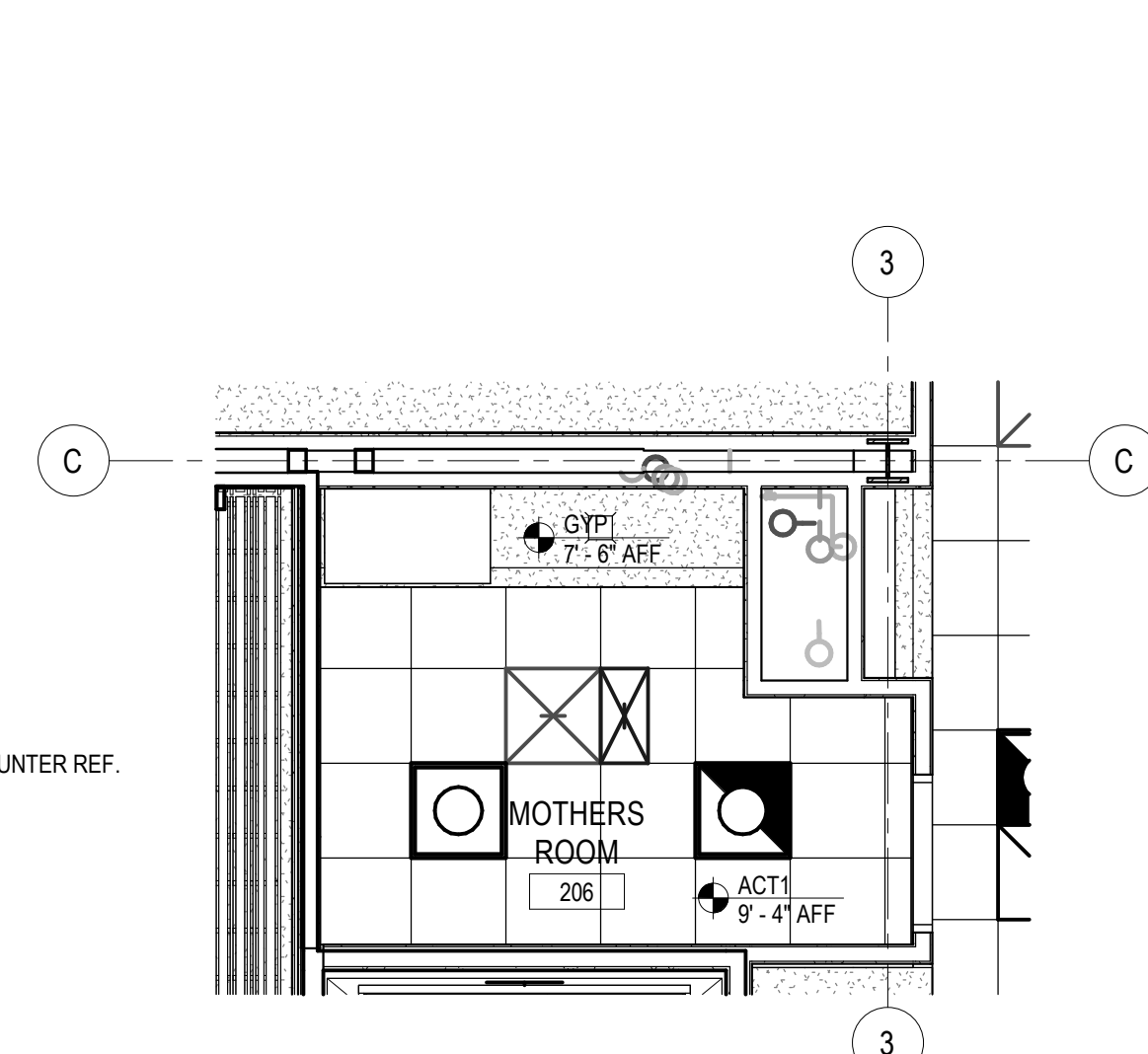
B5 SECTION @ PONY WALL SCREENING
1" = 1'-0"



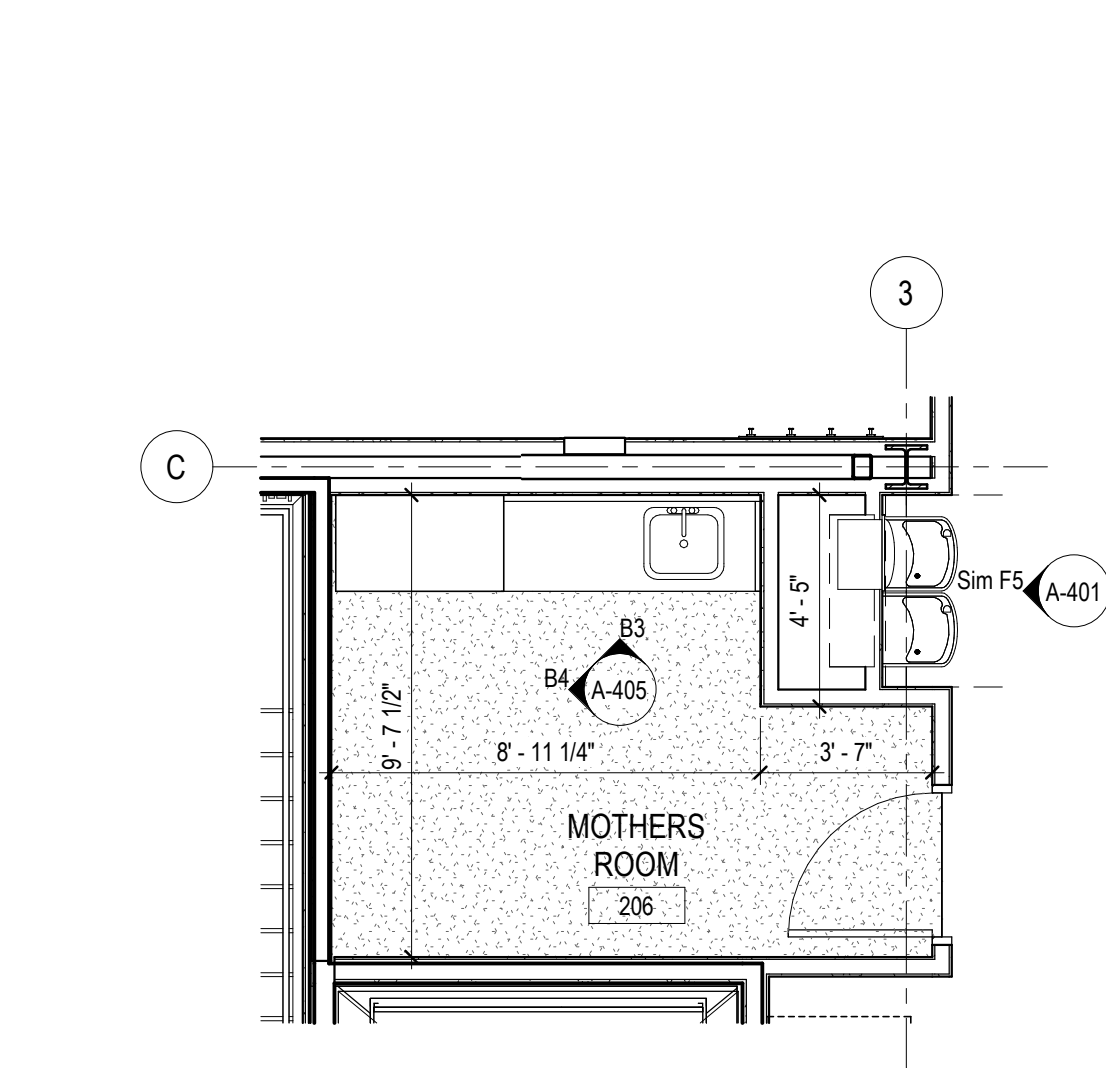
B4 MOTHERS ROOM - WEST
1/4" = 1'-0"



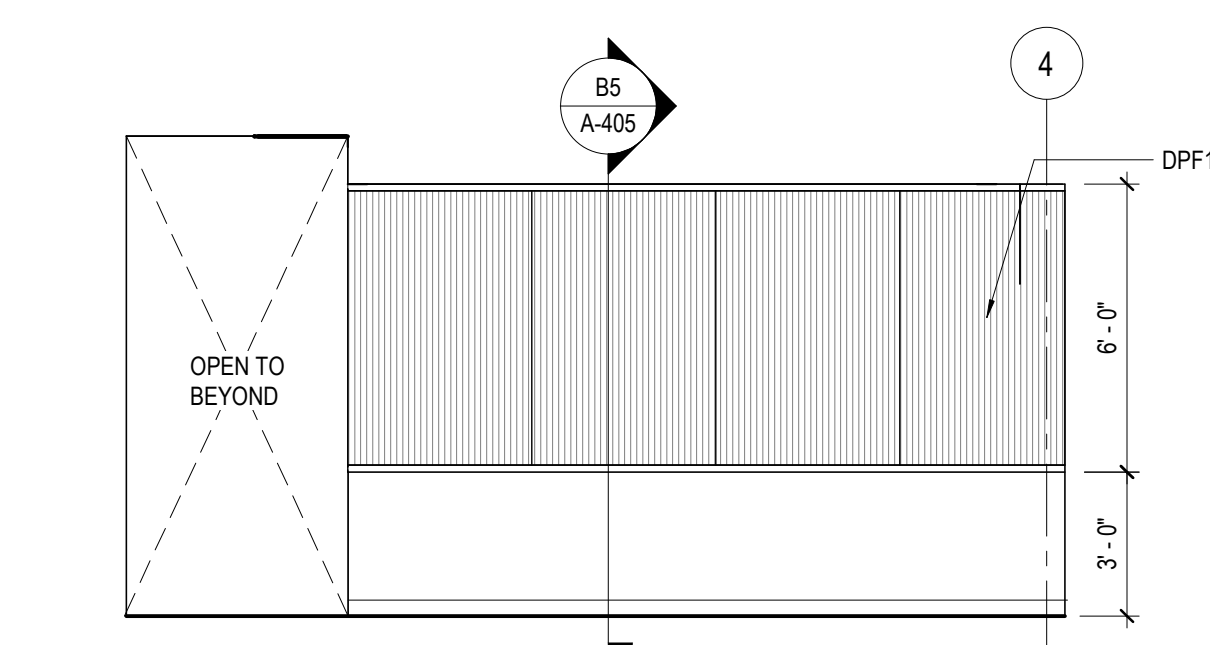
B3 MOTHERS ROOM - NORTH
1/4" = 1'-0"



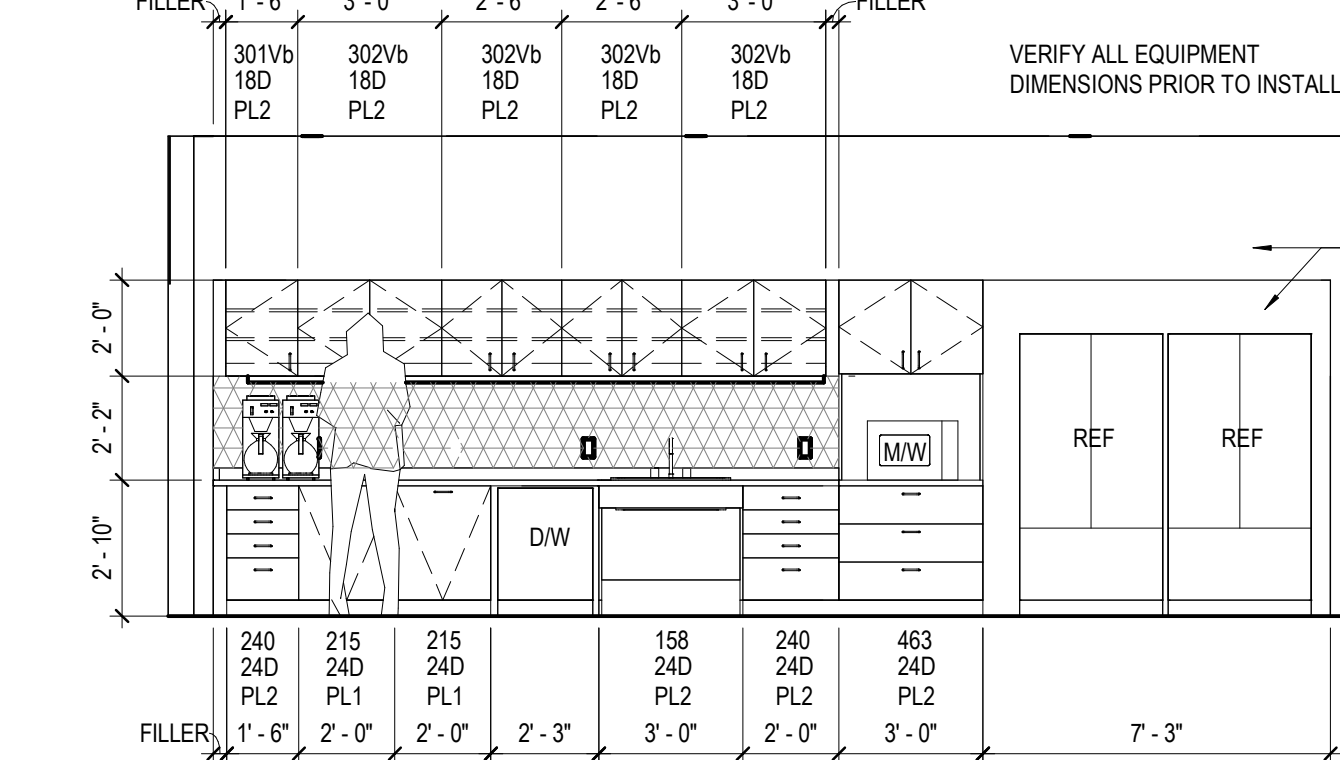
B2 ENLARGED RCP - MOTHERS ROOM
1/4" = 1'-0"



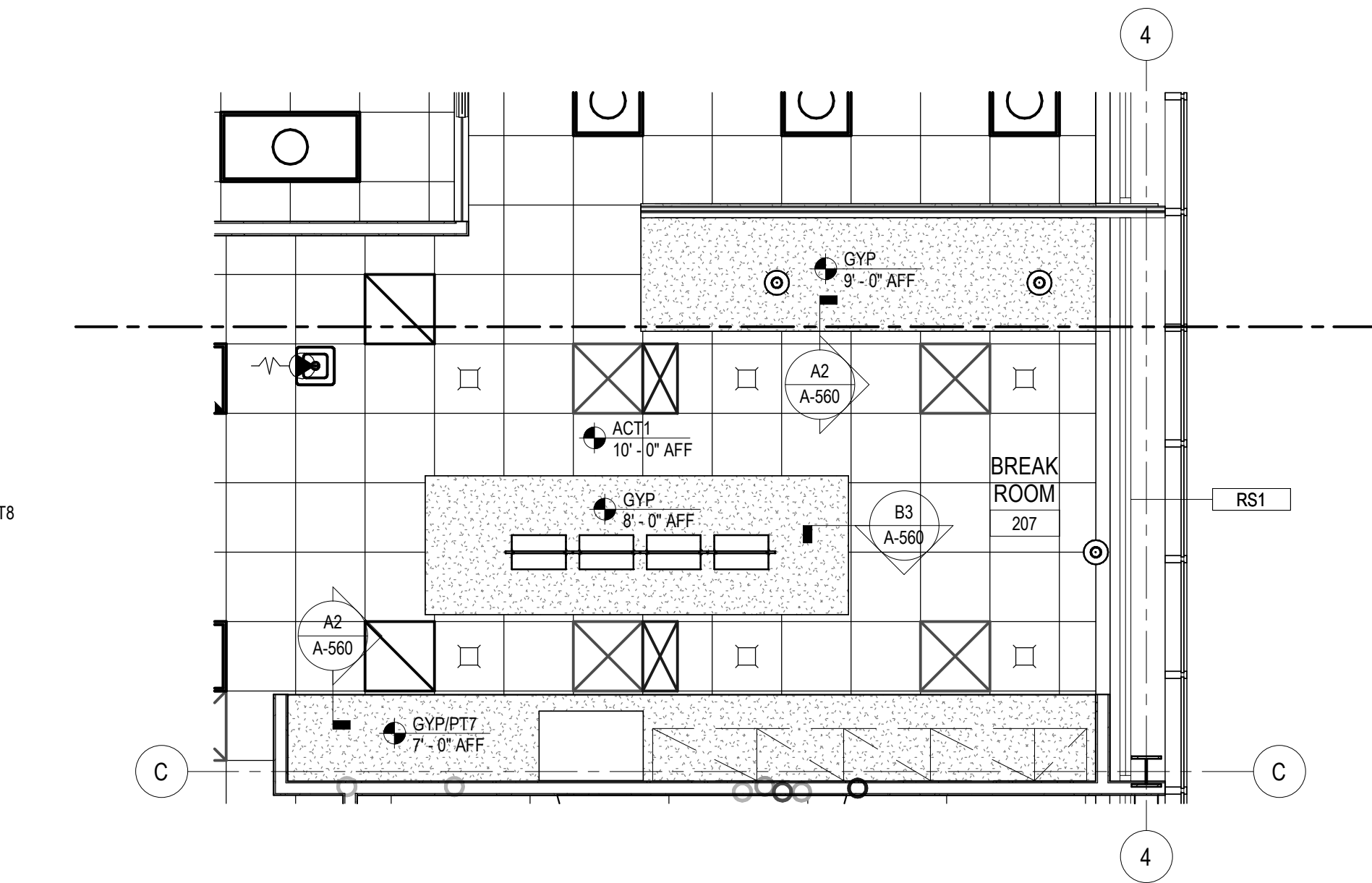
B1 ENLARGED PLAN - MOTHERS ROOM
1/4" = 1'-0"



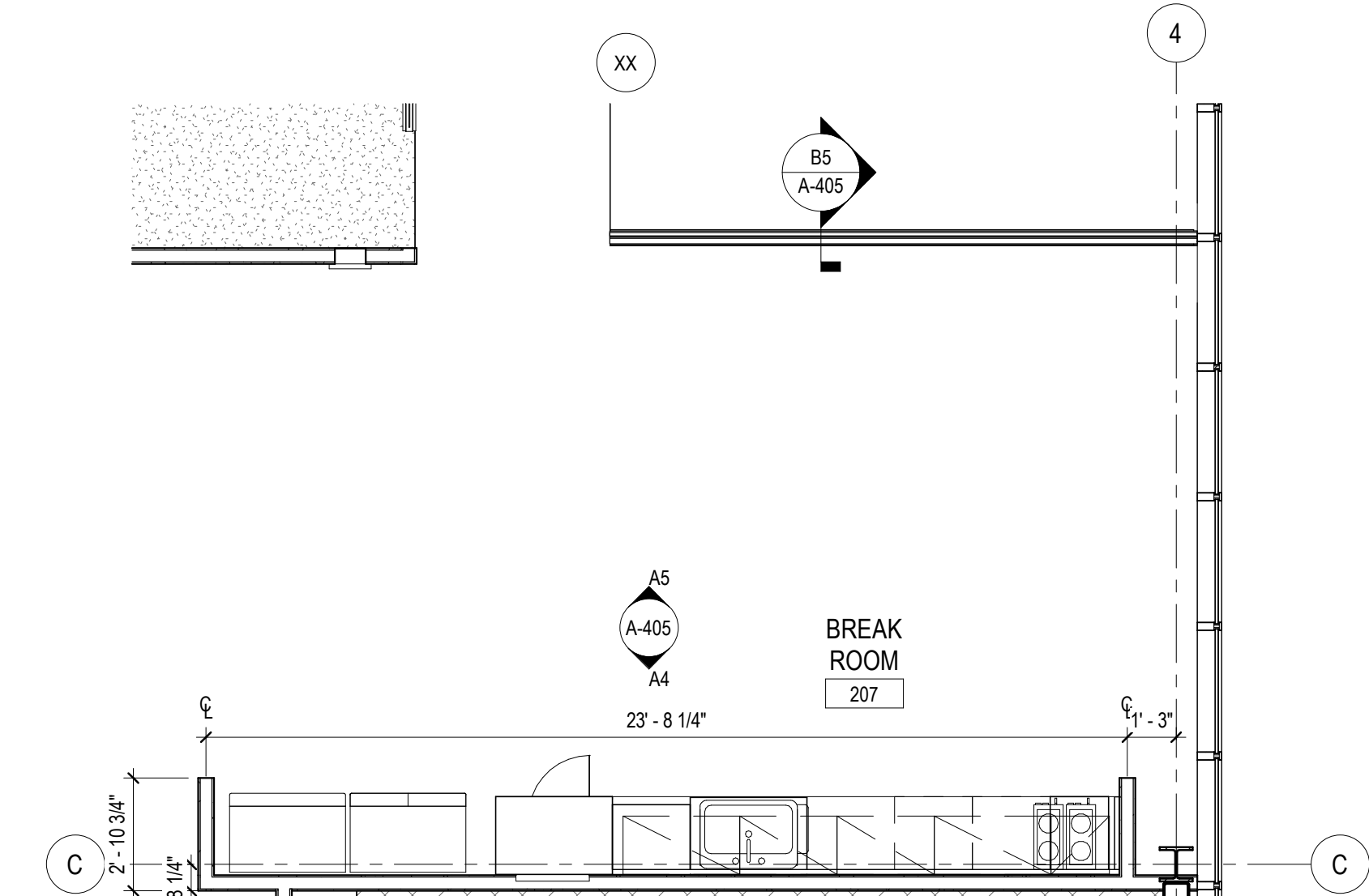
A5 BREAKROOM - NORTH
1/4" = 1'-0"



A4 BREAK ROOM - SOUTH
1/4" = 1'-0"



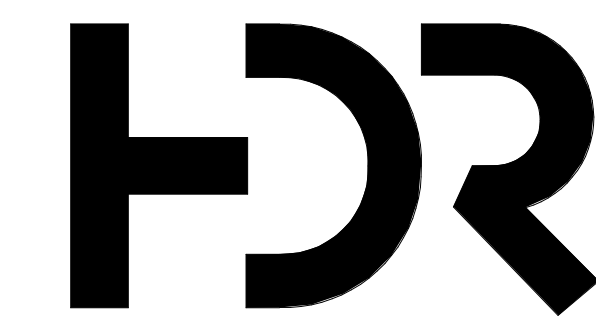
A3 ENLARGED RCP - BREAK ROOM
1/4" = 1'-0"



A2 ENLARGED PLAN - BREAK ROOM
1/4" = 1'-0"

ENLARGED VIEW GENERAL NOTES

- DO NOT SCALE DRAWINGS. IF DIMENSIONAL INFORMATION IS REQUIRED & NOT FOUND, NOTIFY ARCHITECT IMMEDIATELY FOR CLARIFICATION.
- REFER TO A-100 SERIES AND A-150 SERIES FOR FLOOR PLAN AND CEILING PLAN LEGENDS.
- ALL DIMENSIONS ARE TO COLUMN CENTERLINES OR FACE OF FINISHED WALLS OR SURFACES, UN.
- REFER TO A-730 DRAWINGS FOR TYPICAL MOUNTING HEIGHTS AND REQUIRED ACCESSIBILITY CLEARANCES, UN.
- ALL DOOR FRAMES ARE TO BE INSTALLED 4" AWAY OF ADJACENT PERPENDICULAR WALLS, UN.
- REFER TO LIFE SAFETY DRAWINGS FOR ADDITIONAL FIRE/SMOKE RATING REQUIREMENTS.
- ELECTRICAL, TELECOMMUNICATIONS, MECHANICAL, AND PLUMBING DEVICES ARE SHOWN FOR REFERENCE AND LOCATION ONLY. REFER TO DISCIPLINE SPECIFIC DRAWINGS.
- REFER TO I-001 FOR FINISH LEGEND AND I SERIES DRAWINGS FOR INTERIOR FINISHES AND DETAILS.
- REFER TO STRUCTURAL DRAWINGS FOR ADDITIONAL STRUCTURAL SPECIFIC INFORMATION.
- ALL NON-LOAD BEARING INTERIOR WALLS ARE TYPE "A", UN.
- HIGHER RATED FIRE WALLS TAKE PRECEDENCE OVER LOWER RATED WALLS & ARE TO CONTINUE THROUGH ALL SUCH INTERSECTIONS.
- REFER TO A-720 FOR INTERIOR WALL TYPES AND ASSEMBLY DESCRIPTIONS.
- REFER TO A-200 FOR EXTERIOR WALL TYPES AND ASSEMBLY DESCRIPTIONS.



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Project Manager
Project Designer
Project Architect
Landscape Architect
Civil Engineer
Structural Engineer
Mechanical Engineer
Electrical Engineer
Plumbing Engineer
Interior Designer
Fire Protection

Ruth Krueger
Nicole Peterson
Dave Sheppard
Bryant Stowe
Jeff Carper
Joshua Hooker
Chris Work
Jesus Gonzalez
Chris Work
Kristin Gresley
Adam Senk

MARK	DATE	DESCRIPTION
1	06/16/2026	ISSUED FOR BID
1	07/16/2026	BID ADDENDUM 1

Project Number
Original Issue

10404293
02/02/2026



Sheet Name

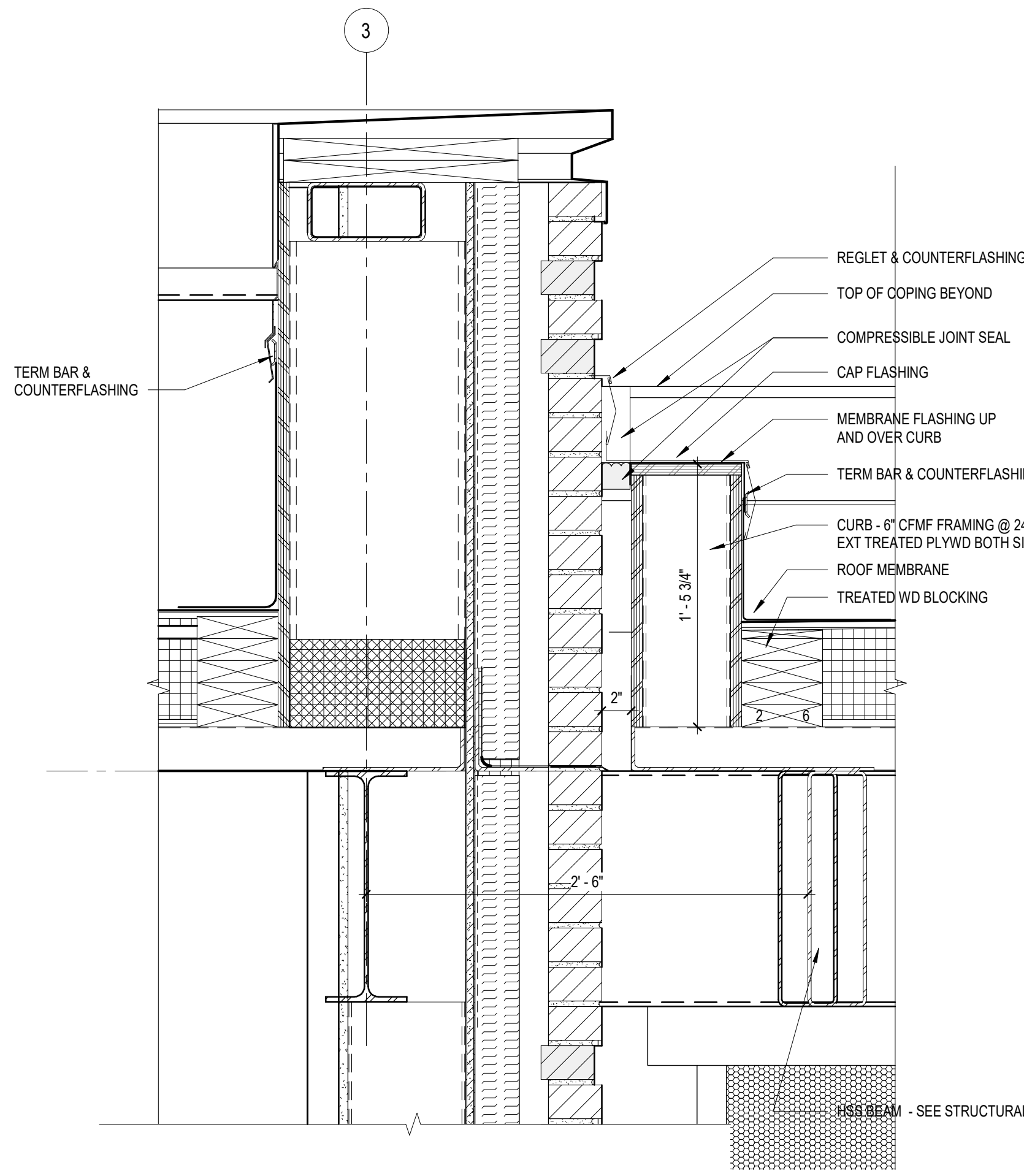
ENLARGED VIEWS -
LEVEL 2 SC WORKS

Sheet Number

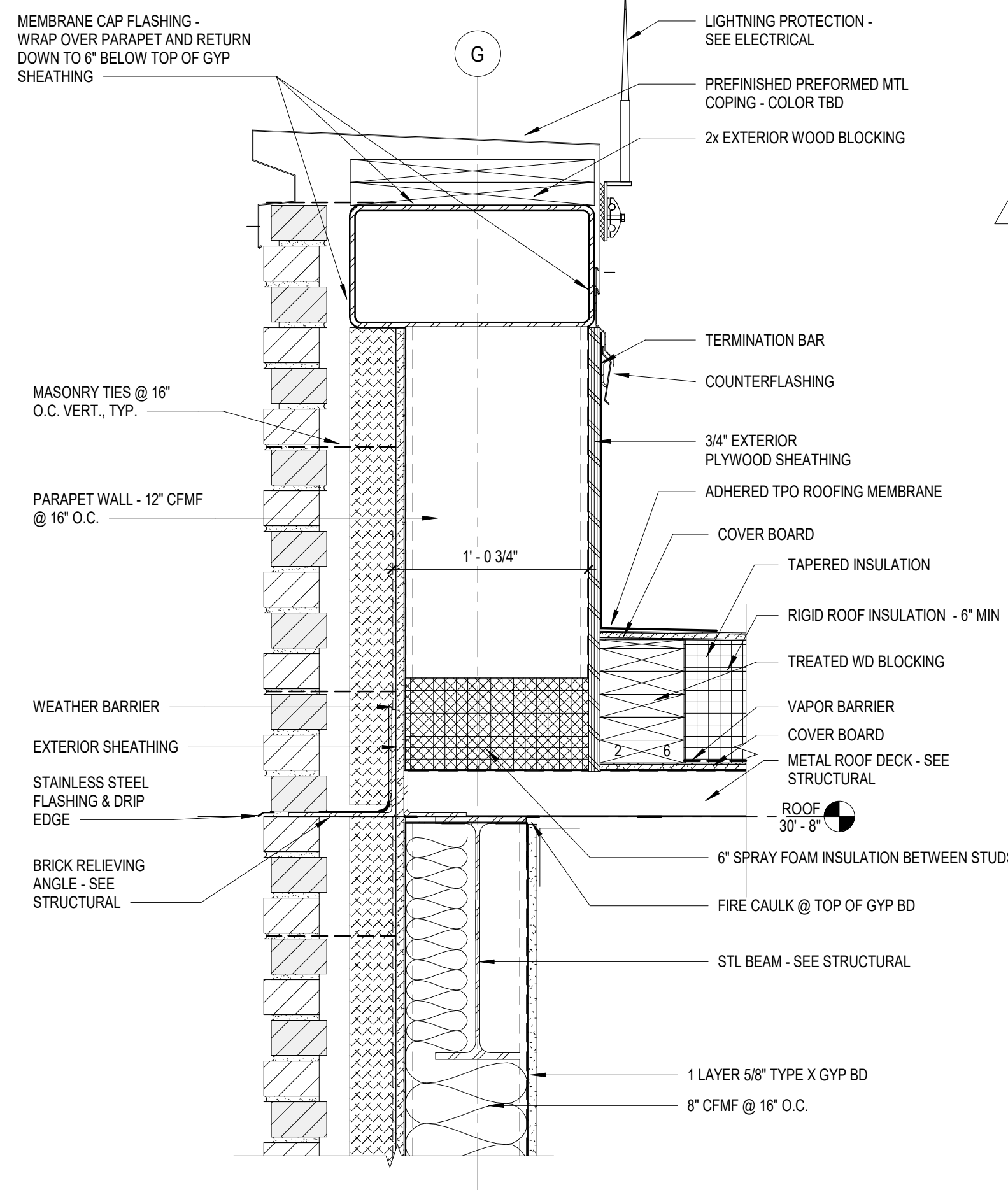
A-405

Project Status
CONSTRUCTION DOCUMENTS

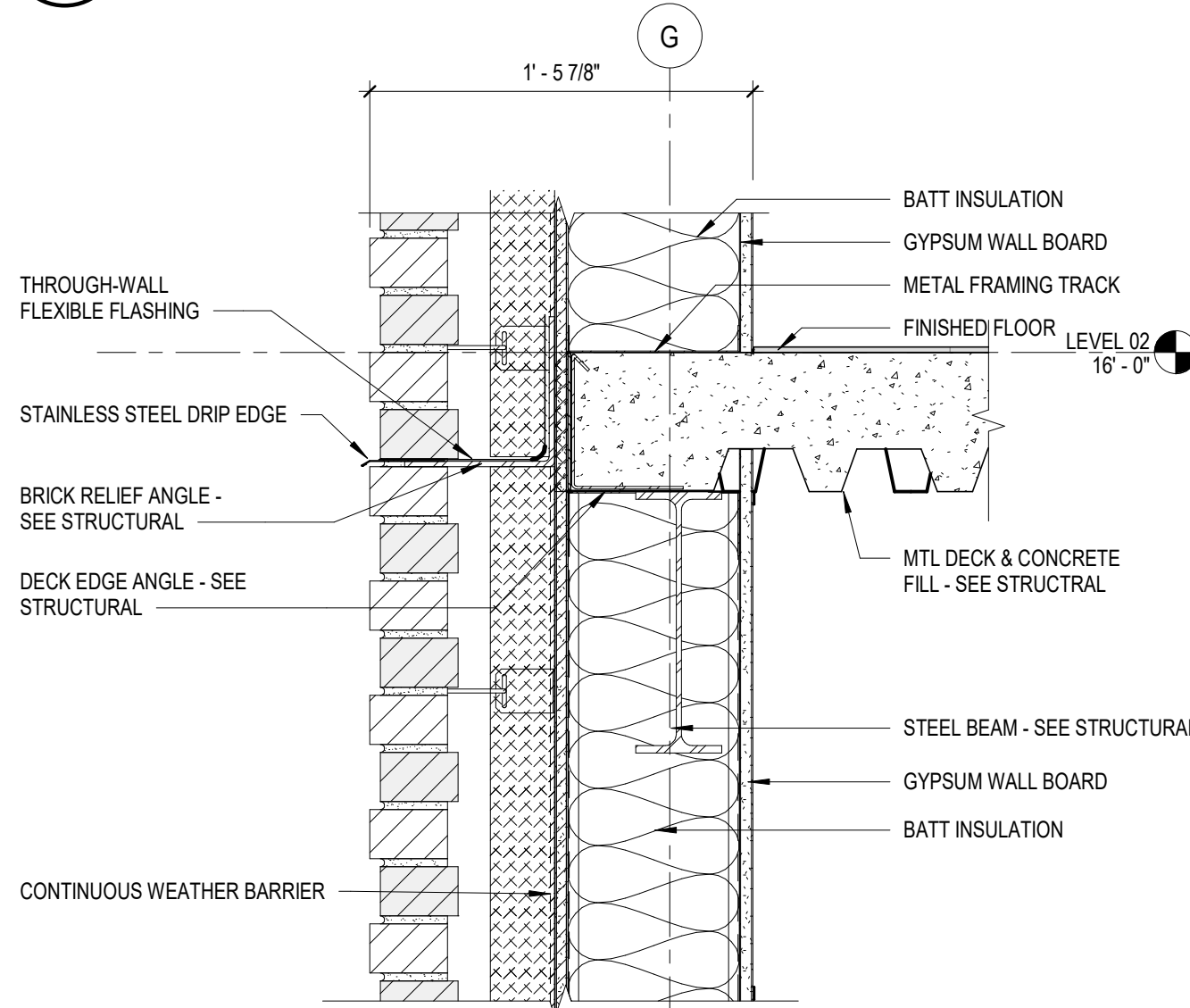
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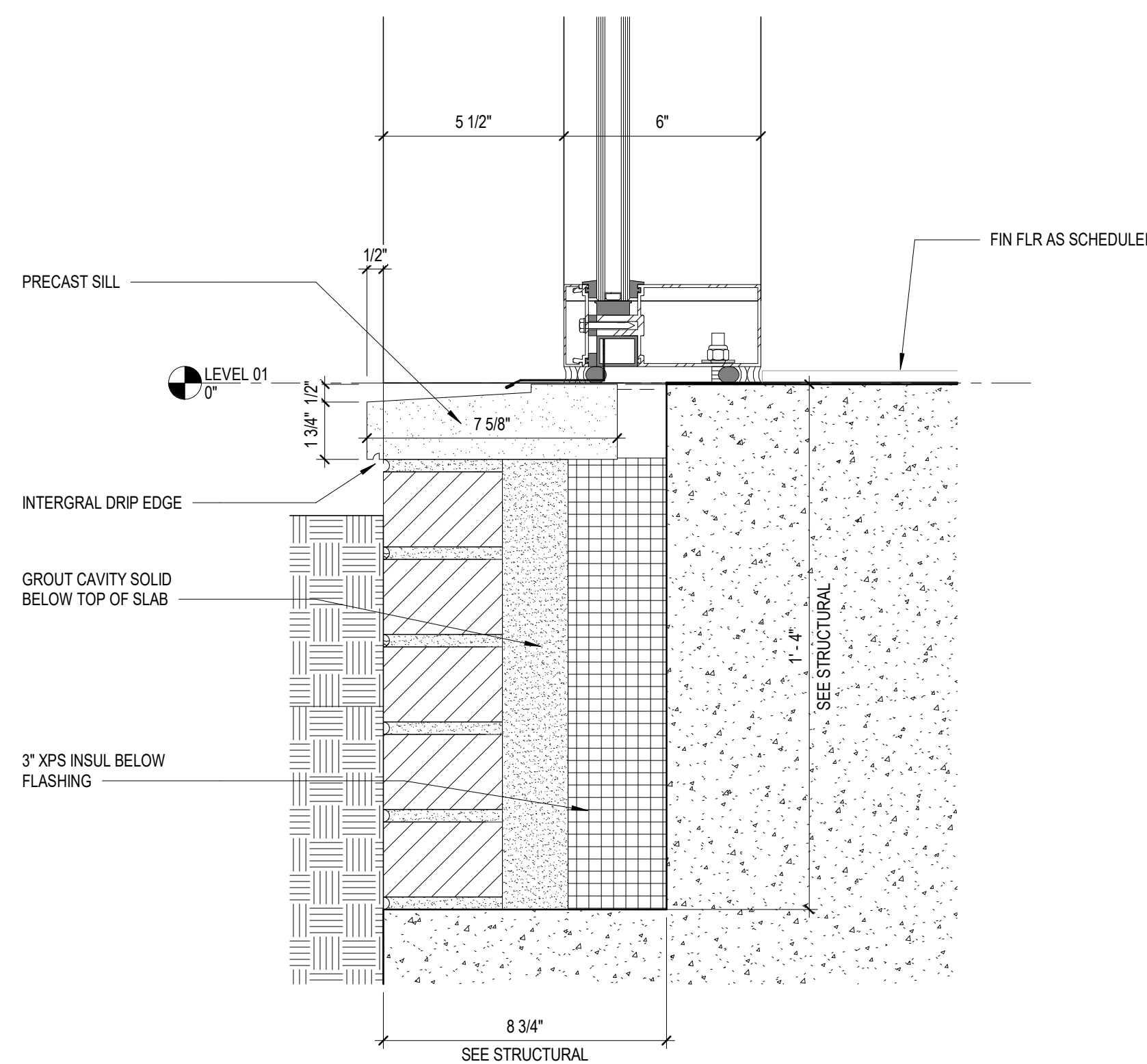
C4 WALL RETURN AT ROOF DETAIL
1 1/2" = 1'-0"



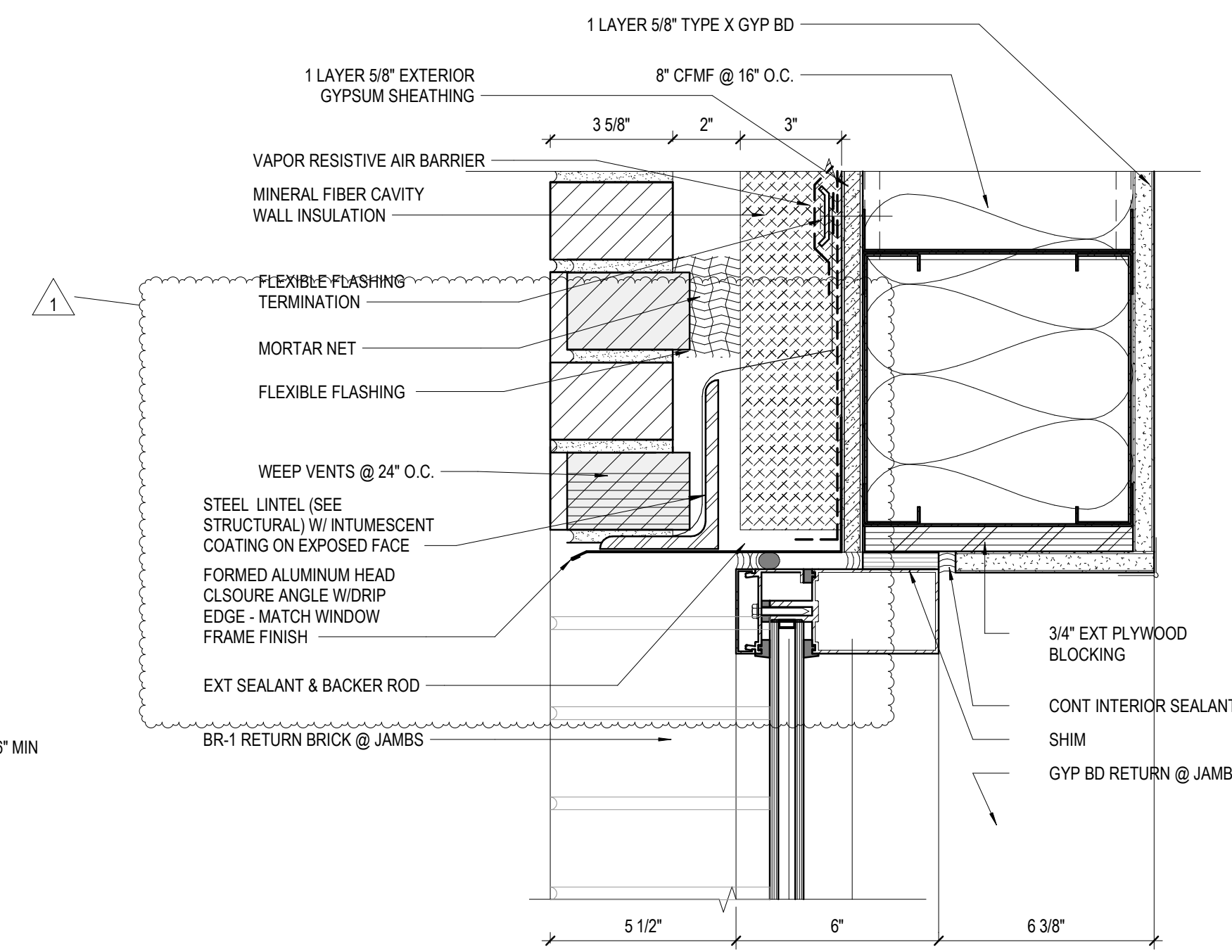
C3 BRICK VENEER PARAPET WALL @ COPING
1 1/2" = 1'-0"



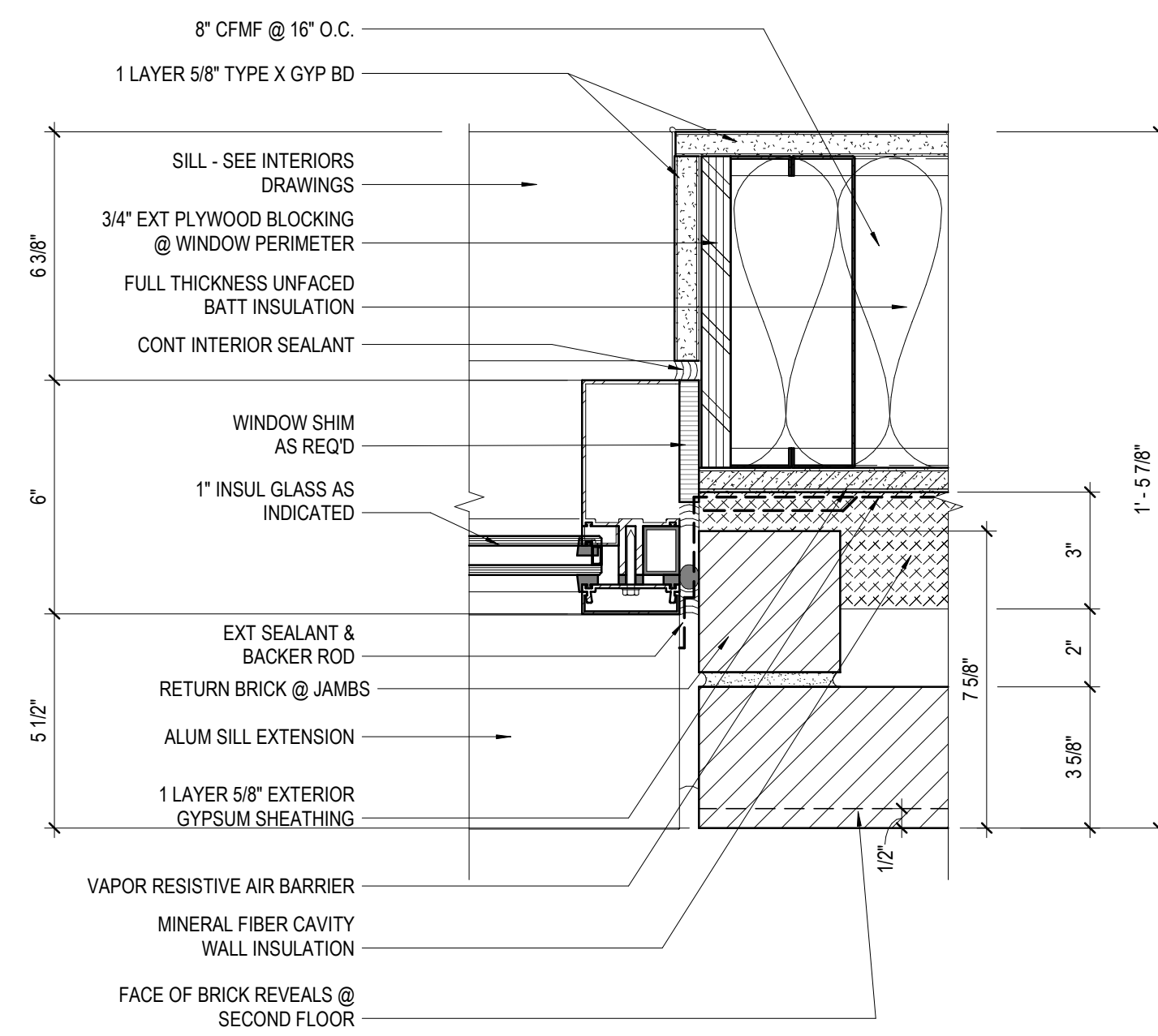
B3 SLAB EDGE AT STUD BACKUP
1 1/2" = 1'-0"



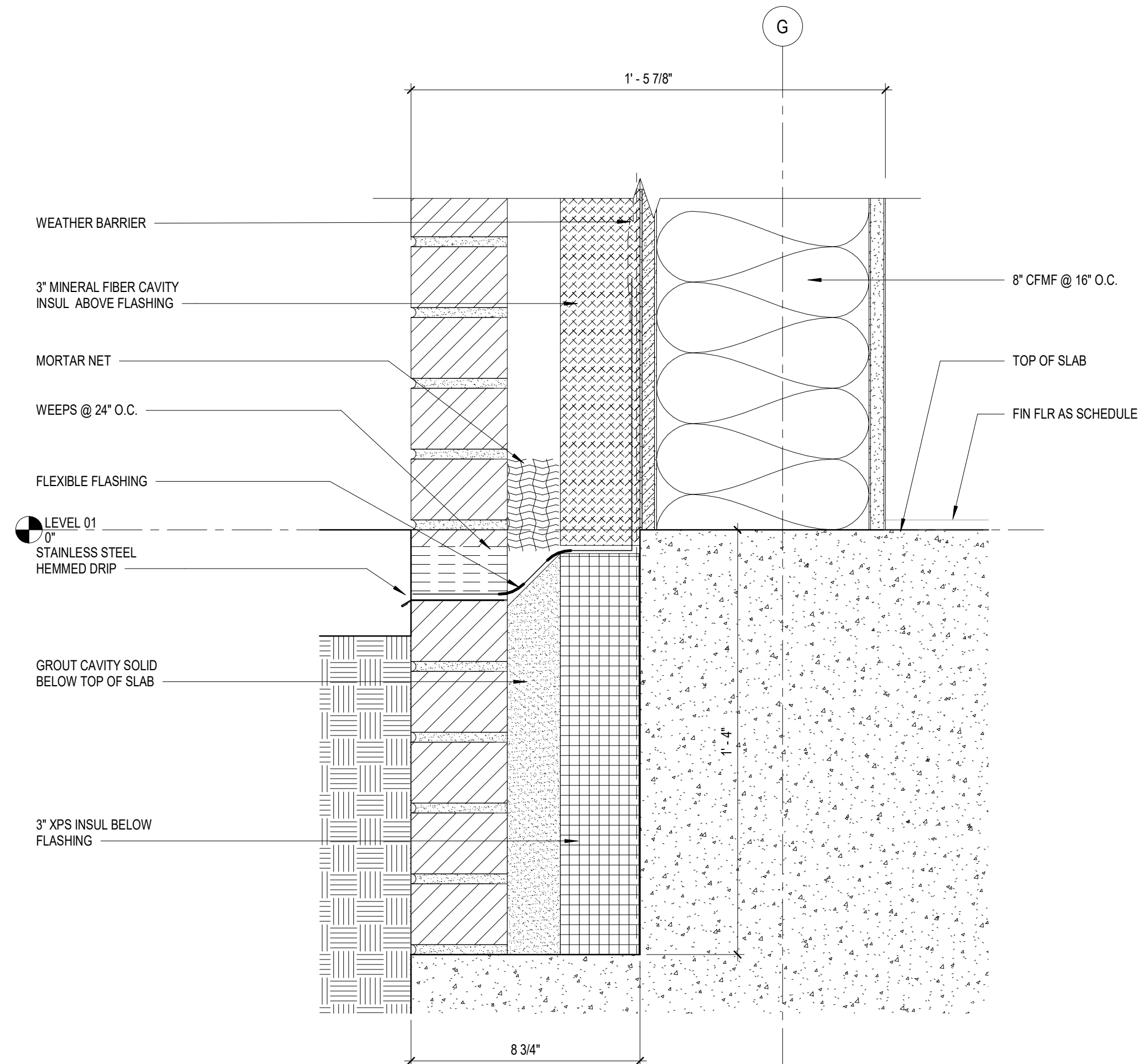
A5 TYP. WINDOW SILL @ FIRST FLOOR
3" = 1'-0"



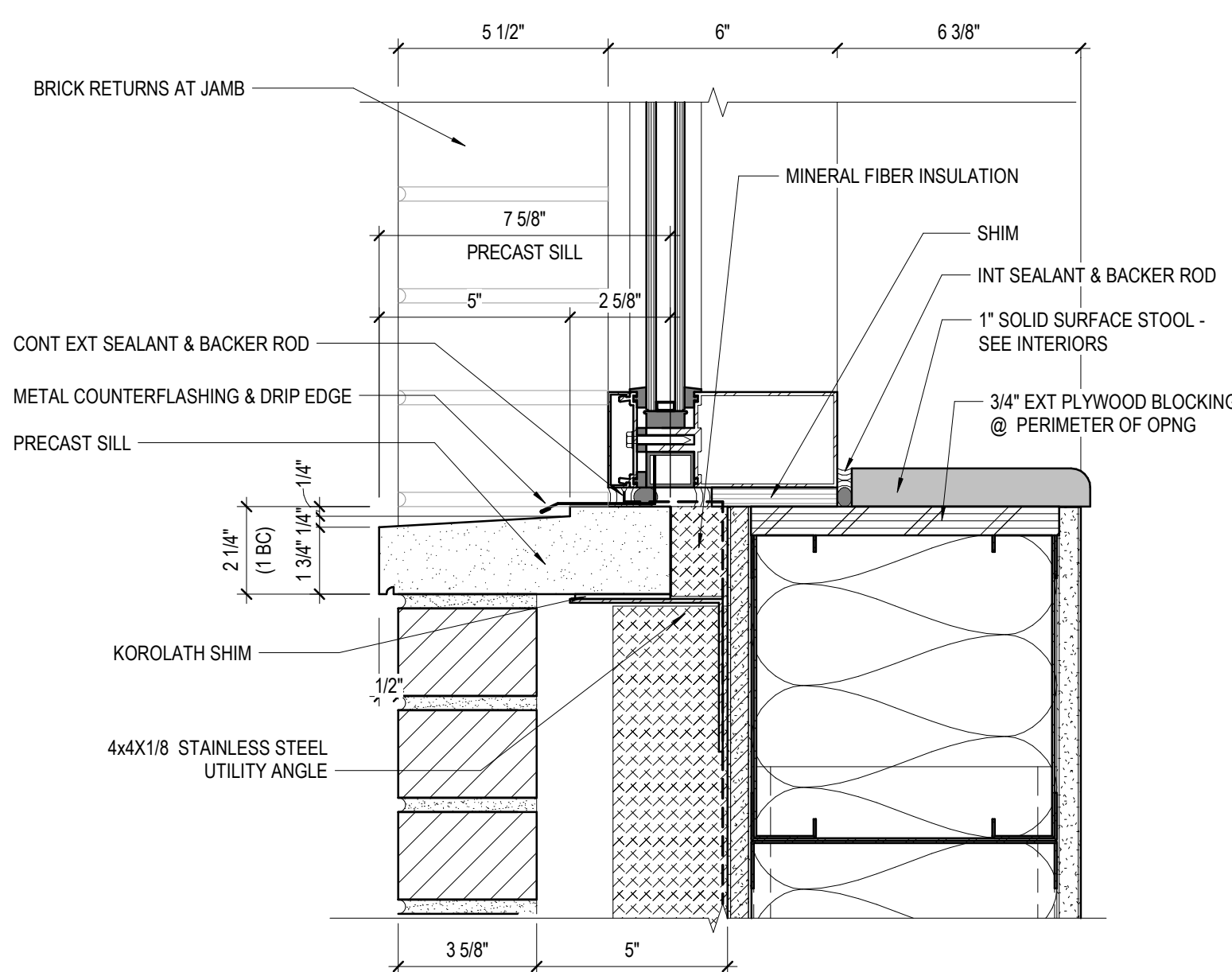
C1 TYP. WINDOW HEAD @ BRICK VENEER
3" = 1'-0"



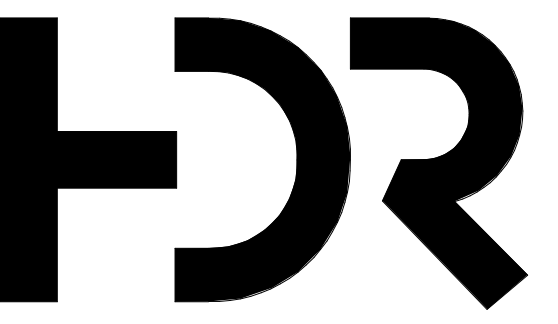
B2 TYP. WINDOW JAMB @ BRICK VENEER
3" = 1'-0"



A4 EXT. BRICK WALL SILL @ FIRST FLOOR
3" = 1'-0"



A2 TYP. WINDOW SILL @ SECOND FLOOR
3" = 1'-0"



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Project Designer: Nicole Peterson
Project Architect: Dave Sheppard
Landscape Architect: Bryant Stowe
Civil Engineer: Jeff Carper
Structural Engineer: Joshua Hooker
Mechanical Engineer: Chris Work
Electrical Engineer: Jesus Gonzalez
Plumbing Engineer: Chris Work
Interior Designer: Kristin Greeley
Fire Protection: Adam Senk

Sheet Reviewer: Author

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Sheet Name

DETAILS - EXTERIOR - SECTION

Sheet Number

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Project Status
CONSTRUCTION DOCUMENTS