



**Crabtree, Rohrbaugh & Associates - Architects**

401 East Winding Hill Road

Mechanicsburg, PA 17055

Pennsylvania • Virginia • Maryland • West Virginia

**ADDENDUM NO. 1**

**July 23, 2026**

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The Solanco Area School District | New District Administration Offices & Turf Fields  
CRA Project No. 3706

TO: All Perspective Bidders and Other Recipients of Contract Drawings and Specifications

This Addendum is hereby made a part of the Contract Document, which will be the basis of the Contract. The Addendum is issued to modify and/or correct the original Contract Documents dated July 8, 2026. Attach this Addendum to your Contract Documents. Receipt of this Addendum must be acknowledged on the Proposal Form. Failure to do so may subject the bidder to disqualification.

**GENERAL**

1. Each Bid must be submitted on the form provided by the Architect/Engineer, and must be accompanied by a bid bond, certified check, or cashier's check equal to ten percent of the total price submitted inclusive of add alternates. The Owner also reserves the right to reject any or all Bids for any reason whatsoever.
2. The last day which Contractors can ask questions in writing will be five days prior to receipt of bids. Questions will be answered by Addendum only.
3. All bidders are hereby notified that they are responsible to review all parts of this addendum for conditions and requirements that may apply to their individual contracts. All Plan Holders shall review their Bidding Documents against the Table of Contents and List of Drawings to ensure that all Specifications Sections and Drawings are in your possession.
4. A pre-bid meeting was held at 2:00pm on Thursday, July 16, 2026. The sign-on sheet is attached to this addendum.
5. Sealed bids for construction of **New District Administrative Office and Athletic Fields** located on the site of Solanco High School, 585 Solanco Road, Quarryville, Pennsylvania 17566 will be received at the Administrative Offices of the Solanco School District at 121 South Hess Street, Quarryville, PA 17566 until **2:00 P.M., prevailing time, on August 12, 2026.**

## **SPECIFICATIONS:**

### SECTION 000015 ADVERTISEMENT FOR BIDS\_MULTIPLE PRIME - FOR PUBLICATION

1. REVISE bid opening from "2:00 P.M., prevailing time, on August 5, 2026" to **"2:00 P.M., prevailing time, August 12, 2026."**

### SECTION 230540 – HVAC PUMPS

1. **ADD** Paragraph 2.1.A.2.E to read as follows:
  - a. Grundfos

### SECTION 230545 – CHEMICAL WATER TREATMENT

1. **REVISE** Paragraph 2.1.A to read as follows:
  - 2.1. MANUFACTURER/TREATMENT AGENCY
    - A. R.L. Clarke Enterprises Inc – Contact 717-371-2300, [rlclarke@rlclarke.com](mailto:rlclarke@rlclarke.com)
      1. Contractor shall contact RLC to coordinate "flush and fill" method for removing system cleaners completely from the closed loop systems.
      2. No Substitutes.

### SECTION 230900 – ATC SYSTEMS

1. **REPLACE** this section in its entirety.

## **DRAWINGS:**

### ARCHITECTURAL DRAWINGS

#### DRAWING A1.1 – OVERALL FIRST FLOOR PLAN

1. **REVISE** dimensions in receiving area.
2. **REPLACE** sheet in its entirety

#### DRAWING A1.4 – FIRST FLOOR REFLECTED CEILING PLAN

1. **ADD** details 3-4/A1.4.
2. **REPLACE** sheet in its entirety

#### DRAWING A3.1 – BUILDING SECTIONS

1. **ADD** location for details 3-4/A1.4
2. **REPLACE** sheet in its entirety

#### DRAWING A3.2 – WALL SECTION

1. **REVISE** section 2/A3.2
2. **REPLACE** sheet in its entirety

#### DRAWING A3.3 – WALL SECTION

1. **REVISE** sections 1-3/A3.3
2. **REPLACE** sheet in its entirety

#### DRAWING A3.4 – WALL SECTION

1. **REVISE** sections 1-4/A3.4
2. **REPLACE** sheet in its entirety

DRAWING A3.6 – WALL SECTION

1. **REVISE** sections 1-3/A3.6
2. **REPLACE** sheet in its entirety

DRAWING A3.7 – WALL SECTION

1. **REVISE** sections 2/A3.7
2. **REPLACE** sheet in its entirety

DRAWING A5.2 – TYPICAL DETAILS

1. **REVISE** detail 4/A5.2
2. **REPLACE** sheet in its entirety

DRAWING A5.3 – DETAILS

1. **REVISE** details 1-2/A5.3
2. **REVISE** detail 8/A5.3
3. **REPLACE** sheet in its entirety

MECHANICAL DRAWINGS

DRAWING M2.1 – GROUND FLOOR HVAC

1. **REPLACE** this sheet in its entirety

DRAWING M2.1 – FIRST FLOOR HVAC PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M2.3 – MECHANICAL ROOF PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M3.1 – GROUND FLOOR HVAC PIPING PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M3.2 – FIRST FLOOR HVAC PIPING PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M4.1 – ENLARGED MECHANICAL ROOM PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M5.1 – MECHANICAL SCHEDULES

1. **REPLACE** this sheet in its entirety

DRAWING M6.1 – MECHANICAL DETAILS

1. **REPLACE** this sheet in its entirety

DRAWING M6.2 – MECHANICAL DETAILS

1. **REPLACE** this sheet in its entirety

DRAWING M7.1 – GROUND FLOOR HVAC ALTERNATE PLAN

1. **REPLACE** this sheet in its entirety

DRAWING M7.2 – GROUND FLOOR HVAC PIPING ALTERNATE PLAN

1. **REPLACE** this sheet in its entirety

**END OF ADDENDUM NO. 1**

**ATTACHMENTS:**

SPECIFICATIONS:

SECTION 230900 - ATC SYSTEMS

DRAWINGS:

|              |                                         |
|--------------|-----------------------------------------|
| DRAWING A1.1 | OVERALL FIRST FLOOR PLAN                |
| DRAWING A1.4 | FIRST FLOOR REFLECTED CEILING PLAN      |
| DRAWING A3.1 | BUILDING SECTIONS                       |
| DRAWING A3.2 | WALL SECTION                            |
| DRAWING A3.3 | WALL SECTION                            |
| DRAWING A3.4 | WALL SECTION                            |
| DRAWING A3.6 | WALL SECTION                            |
| DRAWING A3.7 | WALL SECTION                            |
| DRAWING A5.2 | TYPICAL DETAILS                         |
| DRAWING A5.3 | DETAILS                                 |
|              |                                         |
| DRAWING M2.1 | GROUND FLOOR HVAC                       |
| DRAWING M2.2 | FIRST FLOOR HVAC PLAN                   |
| DRAWING M2.3 | MECHANICAL ROOF PLAN                    |
| DRAWING M3.1 | GROUND FLOOR HVAC PIPING PLAN           |
| DRAWING M3.2 | FIRST FLOOR HVAC PIPING PLAN            |
| DRAWING M4.1 | ENLARGED MECHANICAL ROOM PLAN           |
| DRAWING M5.1 | MECHANICAL SCHEDULES                    |
| DRAWING M6.1 | MECHANICAL DETAILS                      |
| DRAWING M6.2 | MECHANICAL DETAILS                      |
| DRAWING M7.1 | GROUND FLOOR HVAC ALTERNATE PLAN        |
| DRAWING M7.2 | GROUND FLOOR HVAC PIPING ALTERNATE PLAN |

## SECTION 230900 - ATC SYSTEMS

### PART 1 - GENERAL

#### 1.1 SECTION INCLUDES

- A. Control Equipment & Wiring
- B. Software Including Graphics Package
- C. Sequence of Operation

#### 1.2 REFERENCES

- A. American National Standards Institute (ANSI)
- B. ANSI/ISA 5.5-1985 Graphic Symbols for Process Displays
- C. ANSI/IEEE 260.1 2004, Standard Letter Symbols for SI and Certain Other Units of Measurements (SI Units, Customary Inch Pound Units and Certain Other Units)
- D. ANSI/ASHRAE 135-2016, BACnet® - A Data Communication Protocol for Building Automation and Control Networks

#### 1.3 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

- A. Acronyms used in BAS.
  - 1. BAS – Building Automation System
  - 2. EMCS – Energy Management and Control System
  - 3. GUI – Graphical User Interface
  - 4. HVAC - Heating, Ventilation, Air Conditioning
  - 5. I/O - Input/output
  - 6. ISA - Industry Standard Architecture
  - 7. O&M - Operation and Maintenance
  - 8. Niagara4 – Software framework for building device-to-enterprise applications and Internet-enabled products.

#### 1.4 STANDARDS COMPLIANCE

- A. All equipment and material to be from manufacturer's regular production, UL and/or ULC or CSA certified, manufactured to standard quoted plus additional specified requirements.
- B. Where UL and/or ULC or CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
- C. Additional applicable codes and standards:

1. National Electrical Code -- NFPA 70.
2. Local Electrical Codes
3. Federal Communications Commission -- Part J.

#### 1.5 SCOPE OF WORK

- A. Modification and extension of the existing Niagara system to serve all new and existing HVAC equipment.
- B. SOLANCO HIGH SCHOOL: Provide ATC Control for all new equipment and existing equipment including:
  1. Packaged Rooftop Air Handling Units
  2. Boiler
  3. Hot Water Pumps
  4. Exhaust Fans
  5. Cabinet Unit Heaters, Unit Heaters and Connectors
  6. VAV Boxes
  7. Mini-Split Units
  8. Energy Recovery Units
- C. Actuators, sensors, end switches, flow switches, relays, and other control devices shall be replaced throughout. Wiring can be reused if it is compatible with the new system requirements.
- D. Provide ATC Control for all equipment. Match all sequences as noted.
- E. Provide thermostats, temperature sensors, temperature / humidity, sensors, temperature / humidity / CO2 sensors, actuators, control valves and other sensors necessary to maintain environmental comfort throughout the building. Provide actuators for all dampers provided by others and for dampers provided by ATC.
- F. Contractor shall run all new IP wiring to all controllers and devices as required. Owner will provide two interface locations in the project. Final locations to be determined.
- G. Provide full graphics package as part of software. Customize the graphics to match the HVAC system and sequences. Note that graphics software and controls cannot be proprietary, locked, or non-accessible to the owner or his service agencies. The owner shall be given full and complete access as well as be provided with the unlimited permission to permit any outside control service company to access, service, and modify any and all system programming.
- H. The "Scope of Work" to be performed under this Contract shall be used as a guide only and will not be considered as the limit of this contract. Any additional items which are not specifically called for, but which are required by the specification shall be furnished and installed by the contractor without additional cost to the School District.
- I. System shall be a Tridium Niagara System installed by Certified Niagara Technicians and configured with open NICS statements to ensure open architecture to all other Tridium Workstations.

- J. System shall be 100% BACnet IP protocol.
- K. System must be capable of full integration with existing campus server (Niagara N4).
- L. Provide Niagara N4 based Network Manager, DDC Controllers, Building Controllers, Network Management Tools, Programming Tools, Web Browser based Graphical User Interface, sensors, relays, campers, actuators, and other equipment as may be necessary to provide a complete system.
- M. Programmable controllers shall be Distech and shall be compatible with existing District Niagara System. Proprietary or licensed controllers are not permitted.
- N. Programming software, software tools and programming tools shall be licensed to the district so that they can allow anyone to use them. Customer shall be able to download all software upgrades for free.
- O. Designated District personnel shall be trained on use of software. Forty (40) hours of training shall be included in the bid.
- P. Tridium hardware shall be open and serviceable by any trained and certified Tridium service professional. Full access shall be provided to the Owner and his service agencies.
- Q. All labor, material, equipment, and services not specifically referred to in this specification that are required to fulfill the functional intent of this specification shall be provided at no additional cost to the Owner.
- R. The work covered by this specification and related sections consists of providing submittals, labor, materials, engineering, technical supervision, and transportation as required to furnish and install a fully operational BAS to monitor and control the facilities listed herein, and as required to provide the operation specified in strict accordance with these documents, and subject to the terms and conditions of the contract. The work in general consists of but is not limited to, the following:
  - 1. Furnish and install all to achieve system operation, any control devices, conduit and wiring, programming, hardware, software, etc. in the facility as required to provide the operations as specified.
  - 2. Furnish complete operating and maintenance manuals and field training of operators, programmers, and maintenance personnel.
  - 3. Perform acceptance tests and commissioning of the new control system.

#### 1.6 BIDDER QUALIFICATIONS

- A. The Automatic Control System shall be provided and installed complete by competent, trained mechanics regularly employed by the Factory authorized representative of the automatic control equipment. Control manufacturer shall have an established office within a 50-mile radius of the project and that office shall be staffed with installation and service mechanics; factory trained engineers and technicians fully capable of rendering training, instruction, and engineering assistance; as well as providing routine and emergency service on all system components.

1.7 BAS OPEN SYSTEM DESIGN AND QUALIFICATIONS

- A. Open System Design: It is the expressed goal to implement an open Building Automation System that will allow products from different manufacturers and/or suppliers to be integrated into a single unified system in order to provide flexibility for expansion, maintenance, and service of the system. The BAS manufacturer/contractor must provide proof of open system design as outlined below.
- B. The controls system shall utilize the Niagara4 software framework.
  - 1. The Contractor shall have a minimum of 5 years' experience in the sales, installation, engineering, programming servicing and commissioning of Niagara4.
  - 2. Submit the Niagara Compatibility Statement (NiCS) via a letter from the manufacturer. The NiCS shall have no connectivity restrictions and all aspects of the Niagara Framework will be provided to maintain an Open System Design. The System as provided shall confirm with the following NiCS properties (Station Compatibility In, Station Compatibility Out, Tool Compatibility In, AND Tool Compatibility Out shall each have a value of "All").
  - 3. The controls system shall conform to the following guidelines for communication protocols.
- C. BACnet shall be used for all BAS provided controllers.
  - a. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the BACnet International and all controllers used shall be BACnet Listed with documentation on the BACnet website (<https://www.bacnetinternational.net/btl/search.php>)
  - b. The use of BACnet Communications protocol alone shall NOT warrant an "Open System Design." Manufacturers must adhere to all aspects of "BAS Open System Design and Qualifications" and "Acceptable System Manufacturers" sections to comply.
  - c. Modbus shall only be acceptable for third party devices.
  - 2. LonTalk shall only be acceptable for sites with existing LonTalk controls architecture where the owner has explicitly stated that the LonTalk architecture must remain in place.
  - 3. Fox protocol shall NOT be acceptable.
  - 4. Proprietary communications protocols will NOT be acceptable.
  - 5. A software programming tool shall be provided for this project and adhere to the following guidelines:
- D. All software tools needed for full functional use, including programming of controllers, Niagara4 Framework network management and expansion, and graphical user interface use and development, of the BAS described within these specifications shall be provided to the owner or his designated agent.
  - 1. The software programming tool shall be free of charge and openly available for download from the internet.
  - 2. For any manufacturer that does not have a free programming tool the manufacturer must provide the tool with this project for a minimum of 5 years with proof of availability via letter from the manufacturer.
  - 3. Any licensing required by the manufacturer now and to the completion of the warranty period, including changes to the licensee of the software tools and the addition of

hardware corresponding to the licenses, to allow for a complete and operational system for both normal day to day operation and servicing shall be provided.

1.8 PRODUCTS NOT FURNISHED UNDER THIS SECTION

- A. Central personal computers and printers located at District Office and Building Maintenance Office will be provided by the School District

1.9 SYSTEM DESCRIPTION

- A. Description – This specification for a Building Automation System (BAS) as detailed herein shall be strictly enforced. Provide a Building Automation System (BAS) incorporating BACnet Testing Laboratories (BTL) certified BACnet devices communicating over a BACnet IP network at the field (building) level and at the network level. All controllers will connect to the owner's Local and/or Wide Area Network, as designated by the owner, and shall communicate seamlessly with the owners Niagara 4 Server. The BAS shall consist of Direct Digital Control (DDC) controllers, Building Controllers (BC), network management tools, programming tools, web browser based Graphical User Interface, sensors, relays, valves, actuators, and other equipment as may be necessary to provide for a complete and operational control system for the HVAC and other building related systems as described within these specifications.
  - 1. The system installed shall seamlessly connect devices other than HVAC throughout the building regardless of subsystem type, i.e., HVAC, lighting, and power systems devices should easily coexist on the same network channel without the need for gateways. BACnet components not supplied by the primary manufacturer of the BAS shall be integrated to share common software for network communications, time scheduling, alarm handling, and history logging.
  - 2. The documentation contained in this section and other contract documents pertaining to HVAC Controls is schematic in nature. The Contractor shall provide hardware and software necessary to implement the functions shown or as implied in the contract documents.
  - 3. System configuration and monitoring shall be performed via a PC-type computer. Under no circumstances shall the PC be used as a control device for the network. It can be used for storage of data.
  - 4. Provide remote access via WEB Brower and mobile applications for unlimited users without requiring proprietary software fees, seat licensing or restricted/annual licensing.

1.10 SUBMITTALS

- A. Submit in accordance with provisions of Section 230010.
- B. Shop Drawings:
  - 1. Indicate trunk cable schematic showing programmable control unit locations, and trunk data conductors.
  - 2. List of connected data points, including connected control unit and input device.
  - 3. System graphics indicating monitored systems, data (connected and calculated) point addresses, and operator notations.

4. System configuration with peripheral devices, batteries, power supplies, diagrams, modems, and interconnections.
  5. Descriptive data and sequence of operation of operating, user, and application software.
  6. Minimum requirements for Owner supplied hardware.
- C. Product Data: Provide data for each system component and software module including catalog sheets, specifications, wiring, damper and valve schedule, flow diagram of system.

#### 1.11 PROTECTION OF SOFTWARE RIGHTS

- A. Prior to delivery of software, the Owner and the party providing the software will enter into a software license agreement with provisions for the following:
1. Limiting use of software to equipment provided under these specifications.
  2. Limiting copying.
  3. Preserving confidentiality.
  4. Prohibiting transfer to a third party.

#### 1.12 WARRANTY

- A. Provide all services, materials, and equipment necessary for the successful operation of the entire BAS System for a period of 2 year after final acceptance by the Owner.
- B. The adjustment, required testing, and repair of the system includes all computer equipment and all sensors and control devices.
- C. The on-line support services shall allow the local BAS subcontractor to dial out over telephone lines to monitor and control the facility's building automation system. This remote connection to the facility shall be within 2 hours of the time that the problem is reported. This coverage shall be extended to include normal business hours, after business hours, weekends, and holidays.
- D. If the problem cannot be resolved on-line by the local office, the national office of the building automation system manufacturer shall have the same capabilities for remote connection to the facility. If the problem cannot be resolved with on-line support services, the BAS manufacturer shall dispatch the appropriate personnel to the job site to resolve the problem within 4 hours of the time that the problem is reported.

### PART 2 - PRODUCTS

#### 2.1 GENERAL

- A. The Temperature Control System (TCS) and Facility Management Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers, a computer system, graphical user interface software, printers, network devices, valves, dampers, sensors, and other devices as specified herein.

- B. The installed system shall provide secure password access to all features, functions and data contained in the overall FMCS.
- C. Approved Control Companies:
  - 1. DYNATECH Controls, Inc.
    - a. Contact Mark Myers 717-393-5930, mark@dynatechcontrols.com

## 2.2 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURES

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate BACnet communication protocols in one open interoperable system.
- B. All components and controllers supplied under this Division shall be true “peer-to-peer” communicating devices. Components or controllers requiring “polling” by a host to pass data shall not be acceptable.
- C. The supplied system must incorporate the ability to access all data using standard Web browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.
- D. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer’s internal Intranet network. Systems employing a “flat” single tiered architecture shall not be acceptable.
  - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
  - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

## 2.3 ACCEPTABLE SYSTEM MANUFACTURERS AND CONTRACTORS

- A. Provide a building automation system supplied by a company regularly engaged in the manufacturing and distribution of building automation systems for a minimum of 5 years.
- B. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll-free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- C. BACnet/IP communication protocol must be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, FCUs, etc.)
- D. Any approved manufacturer that can supply both equipment and controls must provide controls pricing separately from equipment pricing.

- E. Acceptable Manufacturers
  - 1. Distech Controls (Basis of Design)
  - 2. All other manufacturers/contactors besides the "Basis of Design" manufacturer (including those listed above) must submit a compliance matrix outlining "C – Comply", "D – Does Not Comply", and "E – Exclude" for the entirety of the 230900 and 230993 sections prior to bid award.
- F. Being listed as an approved manufacturer/contractor does not preclude the bidder from meeting all aspects and requirements of this specification.
  - 1. Those bidders not prequalified prior to review of bids will not be considered responsive. To be prequalified a bidder must be accepted to bid the project by the engineer either by a bid addendum or documented RFI response from the engineer. No other prequalifications shall be acceptable.

## 2.4 QUALITY ASSURANCE

- A. All new building automation system products on this project shall be provided by a firm that is a registered ISO 9001:201508 manufacturer, for a minimum duration of 5 years, at time of bid.

## 2.5 COMPUTER HARDWARE

- A. Provide the following computer hardware for this project:
  - 1. Computers will be provided by the Owner.
  - 2. Uninterruptible Power Supplies.
    - a. Provide the OWS, Server, and each network/building controller with individual UPS to provide clean, reliable, noise-filtered power at all times and to protect and maintain systems operation throughout short-term power interruptions of up to 15 minutes duration. Acceptable Manufacturer is APC.

## 2.6 REMOTE ACCESS AND CYBER SECURITY BEST PRACTICES

- A. Remote Access
  - 1. The BAS contractor shall comply with owner IT infrastructure security policies for remote access. The owner IT team shall provide VPN, firewalls, etc. as needed for secure remote access.
  - 2. A VPN and firewall must be used for secure remote access.
  - 3. Cyber Security Best Practices
- B. Unless predetermined by the owner IT team the BAS network shall be separate from the owners IT infrastructure besides a single point connection for remote access (owner provided internet access). All ethernet switches and communication backbone required for a fully operational BAS shall be provided by the BAS contractor.
  - 1. Refer to "Communication Backbone" section of this specification for further details on segmenting the network (VLANs, subnets) and when managed switches (with port security, network user interface, etc.) are required based on building size / type.
  - 2. Do not use factory provided usernames and passwords. Update passwords and usernames regularly for strong system security.

3. Update software and firmware regularly.
4. Adhere to controls manufacturer hardening guidelines where applicable.

## 2.7 OPERATOR SOFTWARE

### A. Real-Time Displays

1. Provide a visual graphical representation of buildings, floor layouts, each piece of mechanical equipment and/or mechanical system that duplicates the represented system, presented as a web page via any industry standard web browser, where applicable.
2. Graphics shall include at a minimum the value of each input, each output, each setpoint, alarms and graphical representation of trend logs.
3. On-Line Help: Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system.

### B. Security:

1. Each operator shall be required to log on to that system with a username and password in order to view, edit, add, or delete data.
2. System security shall be selectable for each operator.
3. The system administrator shall have the ability to set passwords and security levels for all other operators.
4. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
5. Each operator shall automatically be logged off the system if no keyboard or mouse activity is detected.
6. This auto log-off time shall be set per operator password.
7. All system security data shall be stored in an encrypted format.
8. System Diagnostics:

### C. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers.

1. The failure of any device shall annunciate to the operator.
2. Third-Party Windows-Based Programs:

### D. The system shall be capable of utilizing third-party Windows-based programs for such things as spreadsheet analysis, graphing, charting, custom report generation, and graphics design packages.

1. Graphics generation shall be done using standard Windows packages.
2. No proprietary graphics generation software shall be needed.
3. Overrides:

### E. It shall be possible for the operator to override automatic analog and digital output commands.

1. Where the BAS software normally originates these outputs, the provision shall exist for the operator to terminate automatic BAS control of any particular output and to originate a manual analog or digital output command.
2. The provision shall exist for the operator to return analog or digital output command functions to automatic BAS software control.

3. Password Protection: Provide security system that prevents unauthorized use unless operator is logged on.
- F. Trend Data:
1. System shall periodically gather historically recorded selected samples of object data stored in the field equipment (global controllers, field controllers) and archive the information on the operator's workstation (server) hard disk.
    - a. Archived files shall be appended with new sample data, allowing samples to be accumulated over 3 years.
    - b. Systems that write over archived data shall not be allowed unless limited file size is specified.
    - c. Samples may be viewed at the operator's terminal in a trend log.
    - d. Logged data shall be stored in spreadsheet format.
    - e. Operator shall be able to scroll through all trend log data.
    - f. Software shall be included that is capable of graphing the trend logged object data. Software shall be capable of creating two-axis (x,y) graphs that display up to six object types at the same time in different colors and these Graphs shall show object type value relative to time.
  2. Operator shall be able to change trend log setup information such as time intervals and objects logged
  3. Graphics:
- G. The operator's workstation shall display all data associated with the project.
- a. Operator's workstation shall display all data using 3-D graphic representations of all mechanical equipment.
  - b. System shall be capable of displaying graphic file, text, and dynamic object data together on each display.
  2. Information shall be labelled with descriptors and shall be shown with the appropriate engineering units.
    - a. All information on any display shall be dynamically updated without any action by the user.
    - b. Terminal shall allow user to change all field-resident BAS functions associated with the project, such as setpoints, weekly schedules, exception schedules, etc. from any screen no matter if that screen shows all text or a complete graphic display.
    - c. Animated graphic objects shall be displayed as a sequence of multiple bitmaps to simulate motion.
  3. Analog objects may also be assigned to an area of a system graphic, where the color of the defined area would change based on the analog objects value.
    - a. For example, an area of a floor-plan graphic served by a single control zone would change colour with respect to the temperature of the zone or its deviation from setpoint.
    - b. Separate Displays shall be supplied, specific to the project, to form the following overall presentation style.
  4. All Displays will be linked in a logical fashion using hyperlink style (single left mouse click on text/display object/dynamic to load linked display if programmed)
  5. Entire system shall operate without dependency on the operator's terminal. Provide graphic generation software at each workstation.
  6. Alarms:

- H. Operator's terminal shall provide audible, visual, electronic, and printed means of alarm indication.
  - 1. Any alarm may be handled based on its individual or assigned class actions.
    - a. Displayed on the Alarm console.
      - 1) The system shall be provided with a dedicated alarm window or console.
      - 2) This window will notify the operator of an alarm condition and allow the operator to view details of the alarm and acknowledge the alarm.
      - 3) Alarm reports shall be viewable via the BAS system and available for delivery by electronic mail (e-mail) or printing.
  - 2. System shall provide log of alarm messages. Alarm log shall be archived to the hard disk of the system operator's terminal.
    - a. Each entry shall include a description of the event-initiating object generating the alarm, time and date of alarm occurrence, time, and date of object state return to normal, and time and date of alarm acknowledgement.
- I. Scheduling:
  - 1. Operator's terminal display of weekly schedules shall show all information in easy-to-read 7-day (weekly) format for each schedule.
  - 2. Exception schedules (non-normal schedules, such as holidays or special events) shall display all dates that are an exception to the weekly schedules.
  - 3. At the operator's terminal, the system user shall be able to change all information for a given weekly or exception schedule if logged on with the appropriate security access.
  - 4. Archiving:
- J. Store back-up copies of all controller databases in at least one OWS and the server.
  - 1. Provide continuous supervision of integrity of all controller databases.
  - 2. Data base back up and downloading to occur over LAN without operator intervention.
  - 3. Operator to be able to manually download entire controller database or parts thereof.
  - 4. Reports:
- K. Provide a report facility to generate and format for display, printing, or permanent storage, as selected by the operator, the reports as specified in this section.
  - 1. Provide the software to automatically generate any report specified; the user will be able to specify the type of report, start time and date, interval between reports (hourly, daily, weekly, monthly) and output device.
  - 2. As a minimum, the following reports shall be configured on the system:
    - a. Dynamic Reports: To allow operator to request a display of the dynamic value for the user specified points which shall indicate the status at the time the request was entered and updated at an operator modifiable scan frequency.
    - b. Summary Report: To permit the display or printing of the dynamic values for the user specified points.
    - c. Trend Reports: To permit the trending of points selected by the operator, including as a minimum digital input and output, analog input, and output, set points, and calculated values.
    - d. Historical Data Collection: Provision shall be made to ensure historical data is not lost.

- e. Alarm Summary: Provide a summary of all points in alarm and include as a minimum; point acronym, point description, current value, alarm type, limit exceeded, and time and date of occurrence.
- f. Disable Point Summary: Provide a summary of all points in the disabled state and include as a minimum point acronym and point description.
- g. Run Time Summary: Provide a summary of the accumulated running time of selected pieces of equipment with point acronym and description, run time to date, alarm limit setting. The run time shall continue to accumulate until reset individually by means of suitable operator selection.
- h. Schedule Summary: Provide a summary of all schedules and indicate as a minimum, which days are holidays and, for each section, the day of the week, the schedule times, and associated values; for digital schedules value will be on or off; for analog schedules value will be an analog value.
- i. User Record Summary: Provide a summary of all user records to include as a minimum; username, password, initials, command access level and point groups assigned.

## 2.8 BAS CONTROLLERS

### A. All controllers on the job shall have the following minimum requirements:

1. IP Communication (BACnet/IP)
  - a. BACnet/IP communication protocol shall be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, HP's, FCUs, etc.)
  - b. Support for IPv4 addressing
  - c. DHCP support and Auto DNS
  - d. Baud rate of not less than 100 Mbps
  - e. 2 - RJ45 ports each capable of supporting 10/100 Base-T.
    - 1) Supporting controller daisy chaining on the Ethernet network via integral switch functionality.
    - 2) Integrated fail-safe should allow for communication when the controller is powered down.
    - 3) All controllers shall be able to communicate peer-to-peer without the need for a Network Control Unit (such as JACE, NAE, etc.) and shall be capable of assuming all responsibilities typically assumed by a Network Control Unit.
  - f. Any controller on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.
    - 1) The resulting network will be a 'Flat' topology with all devices (controllers, workstations, ...) connecting at the same physical network level
2. Memory and Processing
  - a. 512KB of RAM and 4GB of non-volatile flash memory.
  - b. 32-bit microprocessor operating at a minimum of 600 MHz
  - c. Each individual controller shall have an embedded web based HTML5 visual interface with the following functionality without reliance on any other controller for access:
3. Typical and custom control processes
  - a. Scheduling

- b. Energy management applications
- c. Alarm management applications
- d. Historical/trend data for points specified
- e. Maintenance support applications
- f. Graphical interface
- g. Shall be capable of monitoring/controlling the following types of inputs/outputs:
- 4. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
  - a. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
  - b. Digital outputs including Form C relay outputs and Triac outputs
  - c. Analog outputs of 4-20 mA and 0-10 Vdc.
  - d. A minimum of 10% spare capacity for each point type for future point connection.
  - e. Any software required for programming shall be unlicensed and openly available
- 5. Auto commissioning features shall be available for VAVs, HPs and FCUs to schedule automatic testing and record values (air flows, pressures, temperatures, etc.) for different operating modes. The auto commissioning feature shall be able to email reports and run commissioning on a specified schedule.
- 6. Power and Environmental Requirements:
  - a. 24-VAC with local transformer power
  - b. The controllers shall also function normally under ambient conditions of -40 °F [-40 °C] to 158 °F [-70 °C] and 0% to 90% RH (non-condensing).
  - c. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
  - d. Code Compliance:
- 7. "FIPS 140-2 Level 1 Compliant" cryptographic module
  - a. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
  - b. UL916 Energy management equipment
  - c. FCC Rules part 15, subpart B, class B
  - d. UL94-V0 flammability rating

## 2.9 CONTROL PANELS

- A. Indoor control cabinets located in offices or dry/dust free environments shall be fully enclosed NEMA 1 Type construction with hinged door, and removable sub-panels or electrical sub-assemblies.
- B. All outdoor control cabinets and control cabinets located in mechanical/electrical rooms shall be NEMA 4.
- C. Control panels containing more than 4 controllers shall be provided with a terminal strip for field wiring. All control wiring inside the panel shall be between a terminal strip and controller inputs/outputs. All field control wiring shall be terminated at the terminal strip. Field control wiring inputs/outputs shall never be run directly to inputs/outputs of controller.

## 2.10 Auxiliary Control Devices, Sensors, and Transmitters

- A. All devices to be supplied and installed by the ATC Contractor.

B. Damper Actuators:

1. Features:
  - a. Electronic Damper Actuators: Actuators shall be sized for torque required for sealing the damper at load conditions, shall utilize v-bolt dual nut clamp with v-shaped tooth cradle coupling, and shall be capable of being mechanically or electrically paralleled to increase torque if required. Electronic overload protection or digital rotation-sensing circuitry shall be used to prevent any damage to the actuator during a stall condition (and shall not require the use of end switches for protection). Fail-safe operation shall be provided as mechanical spring return (or electrical if spring return is not available for actuator size).
  - b. Terminal Unit Actuators: Actuators shall be sized for torque required for sealing the damper at load conditions and shall utilize V-bolt dual nut clamp with a V-shaped toothed cradle or an ISO-style direct-coupled mounting pad coupling. Close of differential pressure rating of 200psi.
  - c. Operating Temperature: -22° F to 122° F (-30° C to 50° C)
2. Protection / Rating: Minimum requirement NEMA type 2 / IP54 mounted in any orientation, NEMA 4X for outdoor applications, and UL94-5V(B) flammability for terminal unit actuators
3. Input/Output:
  - a. Two Position: Digital output including Form C relay output
  - b. Modulating: 4-20 mA and 0-10 Vdc.
  - c. End Switches / Auxiliary Switches (if applicable): SPDT, digital inputs from dry contact closure
  - d. Power:
4. Match existing power.
  - a. Electronic Damper Actuators: Two position spring return shall be 24 or 120VAC as required by manufacturer and proportional actuators shall be 10VA at 24VAC or 8W at 24VDC
  - b. Terminal Unit Actuators: maximum of 1 VA at 24VAC or 1 W at 24VDC
  - c. Agency Approvals:
5. Electronic Damper Actuators: ISO 9001, UL, UL(C) and CSA C22.2 No. 24-93.
  - a. Terminal Unit Actuators: CE, UL 60730-1A/-2-14, CAN/CSA E60730-1, CSA C22.2 No. 24-93, CE according to 89/336/EEC.
  - b. Approved Manufacturers / Models:
6. Distech Controls
  - a. Belimo

C. Air Flow Measuring Station:

1. Install new airflow measuring stations on the supply and exhaust side of all Energy Recovery Units.
2. Features:
  - a. Duct Air Flow Measuring Station: Highly accurate thermal dispersion airflow and temperature measuring probe(s) designed for duct sizes 8 – 120". Multiple velocity and temperature points on one or more probes installed in the duct or plenum are averaged to arrive at air measurements. Capable of displaying the flow and temperature at each sensing point. Moisture resistant flex sensors protected from the elements with a thin conformal coating. Includes airfoil-Shaped aluminum

- probes with LCD screen digital display controller and the correct number of ancillary probes based on the size of the duct.
- b. Fan Inlet Air Flow Measuring Station: Shall be capable of monitoring and reporting the airflow and temperature at each fan inlet location scheduled through two or four sensing circuits and a control transmitter that communicates with the building automation system (BAS). Includes aerodynamically shaped, surface mount fan inlet sensors and LCD screen control transmitter.
  - c. Operating Temperature: -20° F to 120° F (-29° C to 49° C)
  3. Protection / Rating: U.L. 94 flame rated, high impact ABS
  4. Input/Output:
    - a. Velocity Output: 4-20mA or 2-10 VDC with 500-ohm resistor
    - b. Temperature Output : 4-20mA or 2-10 VDC with 500-ohm resistor
    - c. BACnet MS/TP (for duct air flow measurement stations)
    - d. Power: 24-VAC (± 15%); 15 VA
  5. Accuracy: ±3% of reading with ±0.25% repeatability and ±0.10° F (0.06° C)
  6. Range: 0-5000 FPM for ducts and 0-10,000 FPM for fan-inlet
  7. Agency Approvals: All components are U.L. Listed and compliant with RoHS directive 2002/95/EC, AMCA, and ISO 9001. In addition, duct airflow measuring stations are compliant with Part 15 of the FCC rules and BTL.
  8. Approved Manufacturer / Model: Ebtron
  9. Water Pressure Sensor:
- D. Features: Provide water pressure sensors as indicated within the sequences of operations and/or controls diagrams with operating range suitable for application. Select range such that it covers from zero pressure to twice the amount of pressure desired for control purposes or that could be encountered. Sensor shall include over pressure input protection of a minimum two times rated input, burst pressure of a minimum five times rated input, and 17-4PH stainless steel wetted parts
1. Operating Temperature: -40° F to 185° F (-40° C to 85° C)
  2. Protection / Rating: 17-4 PH Stainless Steel or NEMA 4X if enclosure provided
  3. Input/Output: 4-20 mA output proportional to water pressure
  4. Power: 3-wire circuit for power and output (COM, OUT, EXC) with EXC being 15-30 VDC (18-30 VAC)
  5. Accuracy: ± 1% of full scale
  6. Range: selectable pressure range 1 – 10,000 psi
  7. Agency Approvals: CE & RoHS Compliant
  8. Approved Manufacturer / Model:
    - a. Setra (Model 2091)
    - b. Distech Controls (PS-2LSP Series)
- E. Water Differential Pressure Sensor:
1. Features: Provide water differential or gage pressure sensors as indicated within the sequences of operations and/or controls diagrams suitable for application. Select range such that it covers from zero differential pressure up to a differential static pressure of 20% to 50% in excess of the maximum static pressure that could be encountered. Remember that if the sensor is used for the control of a chilled water bypass and is located across, for example, a chilled water AHU coil, the pressure drop of both the coil and the associated valve at full design flow have to be taken into account. Sensor shall include

over pressure input protection of a minimum two times rated input, burst pressure of a minimum five times rated input, and 17-4PH stainless steel wetted parts.

2. Operating Temperature: -4° F to 185° F (-20° C to 85° C)
3. Protection / Rating: NEMA 4 or NEMA4X if enclosure provided
4. Input/Output: 4-20 mA output proportional to pressure sensed
5. Power: 3-wire circuit for power and output (COM, OUT, EXC) with EXC being 15-30 VDC (18-30 VAC)
6. Accuracy:  $\pm 1\%$  of full scale
7. Range: selectable pressure range 1 – 500 psi
8. Agency Approvals: CE & RoHS Compliant
9. Approved Manufacturer / Model:
  - a. Setra (Model 231)
  - b. Distech Controls (PS-2LDP Series)

F. Air Pressure Sensor – Duct / Space / Air Differential (Filter/Coil Monitoring):

1. Features: Provide air pressure sensors as indicated within the sequences of operations and/or controls diagrams suitable for application. Select range as detailed below based on application type. Sensor shall include over pressure input protection of a minimum two times rated input or 20 psi (whichever is greater).
  - a. Duct Mounted Static Pressure Sensor: Select range such that it covers from zero duct static pressure relative to the exterior of the duct up to a static pressure of between 20% and 50% in excess of the maximum static pressure that could be encountered in the duct relative to the duct exterior. Typically, for low pressure commercial duct consider using a range of 0 to 2" wc. (0 to 500Pa), for medium pressure duct use a range of 0 to 6" wc. (0 to 1500Pa) and for high-pressure duct use a range of 0 to 10" wc (0 to 2500 Pa).
  - b. Space Static Pressure Sensor: Input range of -0.2" to + 0.2" wc (-50 to +50 Pa).
  - c. Air Differential Pressure Sensor: Select range as required, taking into consideration pressure drop across filter or coil. Typically, 0-2" wc (0 to 500 Pa) range for low-pressure commercial duct.
  - d. Operating Temperature: 32° F to 140° F (0° C to 60° C)
2. Protection / Rating: Polycarbonate (UL 94 V-0 Approved)
3. Input/Output: 4-20 mA, 0-5V, or 0-10V output proportional to pressure sensed
4. Power: 24VAC or 24VDC
5. Accuracy:  $\pm 1\%$  of full scale
6. Range: selectable pressure range 0- 20" w.c.
7. Agency Approvals: UL listed
8. Approved Manufacturer / Model:
  - a. Setra
  - b. Distech Controls

G. Air Pressure Switch:

1. Features: Provide air pressure switches as indicated within the sequences of operations and/or controls diagrams suitable for application. Select range as required, taking into consideration pressure drop across filter or coil. Typically, 0.2-2" wc (0 to 500pa) range for low-pressure commercial duct. Sensor shall include over pressure input protection of a minimum two times rated input or 20 psi (whichever is greater).
2. Operating Temperature: -4° F to 140° F (-20° C to 60° C)

3. Protection / Rating: IP54 (NEMA 13) polycarbonate
  4. Input/Output: SPDT switch digital input from dry contact closure
  5. Power: N/A
  6. Accuracy:  $\pm 1\%$  of full scale
  7. Range: selectable pressure range 0- 12" w.c.
  8. Agency Approvals: N/A
  9. Approved Manufacturer / Model:
    - a. Setra
    - b. Distech Controls
- H. Carbon Dioxide (CO<sub>2</sub>) Sensor:
1. Features: Provide a space or duct carbon dioxide gas detection sensor as indicated within the sequences of operations and/or control diagrams. Optional features include BACnet communication, LCD display, setpoint adjustment, or integral temperature/humidity sensors (optional features shall be provided, if necessary, based on project scope).
  2. Operating Temperature: 32° F to 122° F (0° C to 50° C)
  3. Input/Output: 4-20 mA, 0-10 or 0-5 Vdc output compatible with BMS proportional to carbon dioxide concentration
  4. Power: 24VAC or 24VDC
  5. Accuracy:  $\pm 3\%$  of full scale
  6. Range: 0 to 2000 ppm
  7. Duct / Immersion / Outdoor Temperature Sensors:
- I. Features: Provide Thermistor or RTD temperature sensors as indicated within the sequences of operations and/or control diagrams. Install sensor as detailed below.
- a. Outside Air Temperature Sensor: Provide outside air temperature sensors with Aluminum LB with PVC sun and windscreen weatherproof enclosure with conduit entrance. Install in an area where exhaust or roof heat will not affect readings.
  - b. Duct Mounted Temperature Sensor (ducts less than 10ft<sup>2</sup> [1m<sup>2</sup>] in cross-sectional area): Provide duct mounted, single point probe temperature sensor with 0.25" [6.35 mm] stainless steel probe of length between one-third and two-thirds of the duct width.
  - c. Duct Mounted Averaging Temperature Sensor (ducts greater than 10ft<sup>2</sup> [1m<sup>2</sup>] in cross-sectional area): Provide duct mounted, averaging, temperature sensor with probe length of 12 feet [3.66m] minimum or 1ft per ft<sup>2</sup> (3.25m per m<sup>2</sup>) of duct cross-sectional area, whichever is greater. Copper sheathed or plenum rated flexible construction.
  - d. Liquid Temperature Sensor: Provide immersion thermowell mounted temperature sensors for liquid temperature sensing. Rigid 0.25" [6.35mm] stainless steel probe of length, which is, at minimum, 20% of the pipe width. Provide Brass or Stainless steel thermowell (316 or 304) with thermal grease to aid temperature sensing.
  - e. Strap-on Temperature Sensor: Provide strap-on mounted temperature sensors where thermo well mounted sensors cannot be mounted.
  - f. Operating Temperature: -58° F to 212° F (-50° C to 100° C) dependent upon application
2. Input/Output: thermistor or RTD compatible with BAS
  3. Power: dependent upon sensor type – provide as per manufacturers recommendations
  4. Accuracy:  $\pm 1.0^{\circ}\text{F}$  (0.5 °C)

5. Range: -58° F to 212° F (-50° C to 100° C) dependent upon application
  6. Duct / Outdoor Humidity Sensors:
- J. Features: Provide duct / outdoor humidity sensors as indicated within the sequences of operations and/or control diagrams. Outside air humidity sensors shall have ABS hinged weatherproof housing with conduit entrance and shall be installed in an area where exhaust or roof heat will not affect readings. Duct humidity sensors shall have ABS housing with conduit entrance. In addition, all humidity sensors shall have 9" probe length, 60-micron HDPE filter, reverse voltage protection, and be output limited.
1. Operating Temperature: 32° F to 122° F (0° C to 50° C)
  2. Input/Output: 4-20 mA two wires, 0-10 Vdc and/or 0-5 Vdc output proportional to relative humidity range of 0% to 100%
  3. Power: 24VAC or 24VDC
  4. Accuracy: ± 3% of full scale
  5. Range: 5-95%RH
  6. Space Temperature Sensors:
- K. Features: Provide space temperature sensors as indicated within the sequences of operations and/or control diagrams. Shall consist of an element within a ventilated cover. Space sensors located in mechanical rooms and large public spaces shall contain a network jack but shall have no ability to adjust temperature setpoint (Set Point Adjustment). Space sensors located in other spaces shall include options (setpoint adjustment, network jack, fan speed selection, override switch, and/or digital display) in accordance with the drawings and sequences of operations.
1. Operating Temperature: 32° F to 122° F (0° C to 50° C)
  2. Input/Output: dependent upon sensor type, provide as per manufacturers recommendations
  3. Power: dependent upon sensor type – provide as per manufacturers recommendations
  4. Accuracy: ± 1.0°F (0.5 °C)
  5. Range: 32° F to 122° F (0° C to 50° C)
  6. Space Humidity Sensors:
- L. Features: Provide space humidity sensors as indicated within the sequences of operations and/or control diagrams. Sensor shall have reverse voltage protection and be output limited.
1. Operating Temperature: 32° F to 122° F (0° C to 50° C)
  2. Input/Output: dependent upon sensor type – provide as per manufacturers recommendations
  3. Power: dependent upon sensor type – provide as per manufacturers recommendations
  4. Accuracy: ± 3% of full scale
  5. Range: 5-95%RH
  6. Combination Relative Humidity and Temperature Sensors: Where there is a requirement for the monitoring of both relative humidity and temperature at the same location, the BMS Contractor shall provide a combination relative humidity sensor and temperature sensor. The individual sensors must each meet the specifications details above.
- M. Low Limit Thermostats:
1. Features: Provide low limit thermostats as indicated within the sequences of operations and/or control diagrams. Safety low limit thermostats shall be vapor pressure type with

an element 20' [6.1 m] minimum length. Element shall respond to the lowest temperature sensed by any 1' section. Low limit shall be manual reset only.

2. Operating Temperature: -60° F to 160° F (-51° C to 71° C)
3. Input/Output: 2 SPDT switches, digital inputs from dry contact closure
4. Power: N/A
5. Accuracy:  $\pm 1.0^{\circ}\text{F}$  ( $0.5^{\circ}\text{C}$ )
6. Range: adjustable range 34° F to 70° F ( $1^{\circ}\text{C}$  to  $21^{\circ}\text{C}$ )
7. Current Relay/Switch:

- N. Features: Provide current sensing relays as indicated within the sequences of operations and/or control diagrams. The current sensing relay shall be rated for the applicable load shall have input and output isolation via current transformer, and the output relay shall have an accessible trip adjustment over its complete operating range. Whenever the status of a single speed motor is monitored it shall be done via a current sensing relay. The BAS contractor shall provide current sensing relays at the MCC starters (or at the local starter for motors without a MCC starter).

1. Operating Temperature: 5° F to 140° F ( $-15^{\circ}\text{C}$  to  $60^{\circ}\text{C}$ )
2. Input/Output: digital input from dry contact closure
3. Power: Current relay shall be self-powered with no insertion loss
4. Accuracy:  $\pm 2\%$  of full scale
5. Current Sensor:

- O. Features: Provide current sensors as indicated within the sequences of operations and/or control diagrams. The current sensors shall be rated for the applicable load and shall be reverse polarity protected and output limited.

1. Operating Temperature: -20° F to 120° F ( $-29^{\circ}\text{C}$  to  $49^{\circ}\text{C}$ )
2. Input/Output: 4-20 mA, 0-10 or 0-5 Vdc output proportional to current draw
3. Power: Current sensor shall be self-powered with no insertion loss
4. Accuracy:  $\pm 1\%$  of full scale
5. Damper End Switch:

- P. Features: Provide damper end switches as indicated within the sequences of operations and/or control diagrams. End switches shall prove a damper has reached the position specified. End switches shall be integral to damper actuator unless otherwise specified.

1. Input/Output: SPDT switch, digital input from dry contact closure

## 2.11 COMMUNICATION BACKBONE

- A. To allow for future expandability, cyber security measures, optimal bandwidth, and enhanced data trending this project shall adhere to the below communication backbone requirements.

- B. Fiber Optic Network:

1. Required for all project exceeding 5 levels (including rooftops/cellars), 100m between ethernet connections, 250 controllers, or more than 1 type of operational technology residing on the same network (CCTV, lighting, access, etc.).
2. Network edge switches provided for each floor with provisions for expansion capability.
3. Fiber optic cable shall be run between network switches.
4. 1 Centralized Network Controller with Aggregation Switch shall be provided for the building:

- a. Must be a managed fiber / ethernet network with the following network features:
  - 1) Packet switching and loop detection
  - 2) Port security with MAC address lockdown and the ability to close all open ports including port connected to a daisy-chain of IP devices.
  - 3) Segregation / isolation with VLAN configuration capabilities. The system shall allow system-wide auto-creation of a VLAN simply by specifying one or more ports to be on that VLAN, and automatically ensure that traffic passes between the selected ports. There must not be any restriction on port location.
  - 4) Web browser based graphical user interface for information logging (network overloads, bandwidth consumption, port status, connection status, and trending)
  - 5) Support both Ethernet and Power over Ethernet (PoE)
  - 6) Support fiber optic backbone(s) with Single-strand, Single-mode Optical Fiber OS1/OS2 9/125  $\mu\text{m}$ , up to 12.5 miles [20.1 km] reach
  - 7) BACnet protocol specific network traffic support and support for all other communication protocols
  - 8) Expansion capability of up to 256 Edge Switches
- 5. Edge Switches:
  - a. Shall provide 1 per floor
  - b. Must be compatible with Centralized Network Controller with Aggregation Switch and support the managed network features described above
  - c. Support both Ethernet, Power over Ethernet (PoE), and Spanning Tree Protocol
  - d. Support all communication protocols
  - e. Minimum of 8 RJ45 ethernet ports (all controllers on floor must be connected to Edge switch directly or via daisy-chain IP topology)
  - f. Security Provisions: Individual VLAN provided per every 2 levels
- C. IP (CAT 5 / RJ45) Network
  - 1. BACnet/IP communication protocol shall be used for all BAS manufacturer provided controllers (including terminal devices such as VAVs, HPs, FCUs, etc.)
  - 2. For all buildings NOT exceeding 5 levels (including rooftops/cellars), 100m between ethernet connections, 250 controllers, or more than 1 type of operational technology residing on the same network (CCTV, lighting, access, etc.):
    - a. Ethernet Switches shall be provided as needed to support a fully functional BAS – fiber network shall not be required.
    - b. BACnet/IP communication for all BAS manufacturer provided controllers
    - c. Modbus TCP shall only be used for third party systems / equipment that do not support BACnet/IP
    - d. Modbus RTU and BACnet MS/TP only to be used for third party systems / equipment that do not support BACnet/IP provisions (VFDs, boilers, etc.)
- D. Modbus RTU and BACnet MS/TP (RS-485) Network: Only to be used for systems / equipment that do not have IP provisions (VFDs, boilers, etc.)

## 2.12 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.

- B. Mount sensors rigidly and adequately for operating environment.
- C. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1' [9 m] of sensing element for each 1 ft<sup>2</sup> [1 m<sup>2</sup>] of coil area.
- D. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- E. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- F. Install building pressure pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
- G. High and low limit thermostats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.

#### 2.13 COORDINATION

- A. All work shall be performed at times acceptable to the Engineer/Construction Manager. Provide work schedule at the start of the job for the approval of the Engineer / Construction Manager. Schedule shall show when all staff and sub-contractors shall be on-site.

#### 2.14 ELECTRICAL WORK, WIRING AND SAFETY

- A. Electrical work shall be in accordance ANSI/NFPA 70 and the local Electrical Code.
- B. Based on project location, Regional Regulation Compliance Certifications (CSA C22.1) will be required.
- C. Electrical wiring, terminal blocks and other high voltage contacts shall be fully enclosed or properly guarded and marked to prevent accidental injury to personnel.
- D. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 260000, and manufacturer's recommendations. Where the requirements of this Section differ from other Divisions, this Section shall take precedence.
  - 1. EMT conduit shall be used in mechanical/electrical rooms and exposed spaces.
  - 2. Rigid Galvanized Steel conduit shall be used outdoors.
  - 3. Plenum rated cable shall be used in concealed spaces/hung ceilings.
  - 4. All wiring associated with and required by the BAS shall be the responsibility of this contractor.
- E. The term "wiring" shall be construed to include furnishing of wire, conduit, and miscellaneous material and labor as required to install a total working system.

1. If departures from the contract documents are deemed necessary by the contractor, details of such departures, including changes in related portions of the project and the reasons, therefore, shall be submitted with the drawings to the Engineer for approval.
  2. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- F. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- G. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- H. Each run of communication wiring shall be a continuous length without splices when that length is commercially available.
- I. Label communication wiring to indicate origination and destination.
- J. Fiber optic cable shall comply with the following requirements:
1. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125  $\mu\text{m}$ .
  2. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

#### 2.15 SUBMITTALS

- A. Schematic diagram of each controlled system. Label control points with point names.
- B. Bill of Material for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
- C. Specification sheets for each item including manufacturers descriptive literature, drawings, diagrams, performance and characteristic curves, manufacturer and model number, size, layout, dimensions, capacity, etc.
- D. Control schematics with narrative description and control descriptive logic fully showing and describing operation and/or manual procedures available to operating personnel to achieve proper operation of the building, including under complete failure of the BAS.
- E. Shop drawings for each input/output point showing all information associated with each particular point including sensing element type and location; details of associated field wiring schematics and schedules; point address; software and programming details associated with each point; and manufacturer's recommended installation instructions and procedures for each type of sensor and/or transmitter.
- F. Riser diagrams showing control network layout, communication protocol, and wire types.

- G. Network diagram of control, communication, and power wiring for BAS Server and OWS installation.

#### 2.16 AS-BUILT DOCUMENTATION

- A. As-built documentation shall consist of 4 hard copies and one soft copy for all information described below
- B. The final documentation package shall include:
  - 1. As-built Submittals: Final as built control submittals and technical data sheets.
  - 2. Programming, Sequences, and Graphics: All programming, sequences, and graphics saved to an external hard drive.
  - 3. Operation and Maintenance Manuals: Factory operating and maintenance manuals with any customization required.
  - 4. Test Procedures and Reports: The test implementation shall be recorded with a description of the test exercise script of events and documented as test procedures.

#### 2.17 WARRANTY

- A. The BAS system labor and materials shall be warranted free from defects for a period of 2 Years after final commissioning and owner acceptance.

#### 2.18 TRAINING

- A. BAS Contractor shall provide a minimum of 40 hours of training with course outline and materials for personnel designated by the owner.
- B. If desired manufacturer provided training on the use and operation of all products provided within these specifications shall be available for purchase and attendance by the Owner or his designated agent. A list of training courses with detailed course outline and duration with the associated cost shall be provided as part of the BAS submittals.

#### 2.19 COMMISSIONING

- A. This Contractor shall provide full control system commissioning of the new system.
- B. Provide commissioning data sheets prior to acceptance testing.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install electrical work in accordance with NEC. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.

- C. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- D. Provide service engineer to instruct Owner's representative in operation of system.
- E. Provide basic operator training on data display, alarm, and status descriptions, requesting data, execution of commands, request of logs and graphics design. Include a minimum of 24 hours dedicated instruction time and 10 hours programming time.
- F. All panels shall be installed in an accessible location as approved by the Owner. Panels above the ceiling will not be acceptable.

### 3.2 EXAMINATION

- A. The project plans shall be thoroughly examined for control device and equipment locations. Any discrepancies, conflicts, or omissions shall be reported to the architect/engineer for resolution before rough-in work is started.
- B. The contractor shall inspect the site to verify that equipment may be installed as shown. Any discrepancies, conflicts, or omissions shall be reported to the engineer for resolution before rough-in work is started.
- C. The contractor shall examine the drawings and specifications for other parts of the work. If head room or space conditions appear inadequate—or if any discrepancies occur between the plans and the contractor's work and the plans and the work of others—the contractor shall report these discrepancies to the engineer and shall obtain written instructions for any changes necessary to accommodate the contractor's work with the work of others.

### 3.3 ELECTRICAL WIRING SCOPE

- A. This contractor shall be responsible for power that is not shown on the electrical drawings, to controls furnished by this contractor. If power circuits are shown on the electrical drawings, this contractor shall continue the power run to the control device. If power circuits are not shown, this contractor shall coordinate with the electrical contractor to provide breakers at distribution panels for power to controls. This contractor is then responsible for power from the distribution panel.
  - 1. Coordinate panel locations. If enclosures for panels are shown on the electrical drawings, furnish the enclosures according to the electrician's installation schedule.
- B. This contractor shall not be responsible for power to control panels and control devices that are furnished by others unless it is part of the control interlock wiring.
- C. Refer to Coordination section for what devices this contractor is responsible to mount, and which are turned over to others to mount.
- D. This contractor shall be responsible for wiring of any control device that is furnished as part of this section of specification.

- E. Wiring for controls furnished by others: Provide control wiring for HVAC controls furnished by others. Wiring may include, but not limited to, interlocks, standalone thermostats, safeties, and remote-control devices such as valves, sensors, etc.
- F. Interlock wiring shall be run in separate conduits from BAS associated wiring.
- G. Provide network wiring for equipment that is called to be integrated to the BAS.

### 3.4 ELECTRICAL WIRING AND CONNECTION INSTALLATION

- A. All low voltage control wiring shall be class 2. Control wiring that is not class 2 shall be run in separate conduits from Class 2 wiring. All wiring shall be plenum rated.
- B. Floor level network wiring between terminal units can be combined with thermostat and other low voltage wiring in the same conduit. All other network wiring shall be in dedicated conduits.
- C. Install raceways, boxes, and cabinets according to Division 26 Section "Raceways and Boxes".
- D. Install building wire and cable according to Division 26 Section "Electrical Power Conductors and Cables".
- E. Installation shall meet the following requirements:
  - 1. Conceal cable and conduit, except in mechanical rooms and areas where other conduit and piping are exposed.
  - 2. Install exposed cable in raceway or conduit.
  - 3. Install concealed cable using plenum rated cable.
  - 4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
  - 5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
  - 6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
  - 7. All wiring in lab areas shall be in conduit.
  - 8. All unsupported risers shall be rigid steel conduit. Supported risers shall be EMT.
- F. Rigid conduit shall be steel, hot dip galvanized, threaded with couplings, ¾ inch minimum size, manufactured in accordance with ANSI C-80-1. Electrical metallic tubing (EMT) with compression fittings or intermediate metallic conduit (IMC) may be used as conduit or raceway where permitted by the NEC.
- G. Concealed control conduit and wiring shall be provided in all spaces except in the Mechanical Equipment Rooms and in unfinished spaces. Install in parallel banks with all changes in directions made at 90° angles.
- H. Install conduit adjacent to machine to allow service and maintenance.
- I. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

- J. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.
- K. Ground equipment.

### 3.5 COMMUNICATION WIRING

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling. All wiring shall be plenum rated.
- B. Do not install communication wiring in raceway and enclosures containing Class 1 wiring.
- C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- E. Cable bundling:
  - 1. RS485 cabling run open air in accessible areas can be bundled with other class 2 low voltage cabling.
  - 2. RS485 cabling run between terminal units in conduits above ceilings or under floors or in inaccessible areas can be bundled with other Class 2 low voltage cabling.
  - 3. RS485 cabling run between floors shall be in a communication only conduit.
  - 4. RS485 conduit run long distances between utility rooms or between buildings shall be in a communication only conduit.
  - 5. Ethernet cabling shall be in a communication only conduit.
  - 6. Ethernet and RS485 can be run together.
  - 7. Fiber optics can be run with Ethernet and RS485 cabling as long as the conduit is bent to fiber optic standards and junction boxes are sized for fiber optic use.
- F. FLN Cabling:
  - 1. FLN cabling shall be low capacitance, 20-24-ga, twisted shielded pair.
  - 2. The shields shall be tied together at each device.
  - 3. The shield shall be grounded at one end only and capped at the other end.
- G. Ethernet Cabling:
  - 1. Ethernet shall not be run with any Class 1 or low voltage Class 2 wiring.
  - 2. CAT6, unshielded twisted pair (UTP) cable shall be used for BAS Ethernet.
  - 3. Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room up to 50' away.
  - 4. When the BAS Ethernet connects to an Owner's network switch, document the port number on the BAS As-builts.
- H. When a cable enters or exits a building, a lightning arrestor must be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.

- I. All runs of communication wiring shall be unspliced length when that length is commercially available.
- J. All communication wiring shall be labeled to indicate origination and destination data.
- K. Grounding of coaxial cable shall be in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

### 3.6 IDENTIFICATION

- A. Match the existing wiring and conduit identification methods.

### 3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment, and retest.
  - 3. Calibration test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.
- B. Replace damaged or malfunctioning controls and equipment.
  - 1. Start, test, and adjust control systems.
  - 2. Demonstrate compliance with requirements, including calibration and testing, and control sequences.
  - 3. Adjust, calibrate, and fine tune circuits and equipment to achieve sequence of operation specified.

### 3.8 SYSTEM CHECKOUT AND STARTUP

- A. Inspect each termination in the MER control panels and devices to make sure all wires are connected according to the wiring diagrams and all termination are tight.
- B. After the controls devices and panels are installed and power is available to the controls, perform a static checkout of all the points, including the following:
  - 1. Inspect the setup and reading on each temperature sensor against a thermometer to verify its accuracy.
  - 2. Inspect the setup and reading on each humidity sensor against a hygrometer to verify its accuracy.
  - 3. Inspect the reading on each CO2 sensor using a calibration kit to verify the sensor range accuracy matches the DDC setup.
  - 4. Inspect the reading of each status switch to verify the DDC reads the open and close correctly.
  - 5. Command each relay to open and close to verify its operation.

6. Command each 2-position damper actuator to open and close to verify operation.
  7. Command each 2-position valve to open and close to verify operation.
  8. Ramp each modulating actuator to 0%, 25%, 50%, 75% and 100% to verify its operation.
  9. Ramp each modulating output signal, such as a VFD speed, to verify its operation.
  10. Test each safety device with a real-life simulation, for instance check freezestats with ice water, water detectors with water, etc.
- C. Document that each point was verified and operating correctly. Correct each failed point before proceeding to the dynamic startup.
- D. Verify that each DDC controller communicates on its respective network correctly.
- E. After all the points are verified, and power is available to the mechanical system, coordinate a startup of each system with the mechanical contractor. Include the following tests:
1. Start systems from DDC.
  2. Verify that each setpoint can be met by the system.
  3. Change setpoints and verify system response.
  4. Change sensor readings to verify system response.
  5. Test safety shutdowns.
  6. Verify time delays.
  7. Verify mode changes.
  8. Adjust filter switches and current switches for proper reactions.
  9. Adjust proportional bands and integration times to stabilize control loops.
- F. Perform all program changes and debugging of the system for a fully operational system.
- G. Verify that all graphics at the operator workstations correspond to the systems as installed. Verify that the points on the screens appear and react properly. Verify that all adjustable setpoints and manual commands operate from the operator workstations.
- H. After the sequence of operation is verified, setup the trends that are listed in the sequence of operations for logging and archiving for the commissioning procedure.
- 3.9 SYSTEM COMMISSIONING, DEMONSTRATION AND TURNOVER
- A. The BAS Contractor shall prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system. Prior to acceptance of the BAS by the Owner and Engineer, the BAS contractor shall completely test the BAS using the approved test procedure.
- B. After the BAS contractor has completed the tests and certified the BAS is 100% complete, the Engineer shall be requested, in writing, to approve the satisfactory operation of the system, sub-systems and accessories. The BAS contractor shall submit Maintenance and Operating manuals at this time for approval. An acceptance test in the presence of the Engineer and Owner's representative shall be performed. The Owner will then shake down the system for a fixed period of time (30 days).

- C. The BAS contractor shall fix punch list items within 30 days of acceptance.
- D. When the system performance is deemed satisfactory in whole or in part by these observers, the system parts will be accepted for beneficial use and placed under warranty.

### 3.10 PROJECT RECORD DOCUMENTS

- A. Project Record Documents: Submit three (3) copies of record (as-built) documents upon completion of installation. Submittal shall consist of:
  - 1. Project Record Drawings. As-built versions of the submittal shop drawings provided as AutoCAD compatible files in electronic format and as 11" x 17" prints.
  - 2. Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements in the Control System Demonstration and Acceptance section of this specification.
  - 3. Operation and Maintenance (O & M) Manual.
    - a. Operator's Manual with procedures for operating control systems, logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
    - b. Documentation of all programs created using custom programming language, including setpoints, tuning parameters, and object database.
    - c. Graphic files, programs, and database on electronic media.
    - d. List of recommended spare parts with part numbers and suppliers.
    - e. Licenses, guarantees, and warranty documents for equipment and systems.
- B. Provide updated versions of Operating manuals.

### 3.11 COMMISSIONING

- A. A dedicated commissioning agent shall

## PART 4 - CONTROL SEQUENCES

### 4.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install electrical work in accordance with NEC. Electrical material and installation shall be in accordance with appropriate requirements of Division 26.
- C. Start-up and commission systems. Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.
- D. Provide service engineer to instruct Owners representative in operation of system.
- E. Provide basic operator training on data display, alarm, and status descriptions, requesting data, execution of commands, request of logs and graphics design. Include a minimum of 8 hours dedicated instruction time.

#### 4.2 CONTROL OF HOT WATER PUMPS AND HOT WATER SUPPLY TEMPERATURE

- A. The heating hot water pumps shall be controlled by a panel mounted lead/lag switch and as described elsewhere in this section and the pumps shall be energized through DDC System. The lead/lag sequence shall be as follows: The lead pump shall be energized and run continuously. A system differential pressure switch shall, through a panel mounted time delay relay, energize the lag pump, and initiate a pilot light alarm upon sensing a loss of flow at lead pump. The pilot light will remain lit until the problem has been corrected and then can be reset by pushbutton. The pumps shall automatically alternate weekly through optimal time sequence.

- B. Hot Water Reset Control shall be as follows:

| <u>Outside Air Temperature</u> | <u>Hot Water Supply Temperature</u> |
|--------------------------------|-------------------------------------|
| 0°                             | 180°F                               |
| 70°F and above                 | 140°F                               |

- C. Starter for each pump shall be Hand/Off/Auto Type. When starter is in Auto Position, pump shall be controlled by DDC System.
- D. Provide the following to control variable speed pumping systems:
1. Differential pressure transmitters at the ends of the pipe runs (see Drawings)
  2. Receiver/Controller
  3. All interconnecting wiring and programming.
  4. Interface DDC System with pump system drives.
- E. Speed of pumps shall be varied as required to maintain minimum required pressure at end of system. Points shall be monitored and adjustable thru the computer.
- F. Provide through the DDC System:
1. On/Off Control of each pump
  2. Alarm for each pump
  3. Status of each pump
  4. Percentage speed of each pump
  5. System pressure

#### 4.3 CONTROL OF VARIABLE SPEED HOT AND CHILLED WATER PUMPS

- A. Provide the following to control variable speed pumping system:
1. 2-way modulating ATC valve in pump bypass (sized by pump package manufacturer for min flow) wired to pump control system.
  2. Differential pressure transmitters at the ends of the pipe runs (12 per system)
  3. Receiver/Controller
  4. All interconnecting wiring and programming.
  5. Interface DDC System with pump system drives. DDC System shall control drives.
- B. Speed of pumps shall be varied as required to maintain minimum required pressure at end of system. Points shall be monitored and adjustable thru the computer.

#### 4.4 CONTROL OF BOILERS

- A. Boiler shall be controlled to maintain required supply water temperature. Temperature shall be adjustable thru the computer. ATC Damper for Combustion Air Louver shall be in open position whenever Boiler(s) or Water Heaters are firing.
- B. Provide lead/lag control so that lag boilers are energized in stages upon fall of hot water boiler supply temperature in lead boiler (1) to 150°F (adjustable). Alternate operation of boiler burners will be through DDC system. Energize two (min) boiler/burners below outside temperature of 30°F (adjustable).
- C. Provide gas/oil switchover through the DDC System.
- D. Blend pumps for each boiler shall run continuously when any boiler is enabled.

#### 4.5 CONTROL OF DUCTLESS SPLIT SYSTEM UNITS (AC/CU)

- A. General: The units shall be controlled by wall mounted thermostat provided with the unit. Provide a room temperature sensor connected to the DDC System.

#### 4.6 VAV BOXES – NON-FAN POWERED

- A. Each VAV box shall have a direct digital controller. Multiple VAV boxes controlled by single controller shall not be acceptable. Service technician shall be able to view, change and program all points associated with VAV box from portable service tool plugged into space sensor or at computer.
- B. During the occupied mode, primary air control damper shall modulate to maintain space temperature. On a call for heat, air control damper shall go to minimum heating position.
- C. System operator shall be capable of reading primary air CFM at each VAV box from central operator workstation through air monitoring device.
- D. For dehumidification mode (occupied and unoccupied), on a rise of RH above 60% (adjustable), the VAV box inlet damper shall open and the HW coil shall reheat air to maintain room setpoint.

#### 4.7 PACKAGED ROOFTOP AIR CONDITIONER UNIT (RTAC)

- A. This unit consists of a supply fan and exhaust fan with factory mounted variable speed drives, heat recovery section, direct expansion cooling coil and a hot water coil section.
- B. The ATC contractor shall provide DDC controllers and sensors for the units' control.
- C. The supply fan shall be started from a time schedule in the field installed DDC controller or from any of the intelligent wall unit sensor override pushbutton, located in the space. The Exhaust fan shall only operate if the supply fan is operating.
- D. When indexed to the unoccupied mode, the supply and exhaust fan is off, the outside air and

exhaust air dampers shall be closed. During the unoccupied modes the supply fan shall operate only to maintain the desired night setback temperature 65°F heating and setpoint temperature of 85° F cooling (adj) of all spaces served.

- E. When indexed to the occupied mode by the DDC system, the unit fan shall run continuously and the outdoor air damper shall be positioned to an adjustable minimum position as listed on the unit schedule. With outdoor air temperature below 55°F (adj.), the economizer dampers and Energy Recovery Wheel shall modulate to maintain 55° mixed air temperature. When the outdoor air temperature is above 55°F (adj.), the outdoor air damper shall be positioned to an adjustable minimum position, and the DX cooling will be stages to maintain discharge temperature setpoint. When the outdoor air temperature is below 55°F (adj.), and the unit is in heating mode, gas heat will be enabled to maintain the heating setpoint of 60°F (adj.) discharge air temperature.
- F. Dehumidification Mode: The units shall have modulating hot gas reheat that shall allow for independent control of the DX cooling coil leaving air temperature and the reheat coil leaving air temperatures. See Specification Section 230855 for detailed information
- G. Unit shall have Variable Frequency Drive control.
- H. Supply fan duct static pressure control: a remote duct static pressure sensor located 2/3rds the way down the supply duct, shall modulate the VFD to maintain duct static pressure setpoint.
- I. Exhaust Fan: A remote building static pressure sensor shall modulate the VFD to maintain the required space static pressure setpoint to provide building pressurization control.
- J. Safeties: A low limit thermostat (freezestat) shall de-energize the fan, close the outside air damper and fully open the heating control valve to the coil, if the coil discharge temperature drops below 40°F (adj.).
- K. An air flow switch shall be piped across the filters to provide a dirty filter status indication at the central operator's terminal.
- L. When the unit is indexed to the warm-up mode by the DDC system the supply fan shall start, the outdoor air damper will remain closed and the unit will be in recirculation mode and maintain a discharge temperature at 80°F (adj).
- M. Current switch serving the supply fan shall provide status inputs to the DDC system.
- N. Points List:
  - 1. Discharge Air Temperature (AI)
  - 2. Discharge Air Humidity (AI)
  - 3. Entering OA Temperature (AI)
  - 4. Leaving EA Temperature (AI)
  - 5. Supply Air Static Pressure (AI)
  - 6. Supply Fan VFD Speed (AI)
  - 7. Setpoint Adjustment – Discharge Air Temp (AO)
  - 8. Setpoint Adjustment – Discharge Air Humidity (AO)
  - 9. Hot Water Heating (AO)

10. DX Cooling – 2 Stage (1<sup>st</sup> Stage Modulating, 2<sup>nd</sup> Stage On-Off) (AO)
11. SA Fan VFD Speed (AO)
12. SA Fan Status (BI)
13. SA Fan Start/Stop (BO)
14. Alarms – DAT, Discharge Air Humidity, Smoke Detectors, SA Fan, Compressors, Freezestat
15. Local Building Static Pressure (AI)
16. Dirty Filters (BI)
17. OA Damper Position (AI)
18. CO2 Level
19. Hot Gas Reheat Coil (AO)

#### 4.8 CONTROL OF EXHAUST FANS

- A. Control Type 2: These fans shall be controlled by means of tie-in with wall light switch. Provide time delay so that fan operates for 10 minutes (adjustable) after light switch is turned off.
- B. Control Type 1: These fans shall be tied into DDC time clock for that respective zone. Fan shall be energized only during the occupied cycle.
- C. Control Type 3 & 4: These fans shall be controlled as indicated on drawings.
- D. Control Type 5: These fans shall be controlled by means of wall mounted 2-speed switches.

#### 4.9 CONTROL OF HOT WATER UNIT HEATERS

- A. A single temperature electric space thermostat shall cycle the unit heater fan on and open 2-way electric hot water valve whenever hot water is circulating through the unit heater circuit as sensed by a strap-on aquastat.
- B. The thermostat shall be stand-alone and not connected to DDC System.

#### 4.10 CONTROL OF HOT WATER CONVECTORS, CABINET HEATERS

- A. A single temperature electric thermostat shall modulate the 2-way electric control valve to maintain desired room temperature. For cabinet heaters, fan shall be cycled on a call for heat by thermostat. Provide with thermostat tied to DDC System.
  1. Points:
    - a. Fan Status (on/off), Alarm (BO, BI)
    - b. Supply Leaving Air Temperature (AI)

#### 4.11 DOMESTIC THERMOSTATIC MIXING VALVE

- A. DDC System shall communicate through BACnet protocol with the TMV field controller.
- B. ATC shall map available field points to TMV controller.
- C. Domestic thermostatic mixing valve is enabled based on need and system requirements. ATC

Contractor shall monitor water heater status and alarms. Domestic hot water supply temperature is monitored at the temperature sensor.

D. Points List:

1. Mixed water temperature at valve outlet
2. Valve position (if integrated with BAS)
3. TMV enable / status (if applicable)

E. Alarm:

1. High mixed water temperature (risk of scalding)
2. Valve failure or stuck position
3. Any deviation from setpoint outside allowable deadband

4.12 CONTROL OF DOMESTIC HOT WATER RECIRCULATING PUMP

A. ATC shall map available field points to CP controller.

B. Pumps shall be controlled by a strap-on thermostat to maintain the desired hot water temperature in the return line. Pumps shall be tied into new DDC day-night system and shall be energized during the occupied cycle and de-energized during the unoccupied cycle.

C. Points List:

1. Pump status (ON/OFF)
2. Flow switch status (proving flow)
3. Return water temperature (loop temperature monitoring)
4. Pump runtime / hours (for maintenance)

D. Alarms:

1. Pump failure / not running when required
2. No flow detected / low flow
3. Abnormal return water temperature  
Heating Coil Control Valve Position (AO)

E. A common thermostat shall control the VA box and WF radiation in those spaces that have WF radiation installed.

4.13 DOMESTIC HOT WATER HEATERS

A. Domestic hot water heaters are enabled based on need and system requirements. ATC Contractor shall monitor water heater status and alarms. Domestic hot water supply temperature is monitored at the temperature sensor.

B. Points List:

1. Cold water inlet temperature
2. Hot water outlet temperature
3. Storage tank temperature
4. Water heater ON/OFF status
5. Firing rate / modulation (if available)

6. Gas pressure (high/low) – for gas-fired units
7. Internal alarms/faults (ignition failure, sensor faults, low-water cutoff)

C. Alarms:

1. High tank temperature (>150–160°F)
2. Low hot water outlet temperature (failure to meet setpoint)
3. Ignition failure / water heater fault
4. Gas pressure high / low
5. Low water cutoff activation

4.14 POINTS LIST - BAS

- A. Refer to following points list. Refer to Section 23 0900-1.2K for additional points. These lists are for information only. Provide total number of points required to provide specified control sequence.

POINTS LIST

Air Handlers, Rooftop Air Units, Heat Recovery Units, Unit Ventilators, Fan Coils, Blower Coils (In addition to specifics in Equipment Specification)

ANALOG INPUT:                      Space Temperature  
                                            Discharge Air Temperature  
                                            Outside Air CFM

ANALOG OUTPUT:                      Setpoint Adjustment  
                                            Damper Positions  
                                            Valve Positions - Hot Water, Chilled Water (as applicable)

BINARY INPUT:                      Status  
                                            Freeze  
                                            Smoke (Units - over 2000 CFM)  
                                            Air Flow (Air Handler Units Only - over 1000 CFM)

BINARY OUTPUT:                      Off-On

ALARMS:                                      High Analog  
                                            Low Analog  
                                            Freeze  
                                            Smoke (Units - over 2000 CFM):  
                                            Condensate Overflow Shutdown/Alarm

PROGRAMS:                                      Time Scheduling  
                                            Start/Stop Opt.  
                                            Trend

EXHAUST FANS (All Fans):

BINARY INPUT:                      Current  
BINARY OUTPUT:                      Off-On  
ALARM:                                      Air Flow

|                                       |                                                             |
|---------------------------------------|-------------------------------------------------------------|
| PROGRAMS:                             | Time Schedule<br>Start-Stop Opt.                            |
| <u>HVAC PUMPS:</u>                    |                                                             |
| BINARY INPUT:                         | Status On-Off<br>Flow<br>Zone Pressures<br>% Flow           |
| BINARY OUTPUT:                        | On-Off<br>Zone Pressure (Adjustment)<br>% Flow (Adjustment) |
| ALARM:                                | Flow<br>High Pressure<br>Low Pressure<br>Failure            |
| PROGRAMS:                             | Trend                                                       |
| <u>CHILLERS:</u>                      |                                                             |
| BINARY INPUT:                         | Status-On-Off                                               |
| BINARY OUTPUT:                        | On-Off                                                      |
| ALARM :                               | General - Chiller                                           |
| MISCELLANEOUS:                        | Chiller Plant Manager Interface                             |
| <u>THERMAL STORAGE:</u>               |                                                             |
| BINARY INPUT:                         | Temperature<br>% Ice Build                                  |
| ALARM :                               | Low Water<br>High Ice<br>General                            |
| PROGRAMS:                             | Time Schedule<br>Trend                                      |
| <u>BOILERS:</u>                       |                                                             |
| BINARY INPUT:                         | Status-On-Off                                               |
| BINARY OUTPUT:                        | On-Off                                                      |
| ALARM:                                | General                                                     |
| MISCELLANEOUS:                        | Burner Communication Interface (Full Interface Required)    |
| <u>WATER HEATERS/TANK:</u>            |                                                             |
| BINARY INPUT:                         | Status-On-Off                                               |
| BINARY OUTPUT:                        | On-Off                                                      |
| ALARM:                                | General                                                     |
| <u>PUMPS (Plumbing System Pumps):</u> |                                                             |
| BINARY INPUT:                         | Status On-Off<br>Flow                                       |
| BINARY OUTPUT:                        | On-Off                                                      |

ALARM: Flow

THERMOSTATIC MIXING VALVE:

BINARY INPUT: Status-On-Off

BINARY OUTPUT: On-Off

ALARM: General

4.15

END OF SECTION 230900



1 OVERALL FIRST FLOOR PLAN  
1/8" = 1'-0"

GENERAL NOTES:

1. ALL DOOR JAMBS SHALL BE LOCATED 4" FROM INSIDE CORNER OF WALL ON HINGE SIDE UNLESS OTHERWISE INDICATED.
2. COORDINATE LOCATION OF MEP EQUIPMENT, DEVICES, OUTLET BOXES, ETC. WITH OTHER EQUIPMENT AND FINISH SCHEDULE PRIOR TO INSTALLATION.
3. ALL EXTERIOR ENTRANCE PADS SHALL BE SLOPED 2% MAX AWAY FROM THE BUILDING TO EDGE OF PAD. REFER TO STRUCTURAL DRAWINGS.
4. UNLESS NOTED OTHERWISE, ALL FLOOR DRAINS SHALL BE SET 1/4" MAX. BELOW FIN FLOOR. DISH FIN. FLOOR MIN. OF 24" RADIUS TO TOP OF FLOOR DRAIN. REFER TO PLUMBING DRAWINGS.
5. UNLESS NOTED OTHERWISE, WHERE DIFFERENT FLOOR ELEVATIONS OCCUR ON OPPOSITE SIDES OF INTERIOR MASONRY WALLS, PROVIDE COLD FLUID APPLIED WATERPROOFING (CFWP) ON THE BACKFILLED FACE OF WALL. APPLY CFWP FROM UNDERSIDE OF CONC. SLAB TO TOP OF FOOTING BELOW. CFWP NOT TO INTERFERE WITH INSTALLATION OF CONC. SLAB VAPOR BARRIER.
6. GC TO PROVIDE ALL LOUVERS COORDINATE WITH MEP DRAWINGS.
7. ALL WALL LAYOUT DIMENSIONS ARE FROM FACE OF STUD & FACE OF CMU UNLESS OTHERWISE NOTED.
8. PROVIDE REQUIRED BLOCKING FOR ALL TV WALL MOUNTED BRACKETS.

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REVISIONS

| NO. | DATE      | DESCRIPTION OF CHANGES |
|-----|-----------|------------------------|
| 1   | 7/23/2026 | ADDENDUM #1            |
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NEW CONSTRUCTION FOR  
NEW DISTRICT ADMINISTRATION OFFICES  
THE SOLANCO SCHOOL DISTRICT  
585 SOLANCO ROAD, QUARRYVILLE, PA 17566



OVERALL FIRST FLOOR PLAN  
PLOT SCALE:  
1/8" = 1'-0"  
FILENAME:  
DATE:  
JULY 8, 2026

PROJECT  
3706

A1.1



- REFLECTED CEILING PLAN GENERAL NOTES:**
1. UNLESS NOTED OTHERWISE, GYPSUM BULKHEADS TO BE 3/8" METAL STUDS AT 16" O/C WITH 5/8" GWB EACH SIDE, EXTENDING MIN 2" BELOW ADJACENT CEILING.
  2. CEILING GRID SHALL BE COORDINATED WITH MEP EQUIPMENT AND DEVICES.
  3. UNLESS NOTED OTHERWISE, ALL VISIBLE STRUCTURAL STEEL, ROOF/FLOOR DECK, DUCTWORK, PIPING, CONDUIT, HANGER WIRES, ETC AT EXPOSED LOCATIONS OR ABOVE CEILING CLOUDS SHALL BE PAINTED.
  4. REFER TO ROOM FINISH SCHEDULE FOR CEILING TYPES.
  5. ALL VISIBLE HANGER WIRES, STRUCTURE AND BRACING AT EXPOSED CEILING GRID OR CEILING CLOUD LOCATIONS SHALL BE INSTALLED PLUMB AND LEVEL.
  6. FOR WINDOWS THAT REQUIRE TWO OR MORE ROLLER SHADES, EACH ROLLER SHADE SHALL TERMINATE AT THE CENTER OF THE WINDOW MULLION. REFER TO HOLLOW METAL AND ALUMINUM FRAME ELEVATIONS FOR DIMENSIONS AND WINDOW MULLION DESIGN AND ROLLER SHADE BRAKES.

**LEGEND**

|  |                                              |  |                          |
|--|----------------------------------------------|--|--------------------------|
|  | 2' x 4' SUSPENDED CEILING SYSTEM             |  | 2' x 4' LIGHT FIXTURE    |
|  | 2' x 4' SECOND LOOK SUSPENDED CEILING SYSTEM |  | 1' x 4' LIGHT FIXTURE    |
|  | FAUX WOOD - 3/4" PLYWOOD ON 3/8" METAL STUD  |  | 2' x 2' LIGHT FIXTURE    |
|  | LINEAR METAL - WOOD LOOK                     |  | SEE MEP DRAWINGS         |
|  | LINEAR METAL SOFFIT                          |  | SEE MEP DRAWINGS         |
|  | GYPSUM WALLBOARD                             |  | RECESSED DOWN LIGHT      |
|  |                                              |  | PENDANT LIGHT FIXTURES   |
|  |                                              |  | ROLLER SHADE - MANUAL    |
|  |                                              |  | ROLLER SHADE - MOTORIZED |

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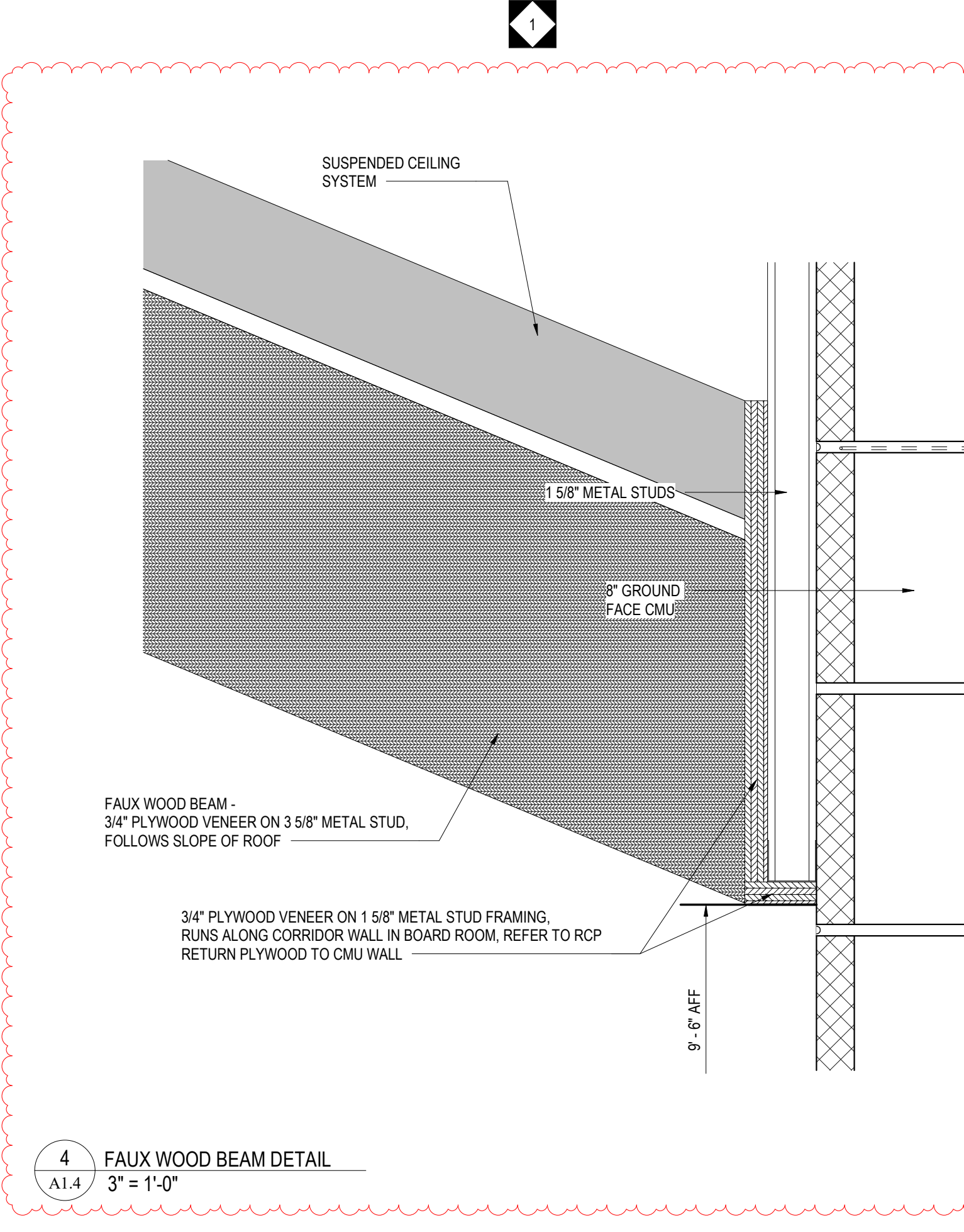
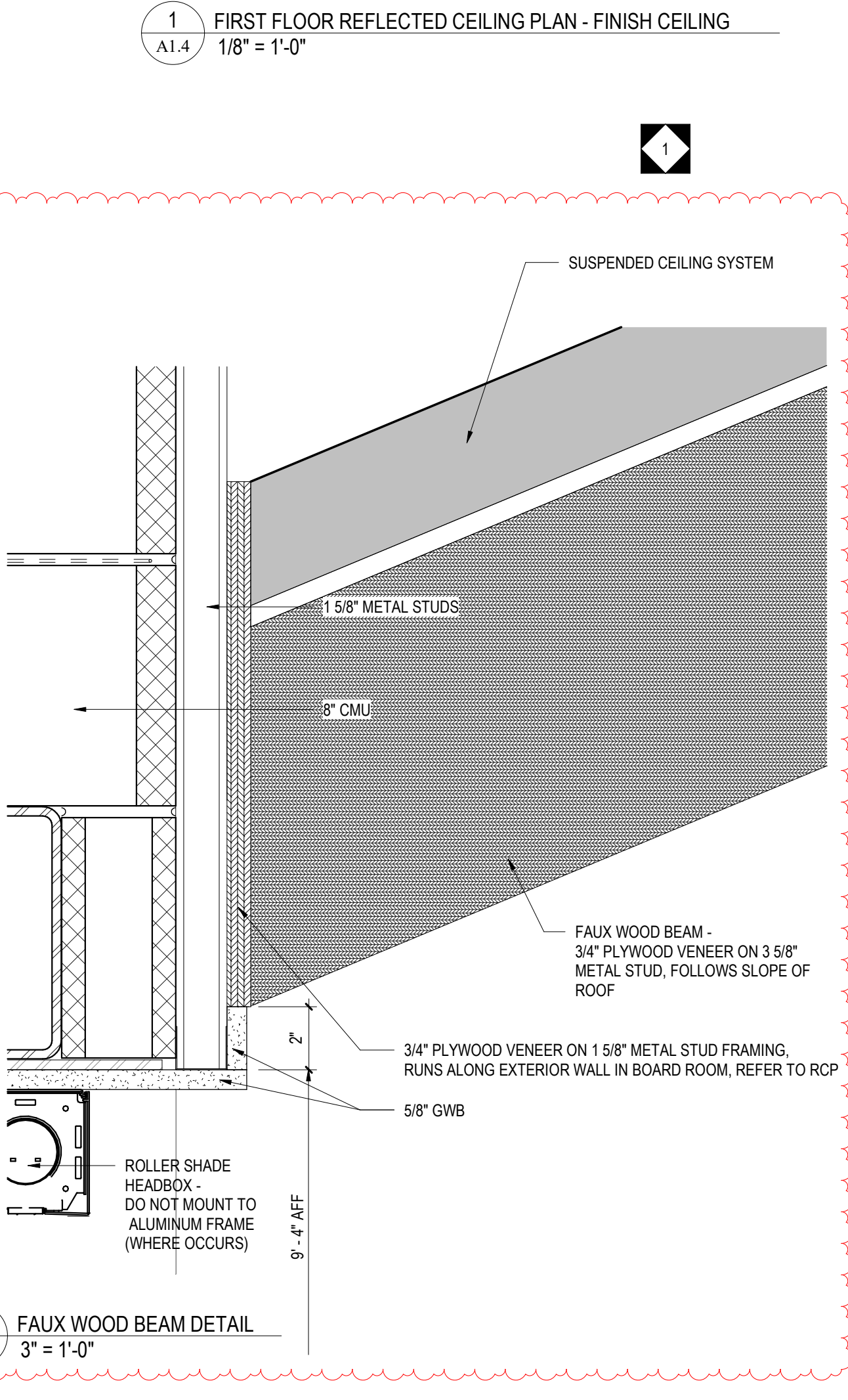
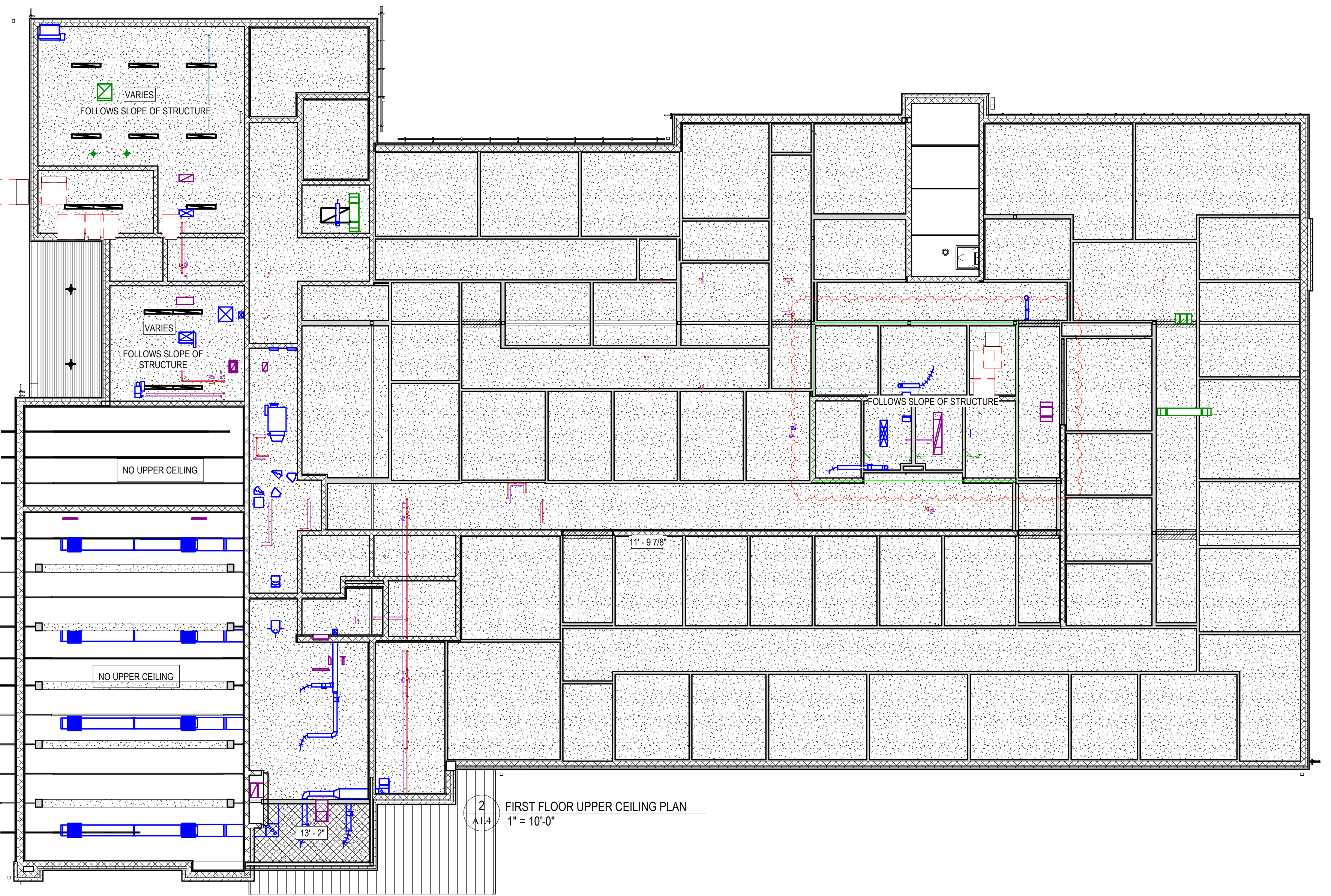
NEW CONSTRUCTION FOR  
NEW DISTRICT ADMINISTRATION OFFICES  
THE SOLANCO SCHOOL DISTRICT  
585 SOLANCO ROAD, QUARRYVILLE, PA 17566

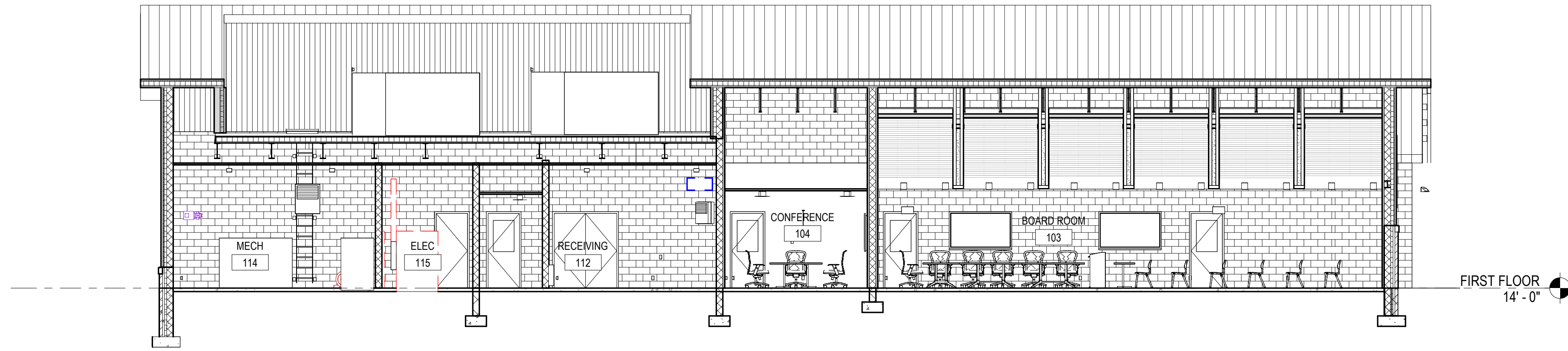
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FIRST FLOOR REFLECTED CEILING PLAN

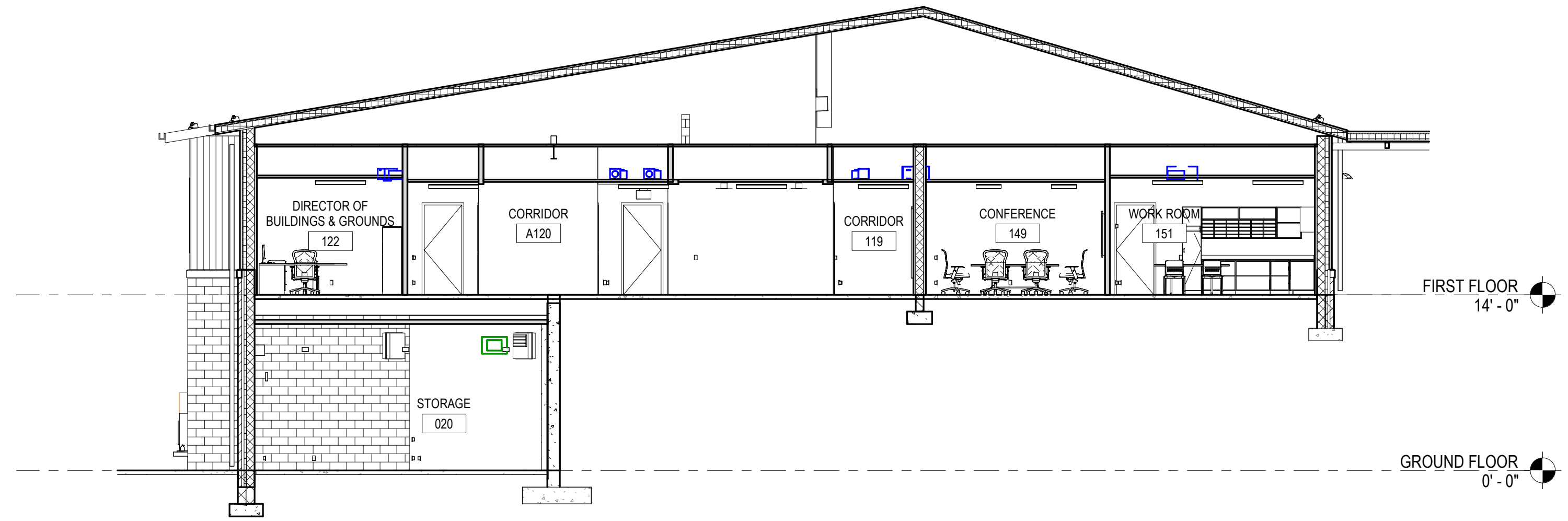
PLOT SCALE: As indicated  
FILENAME:  
DATE: JULY 8, 2026

**PROJECT**  
3706  
**A1.4**

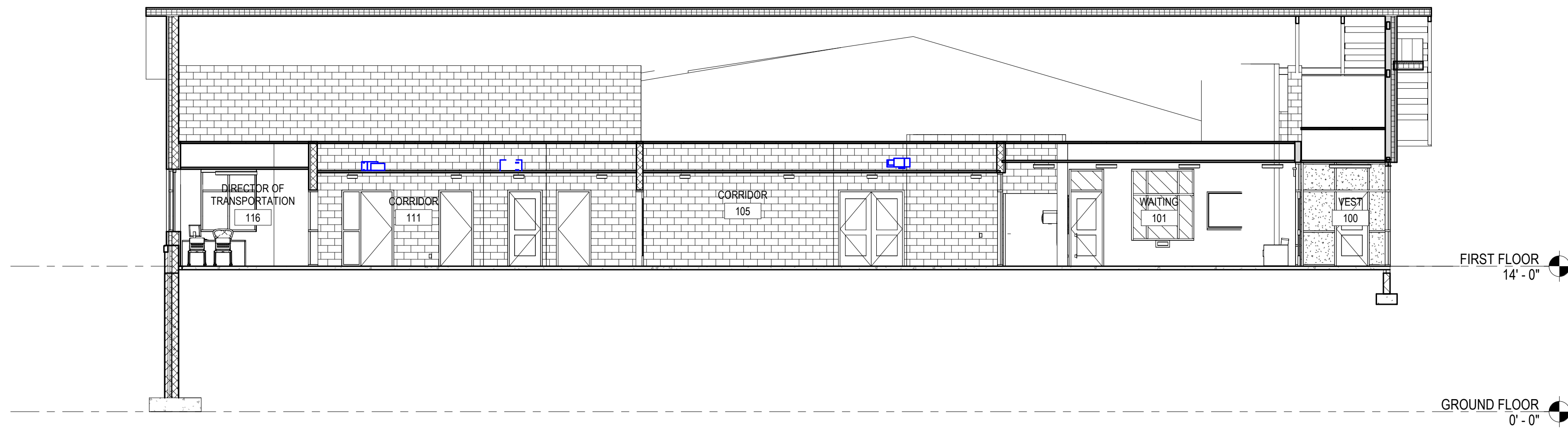




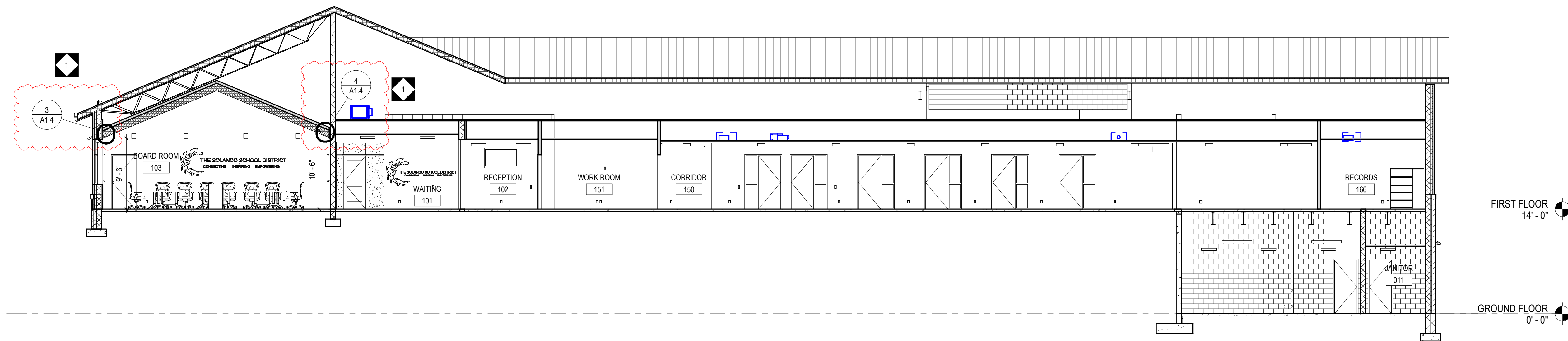
1 OVERALL BUILDING SECTION  
A3.1 1/8" = 1'-0"



2 OVERALL BUILDING SECTION  
A3.1 1/8" = 1'-0"



3 OVERALL BUILDING SECTION  
A3.1 1/8" = 1'-0"



4 OVERALL BUILDING SECTION  
A3.1 1/8" = 1'-0"

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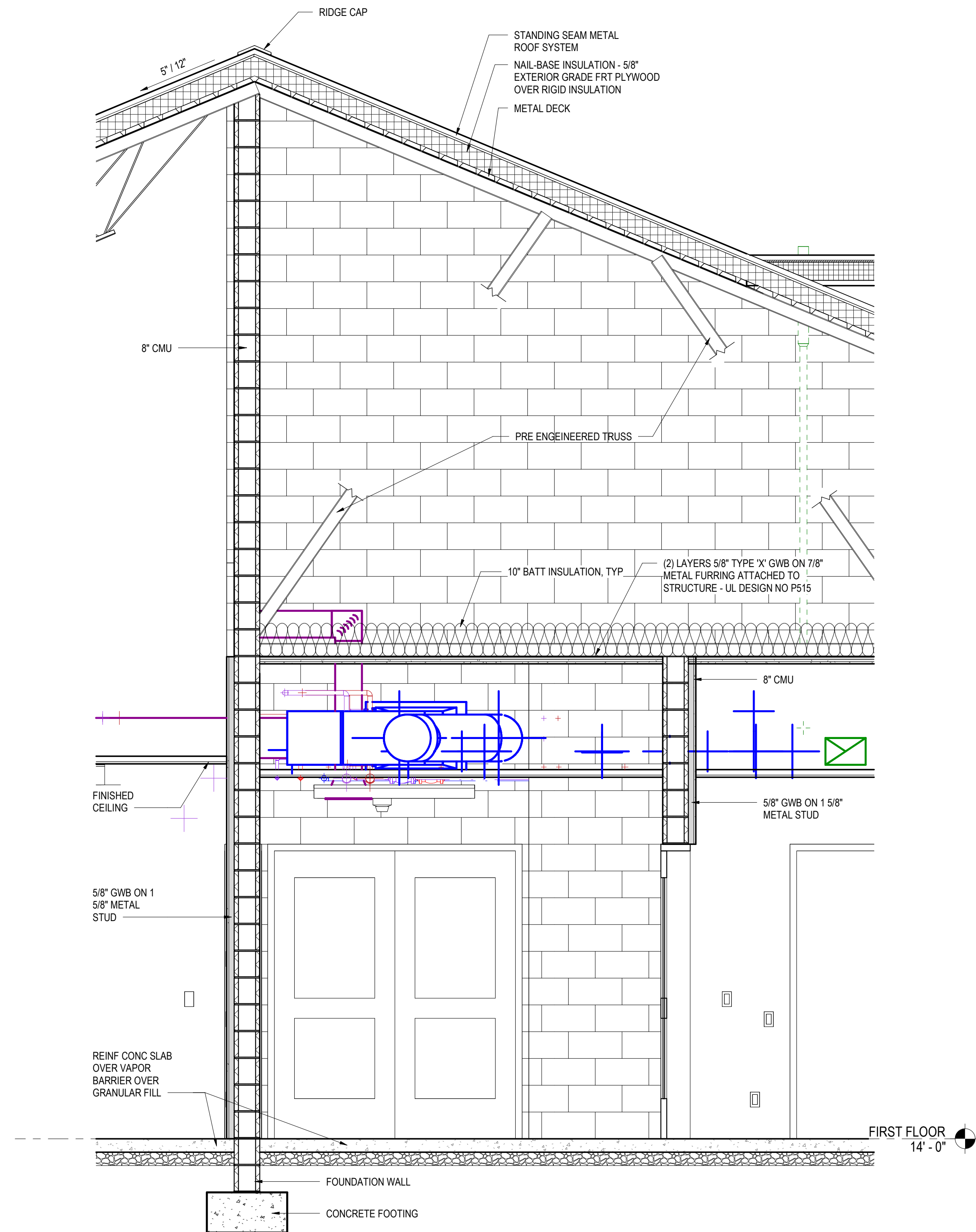
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NEW DISTRICT ADMINISTRATION OFFICES  
THE SOLANCO SCHOOL DISTRICT  
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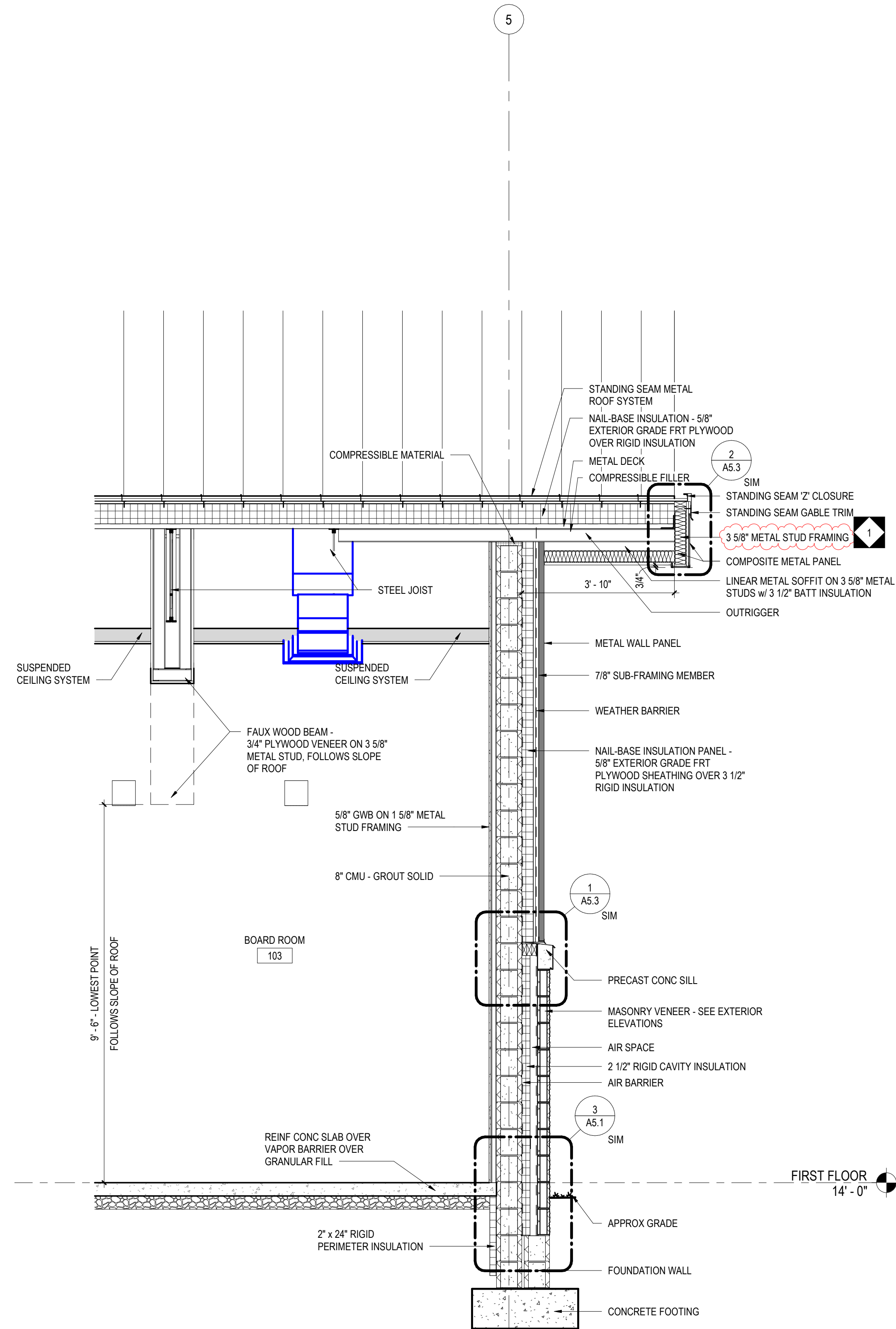


BUILDING SECTIONS  
PLOT SCALE:  
1/8" = 1'-0"  
FILENAME:  
DATE:  
JULY 8, 2026

PROJECT  
3706  
A3.1



1 WALL SECTION  
1/2" = 1'-0"



2 WALL SECTION  
1/2" = 1'-0"

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WALL SECTIONS

PLOT SCALE:  
1/2" = 1'-0"  
FILENAME:  
DATE:  
JULY 8, 2026

PROJECT  
3706

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**NEW CONSTRUCTION FOR  
DISTRICT ADMINISTRATION  
THE SOLANCO SCHOOL DISTRICT**  
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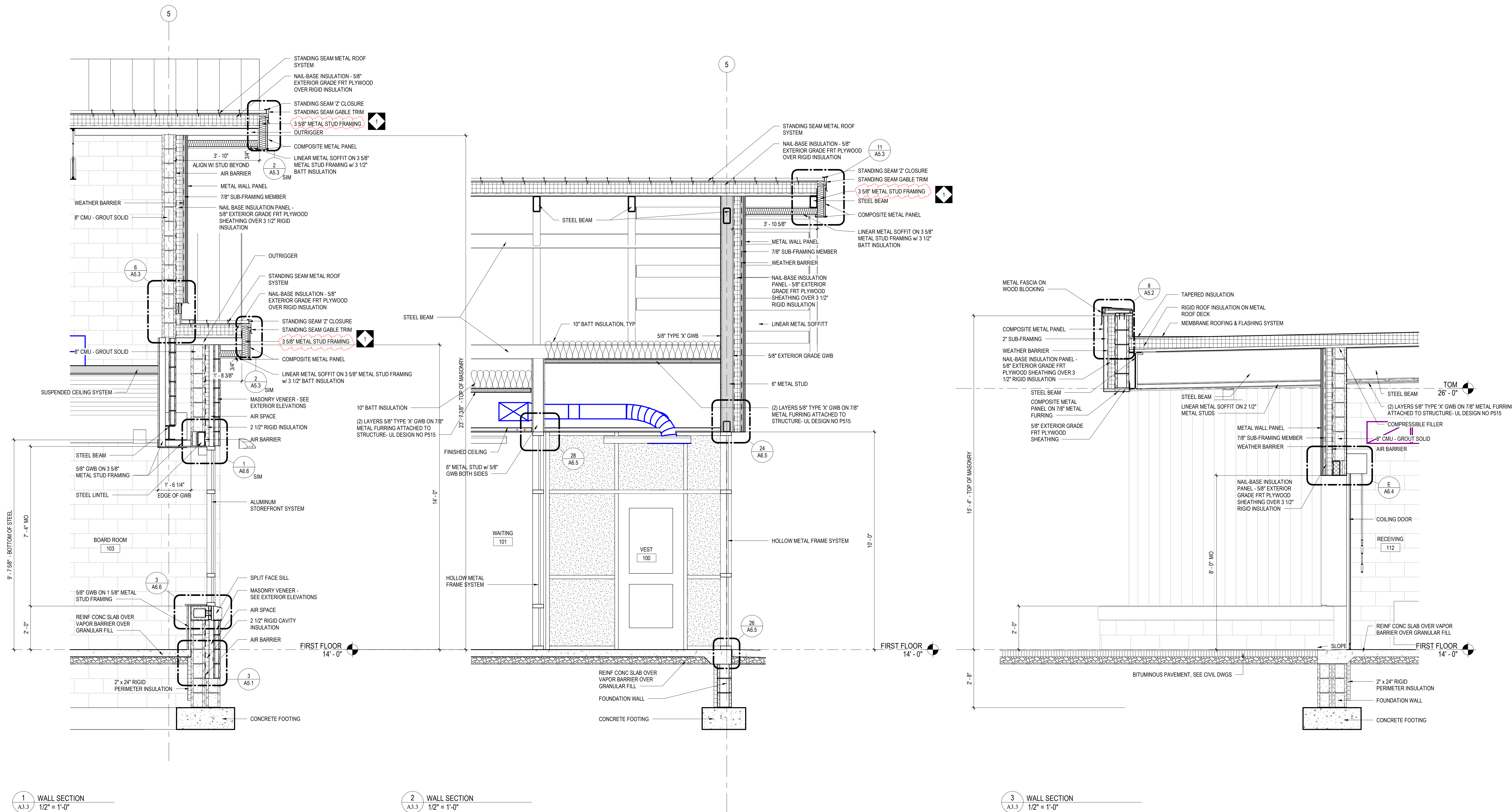
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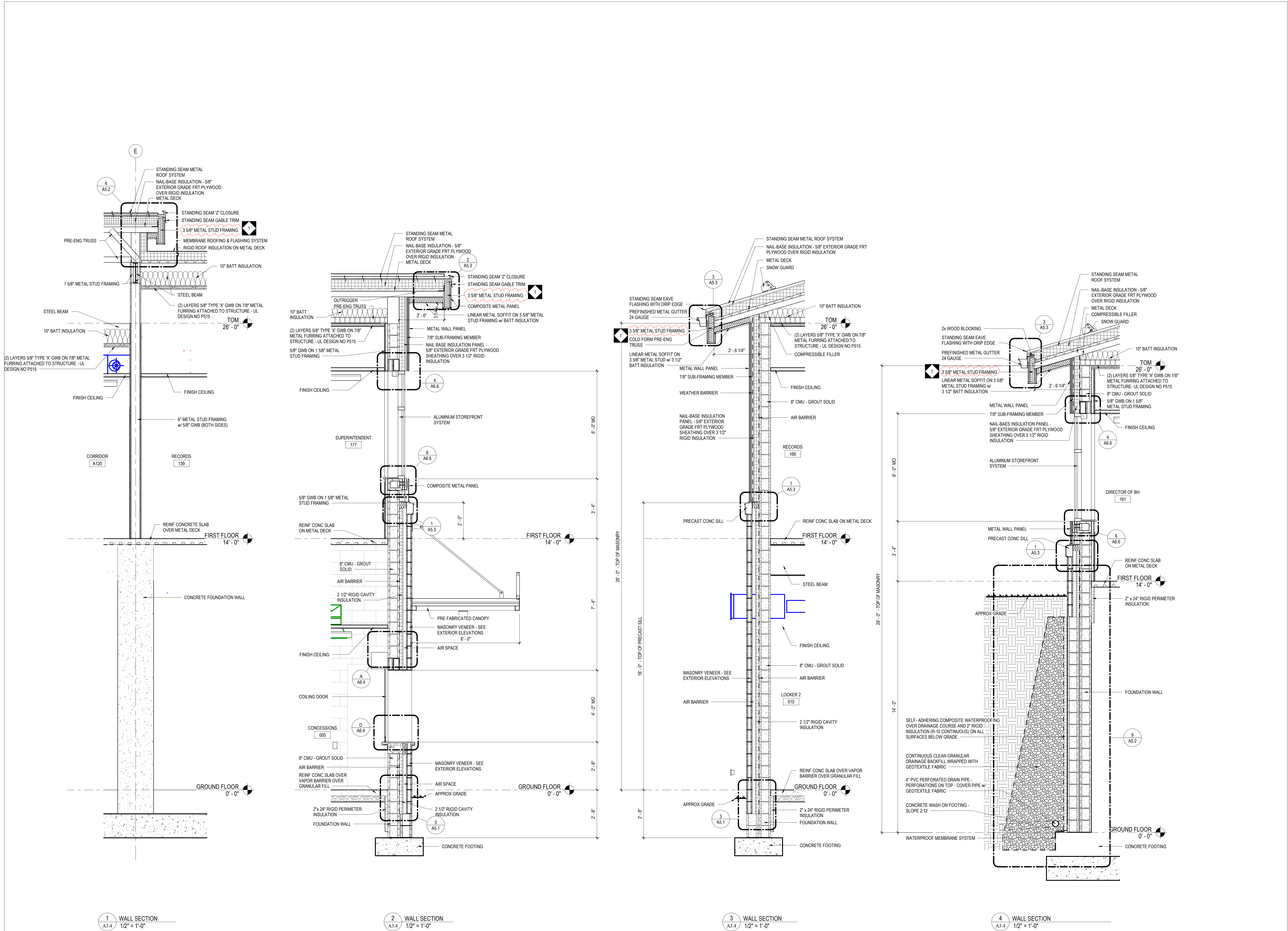
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NEW CONSTRUCTION FOR

NEW DISTRICT ADMINISTRATION OFFICES

THE SOLANCO SCHOOL DISTRICT

585 SOLANCO ROAD, QUARRYVILLE, PA 17566

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WALL SECTIONS

PLOT SCALE: 1/2" = 1'-0"

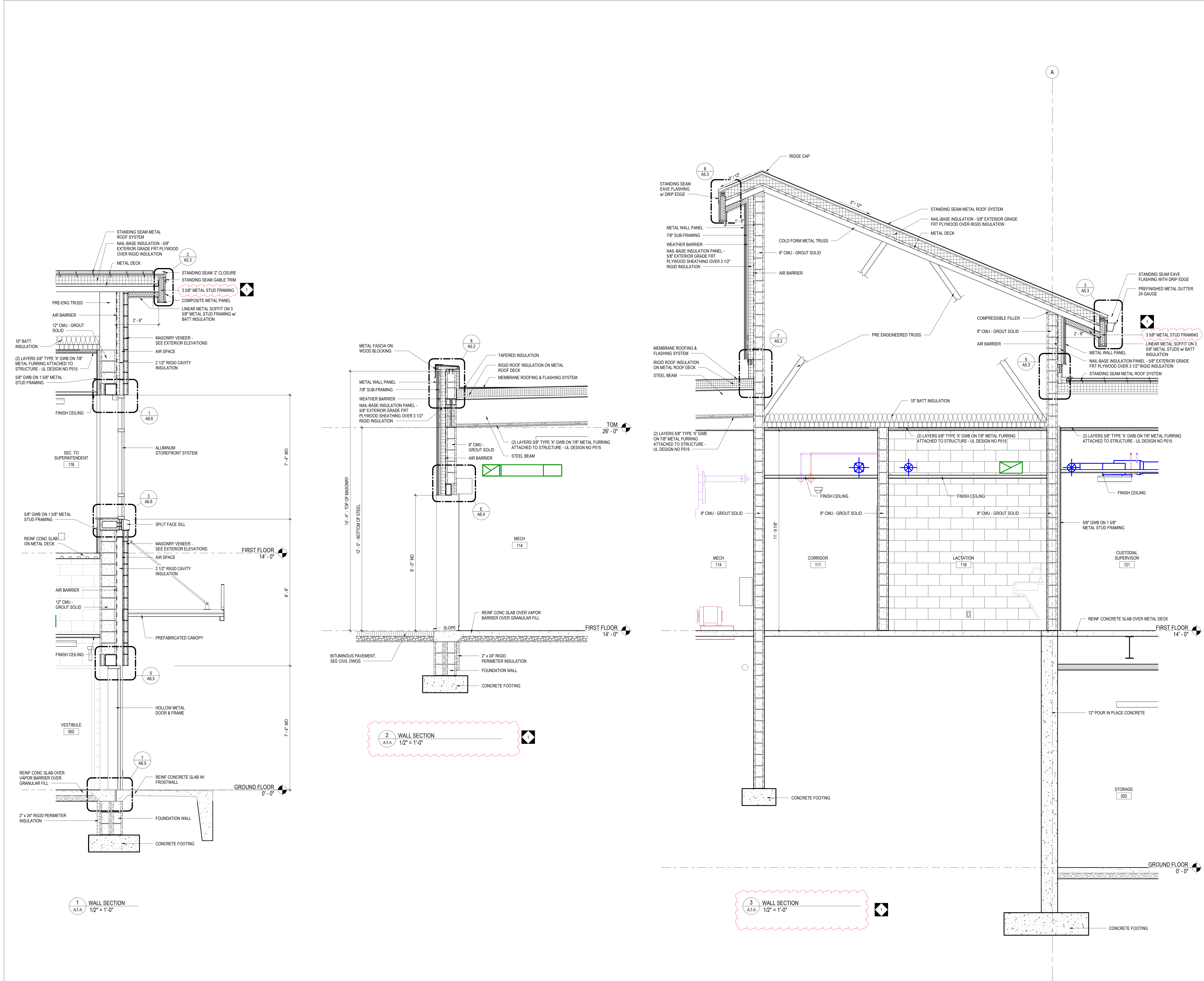
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DATE: JULY 8, 2026

PROJECT

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NEW DISTRICT ADMINISTRATION OFFICES  
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WALL SECTIONS

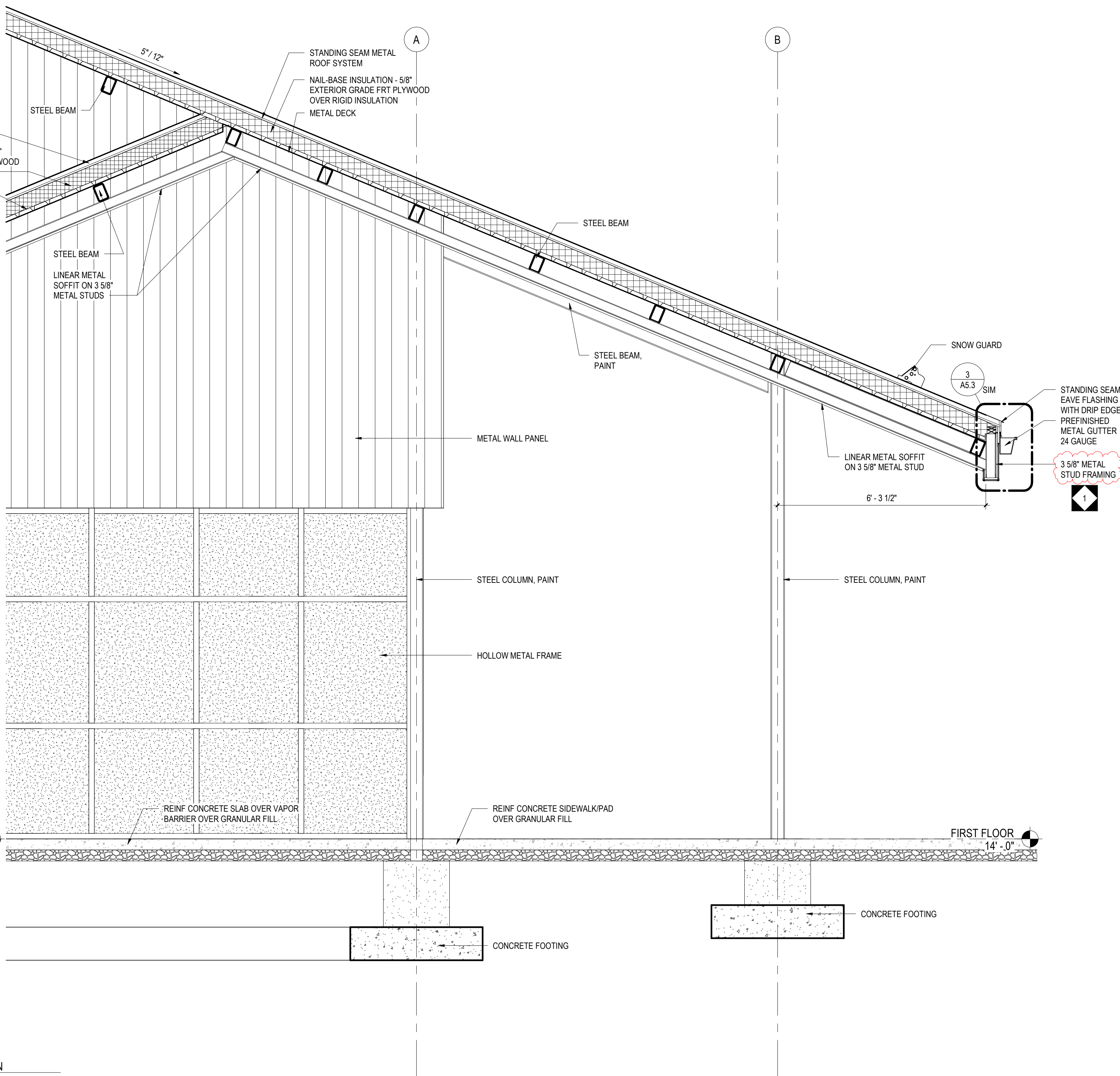
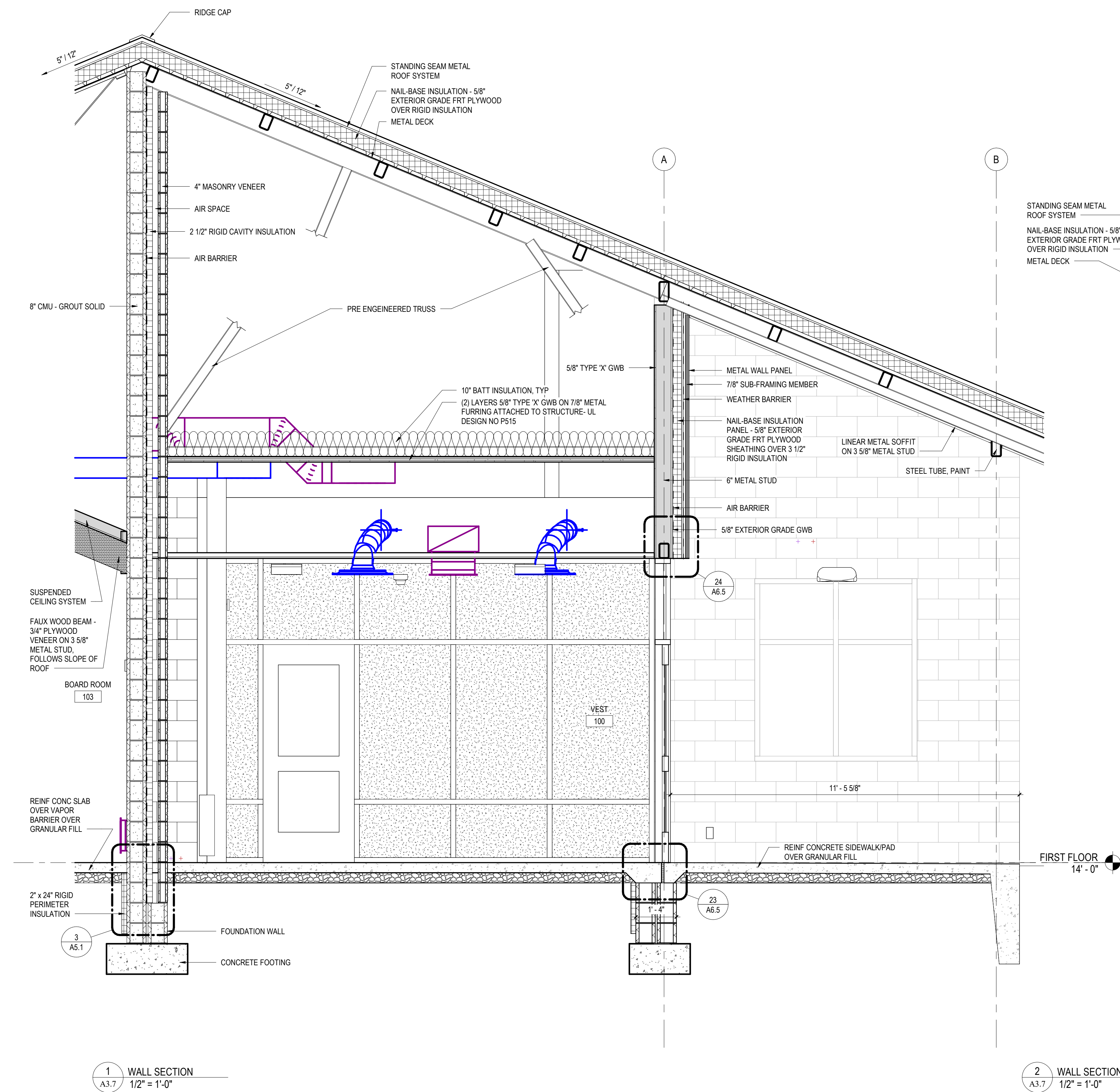
PLOT SCALE:  
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FILENAME:

DATE:  
JULY 8, 2026

PROJECT  
3706

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WALL SECTIONS

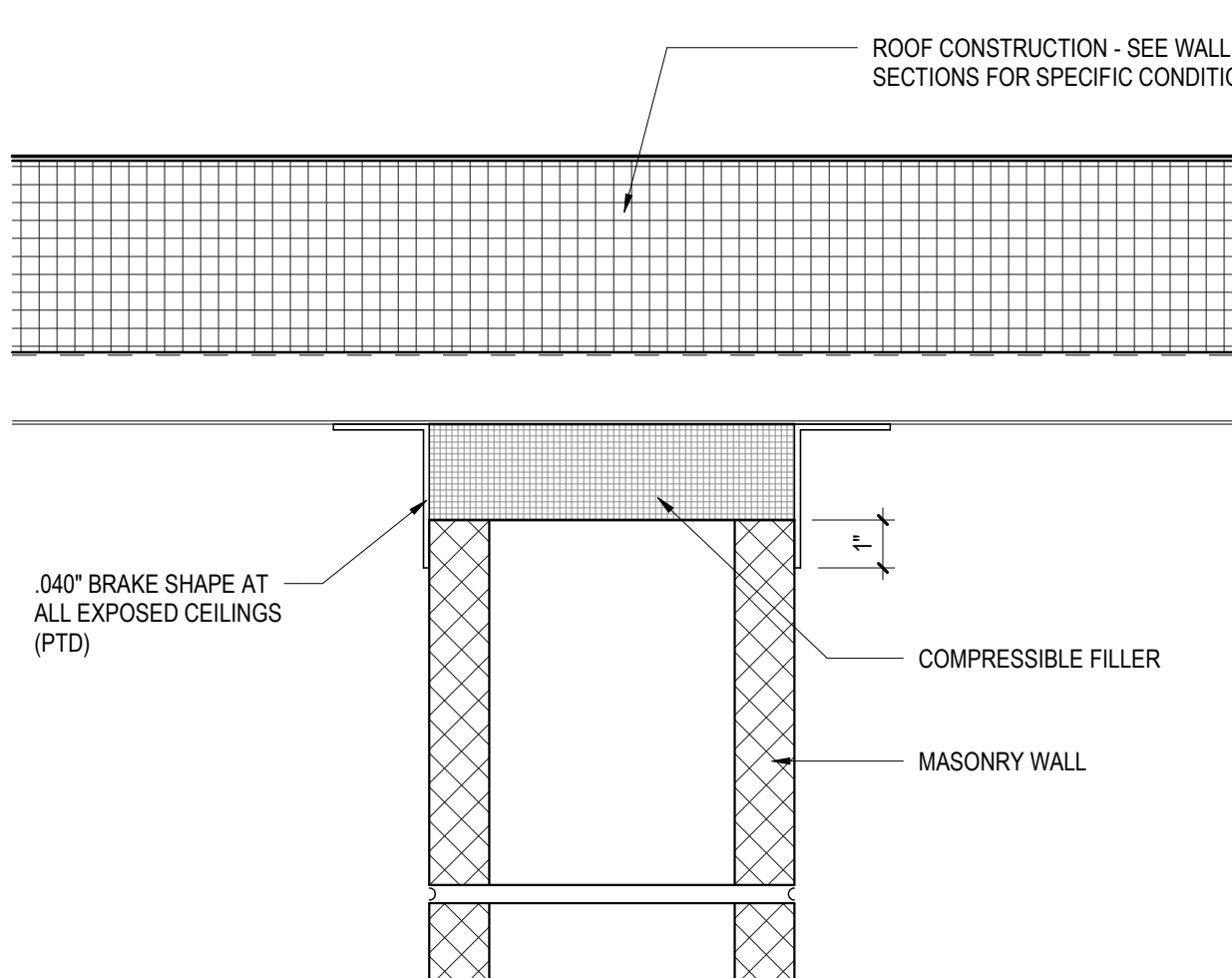
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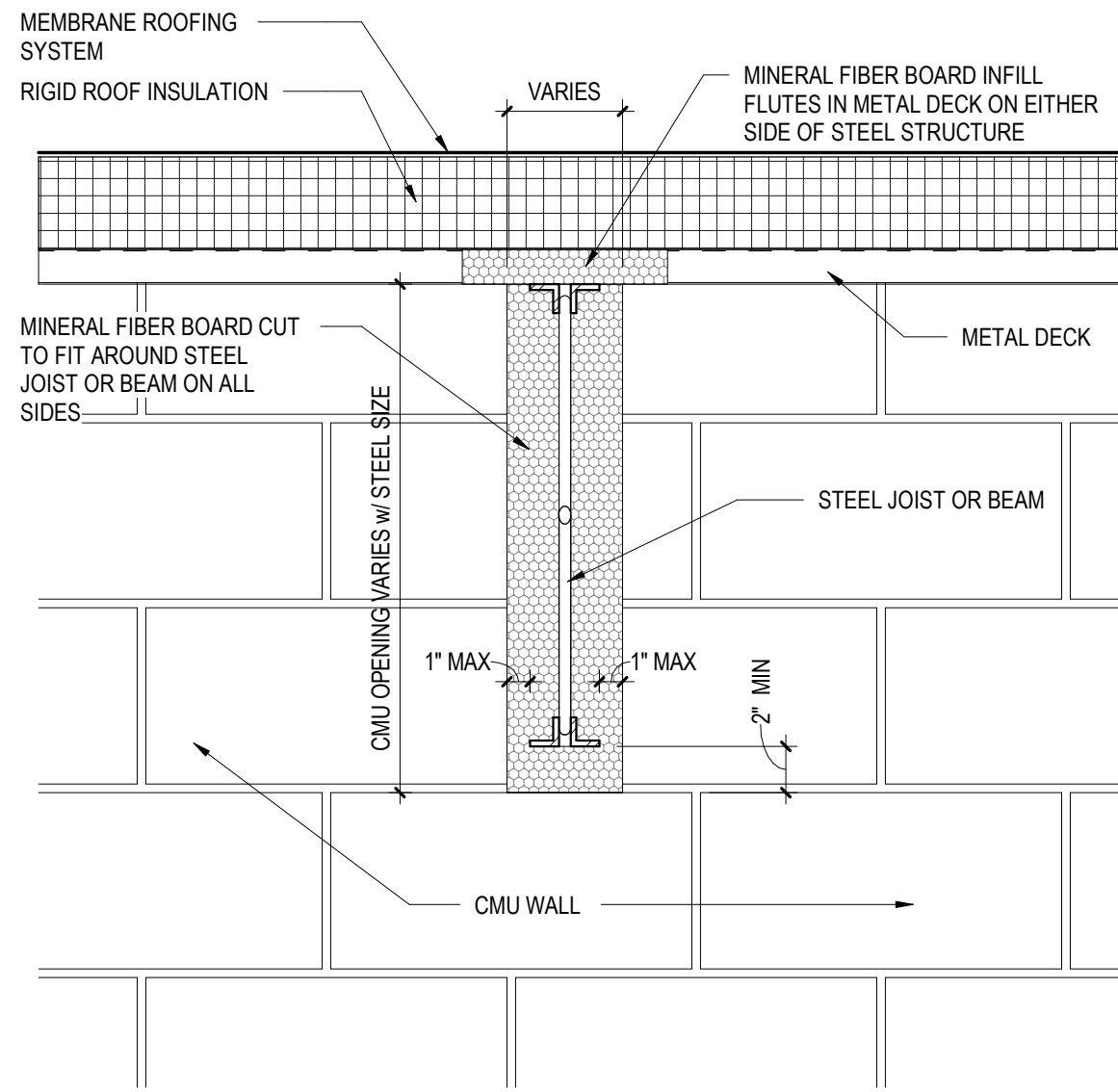
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JULY 8, 2026

PROJECT  
3706

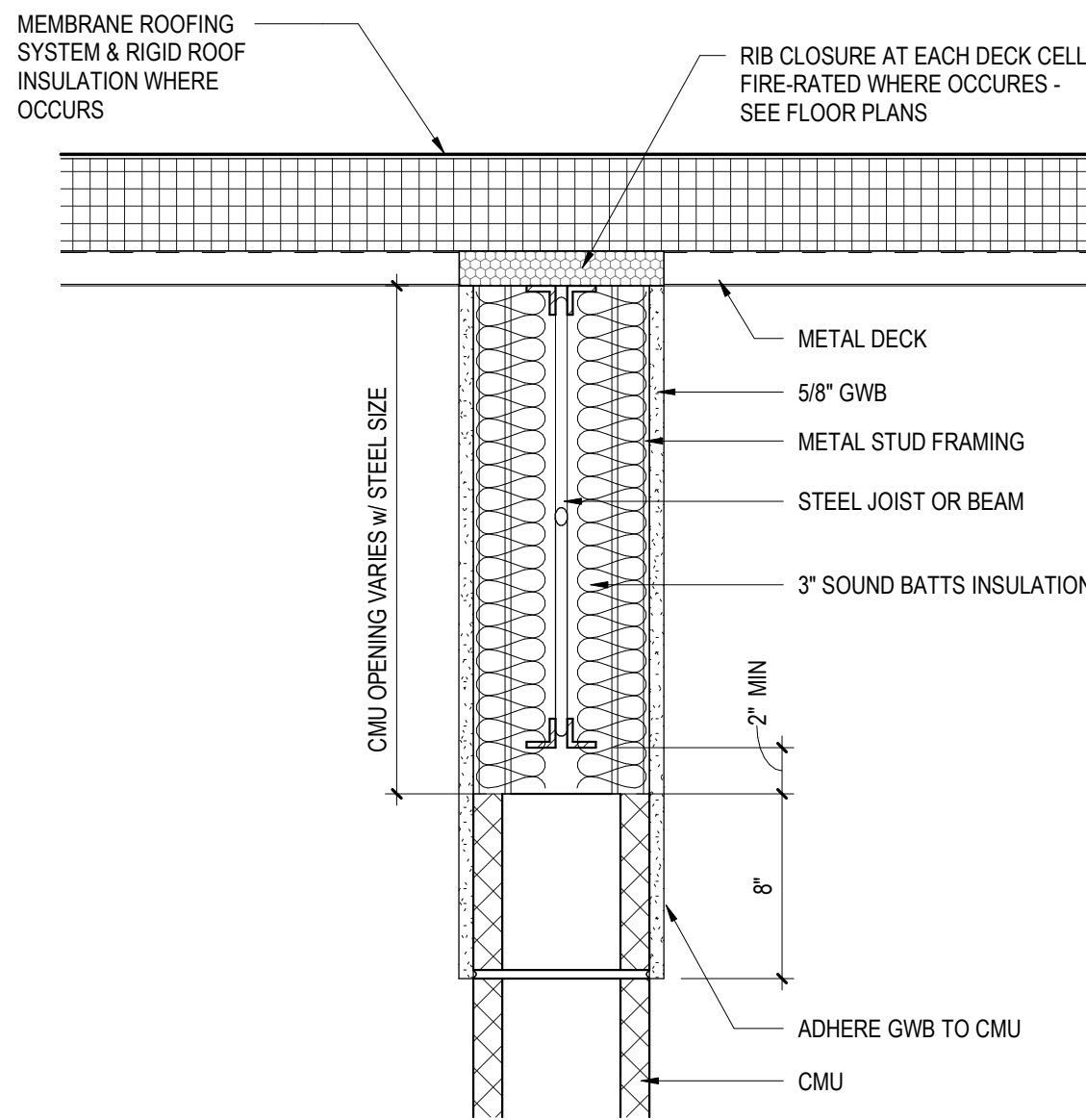
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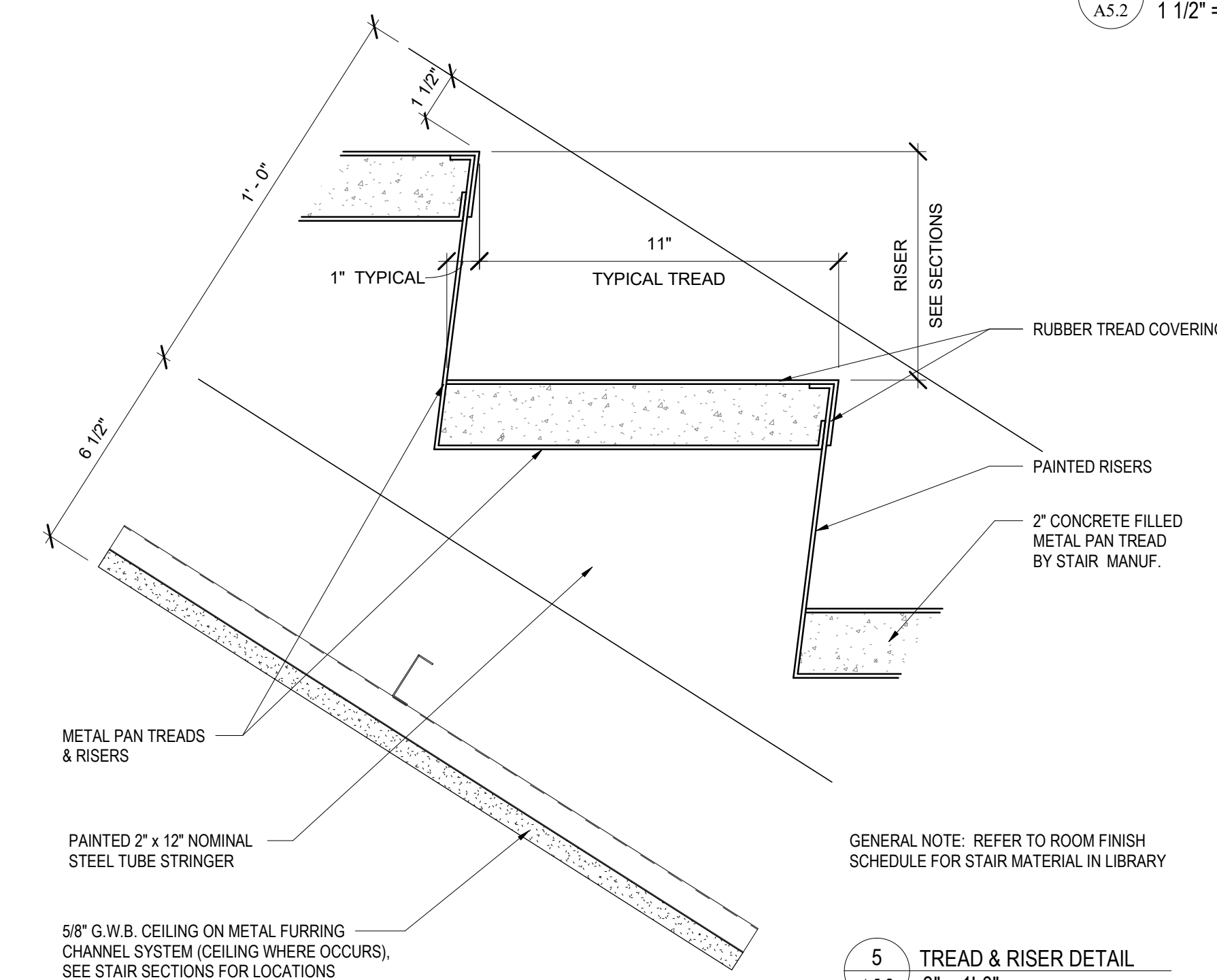
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A5.2 3" = 1'-0"



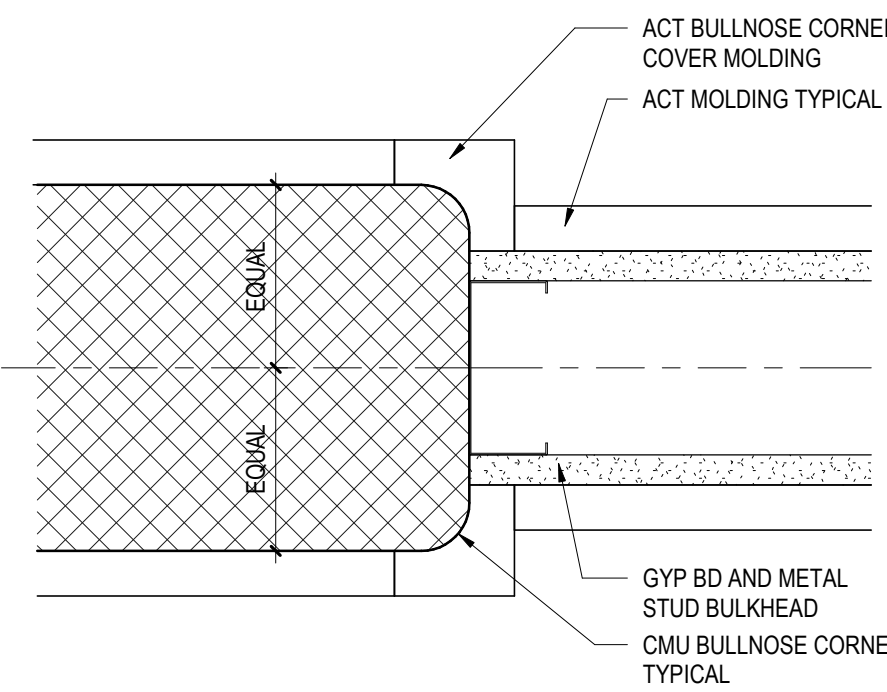
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A5.2 1 1/2" = 1'-0"



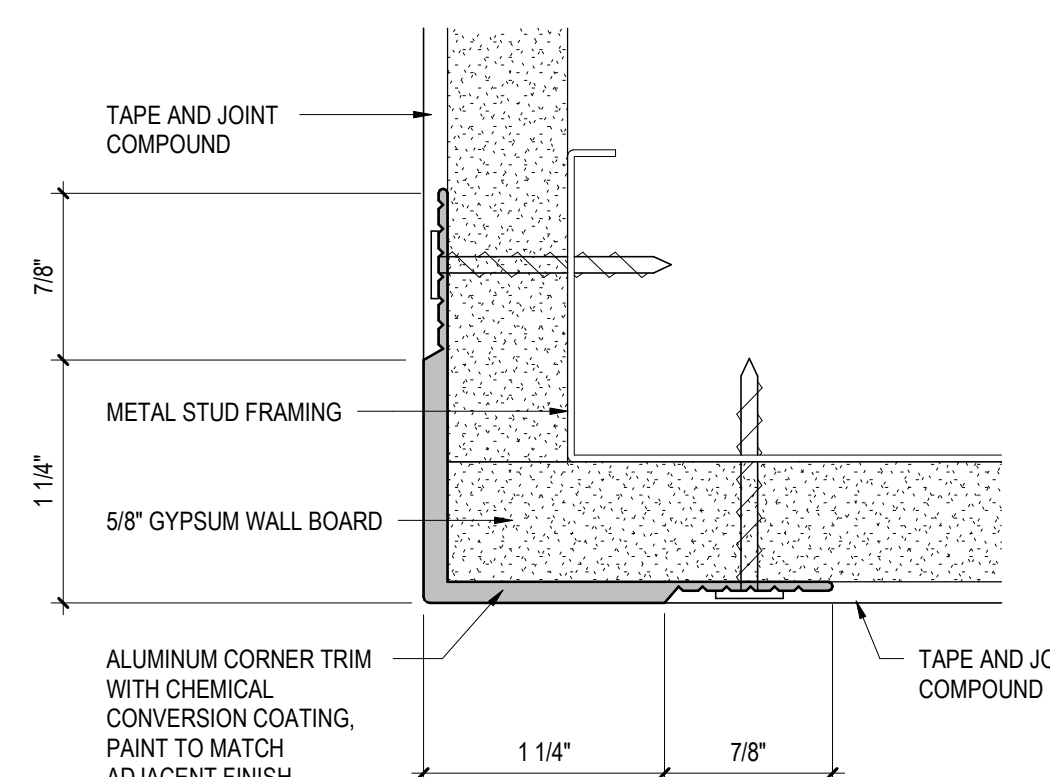
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A5.2 1 1/2" = 1'-0"



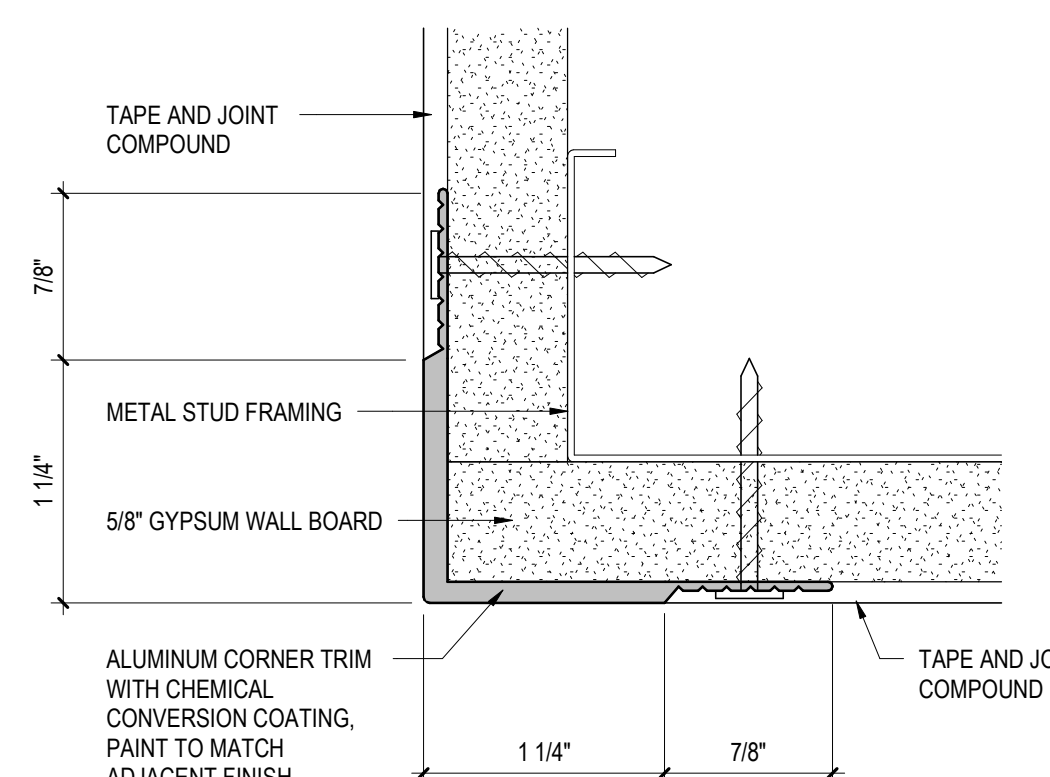
4 EDGE OF DECK - STANDING SEAM  
A5.2 3" = 1'-0"



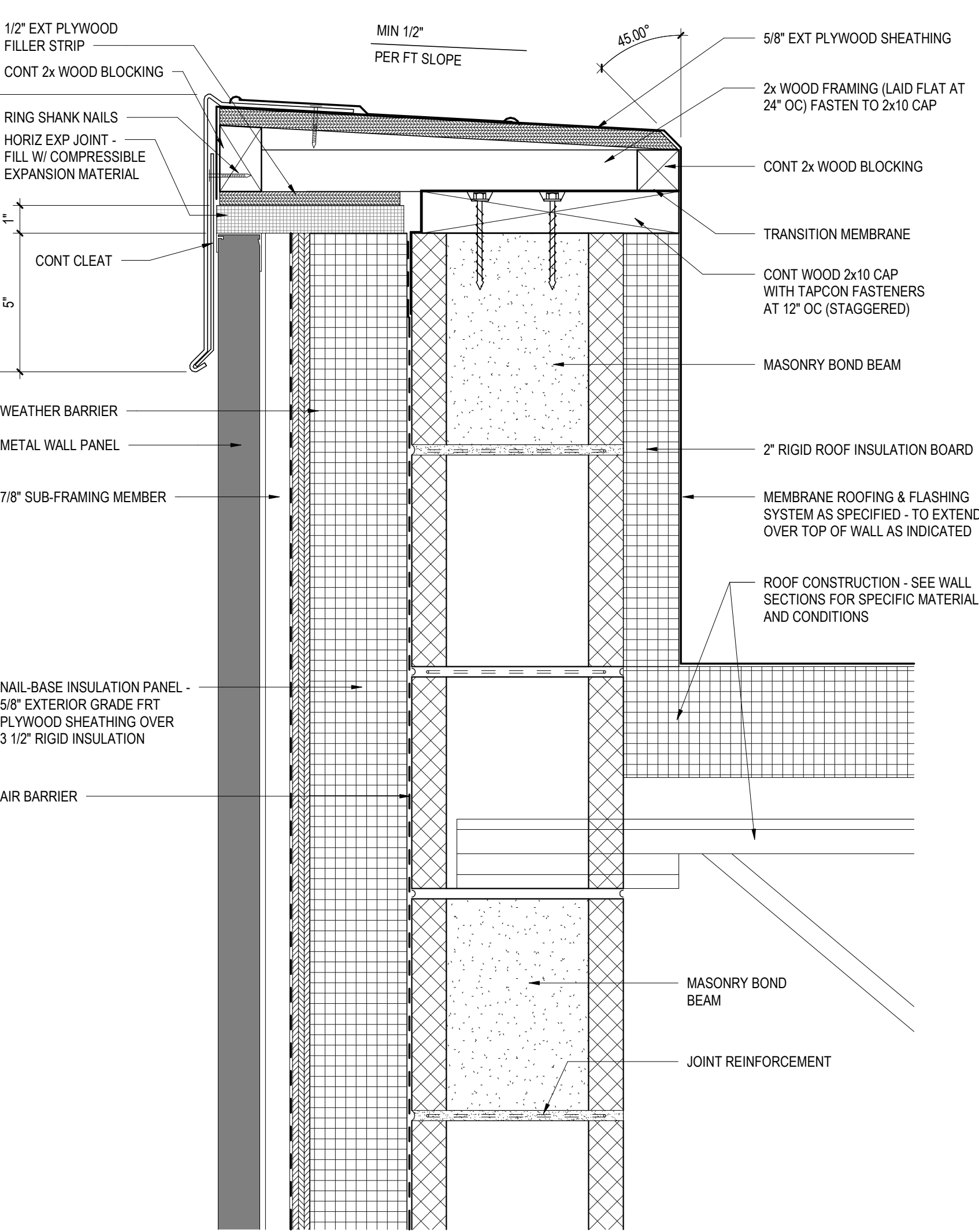
5 TREAD & RISER DETAIL  
A5.2 3" = 1'-0"



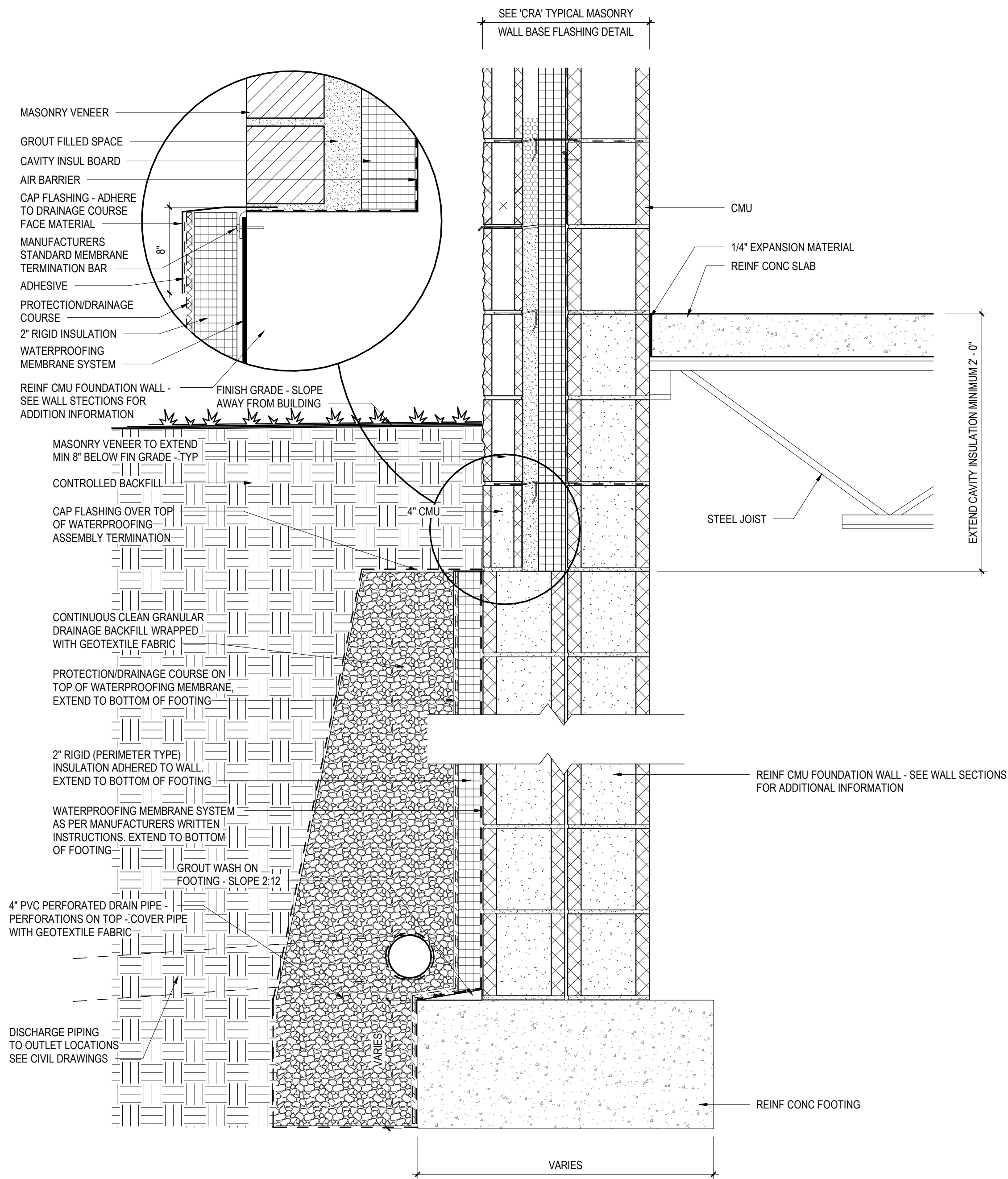
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A5.2 3" = 1'-0"



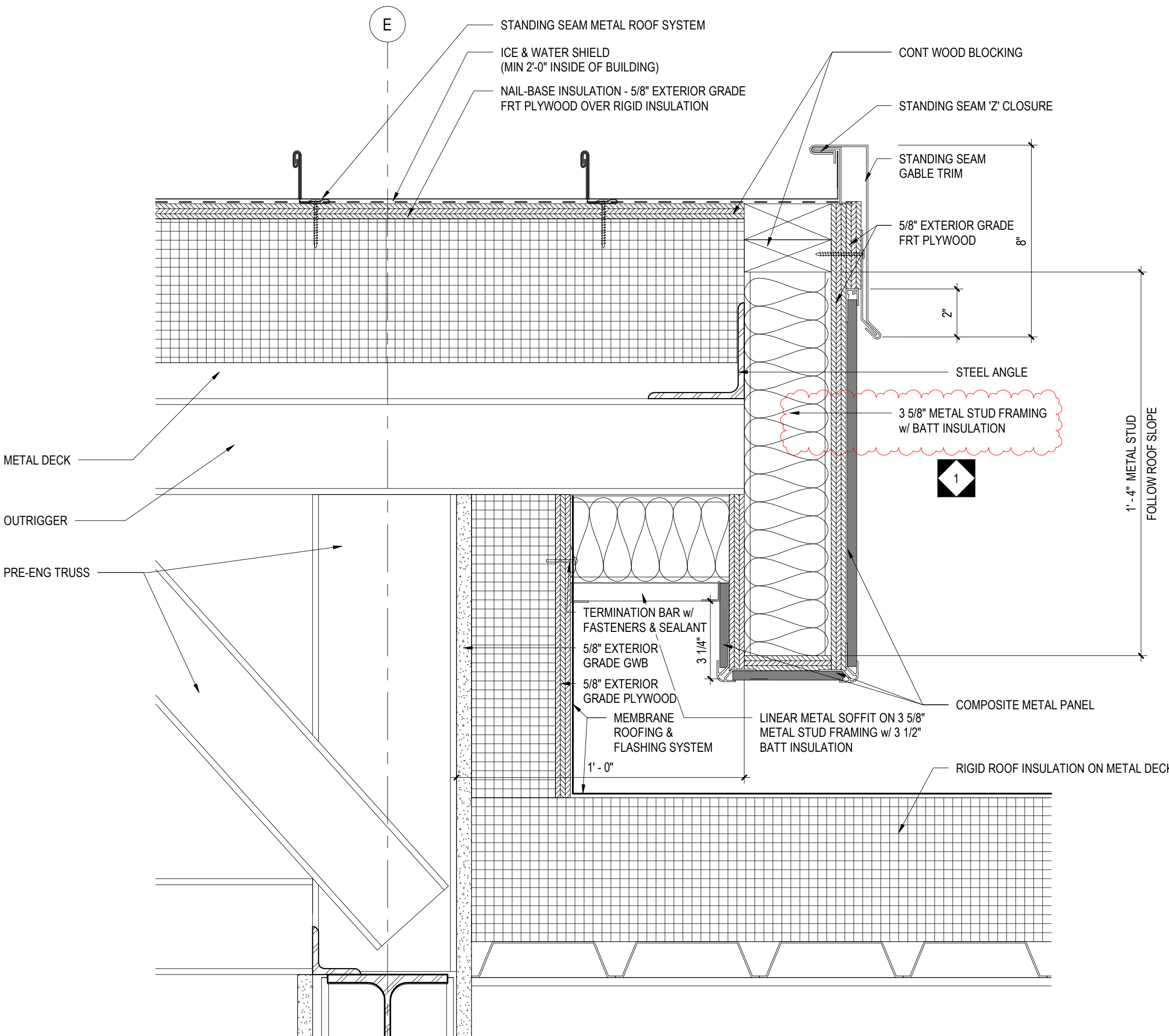
7 TYPICAL GWB CORNER TRIM DETAIL  
A5.2 12" = 1'-0"



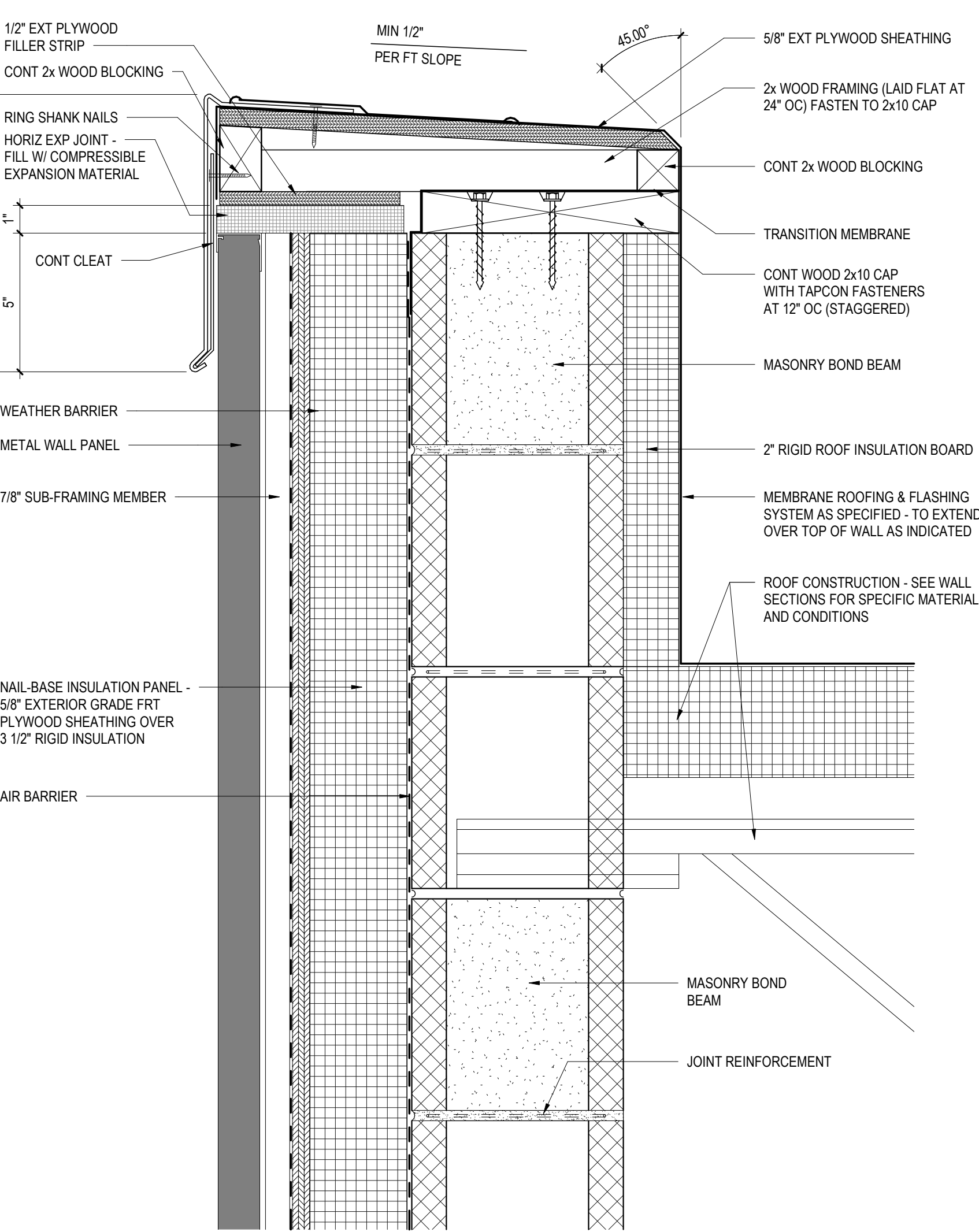
8 METAL PANEL ROOF PARAPET FASCIA DETAIL  
A5.2 3" = 1'-0"



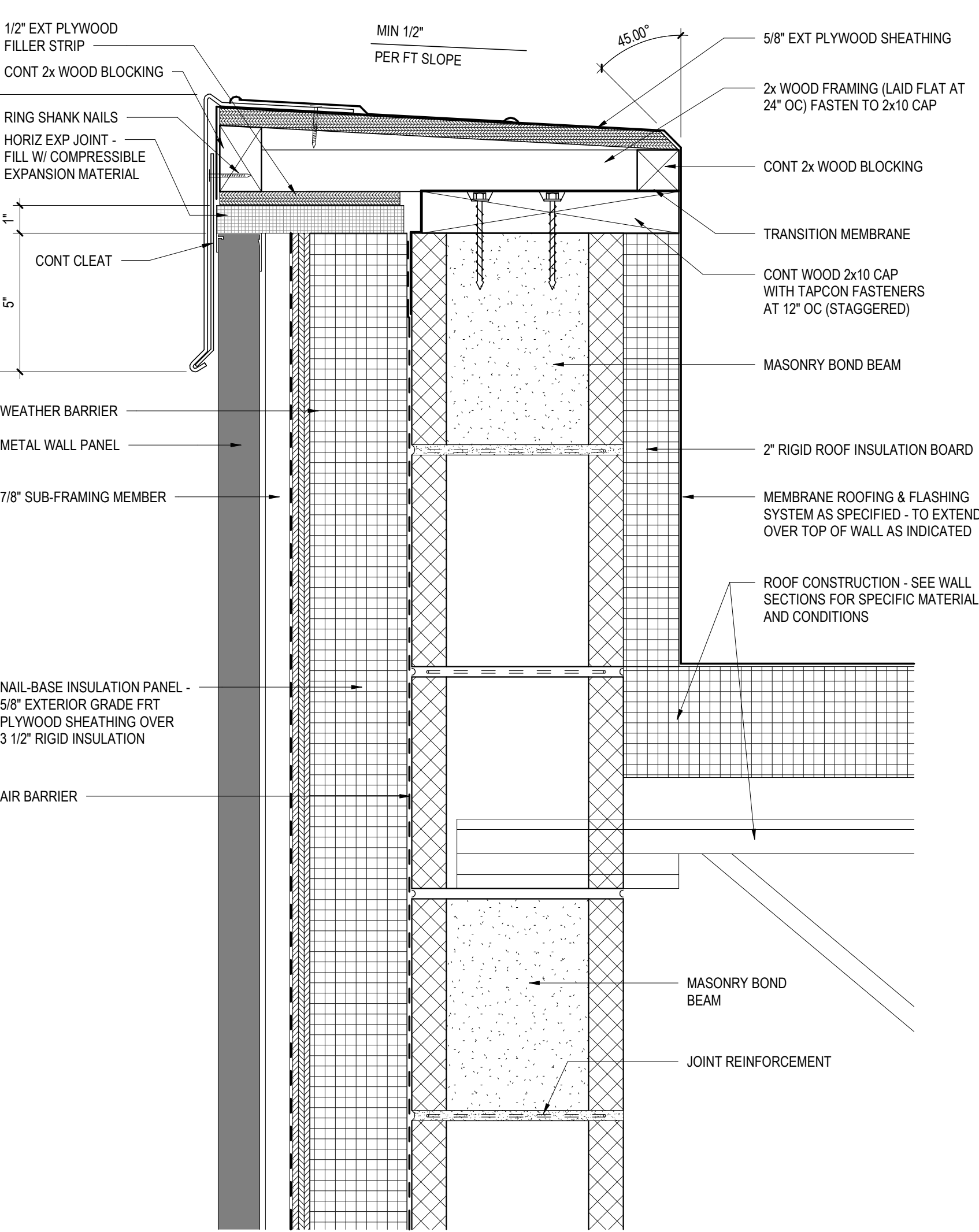
9 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 1 1/2" = 1'-0"



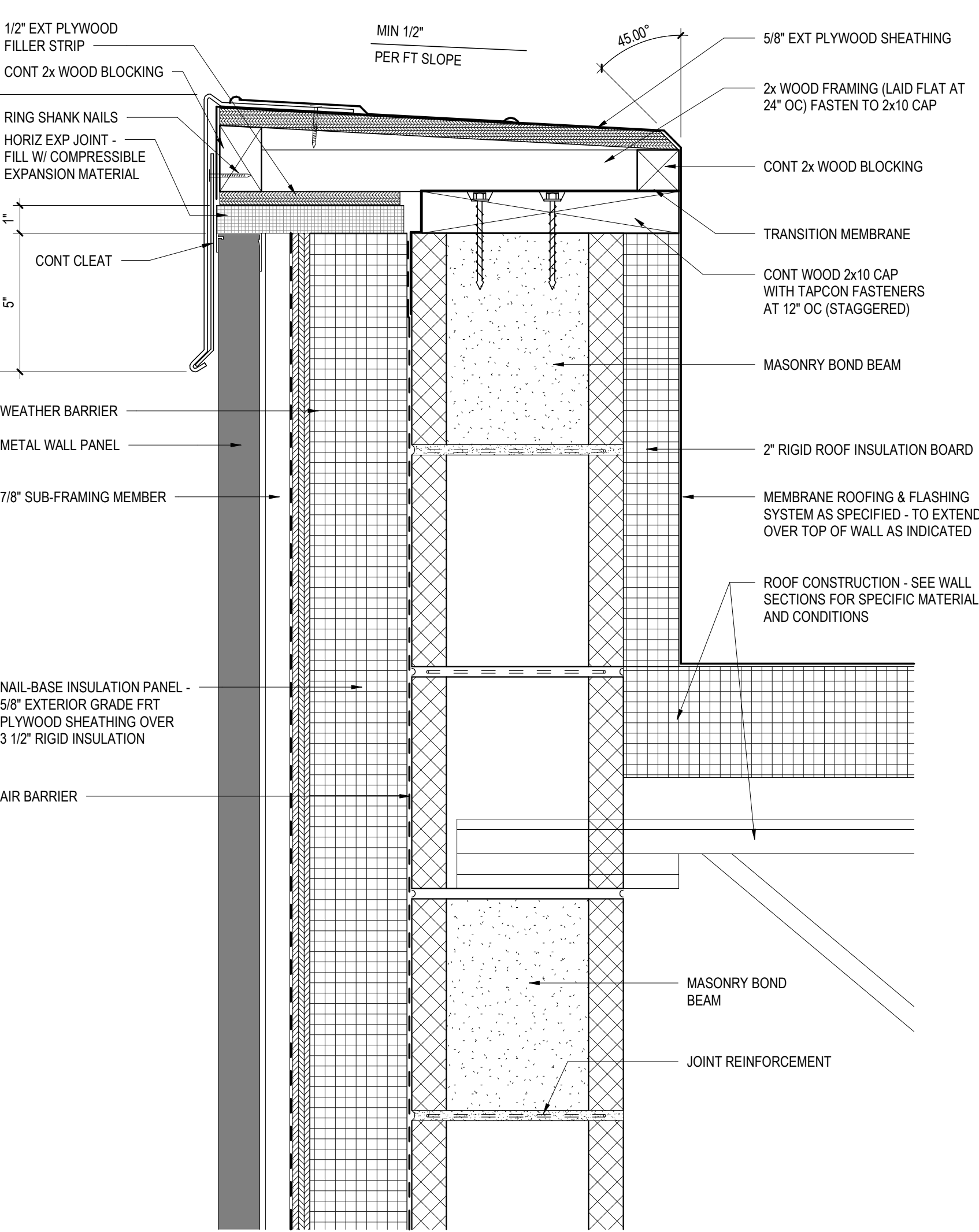
10 ROOF TO WALL FLASHING DETAIL - METAL STUD  
A5.2 3" = 1'-0"



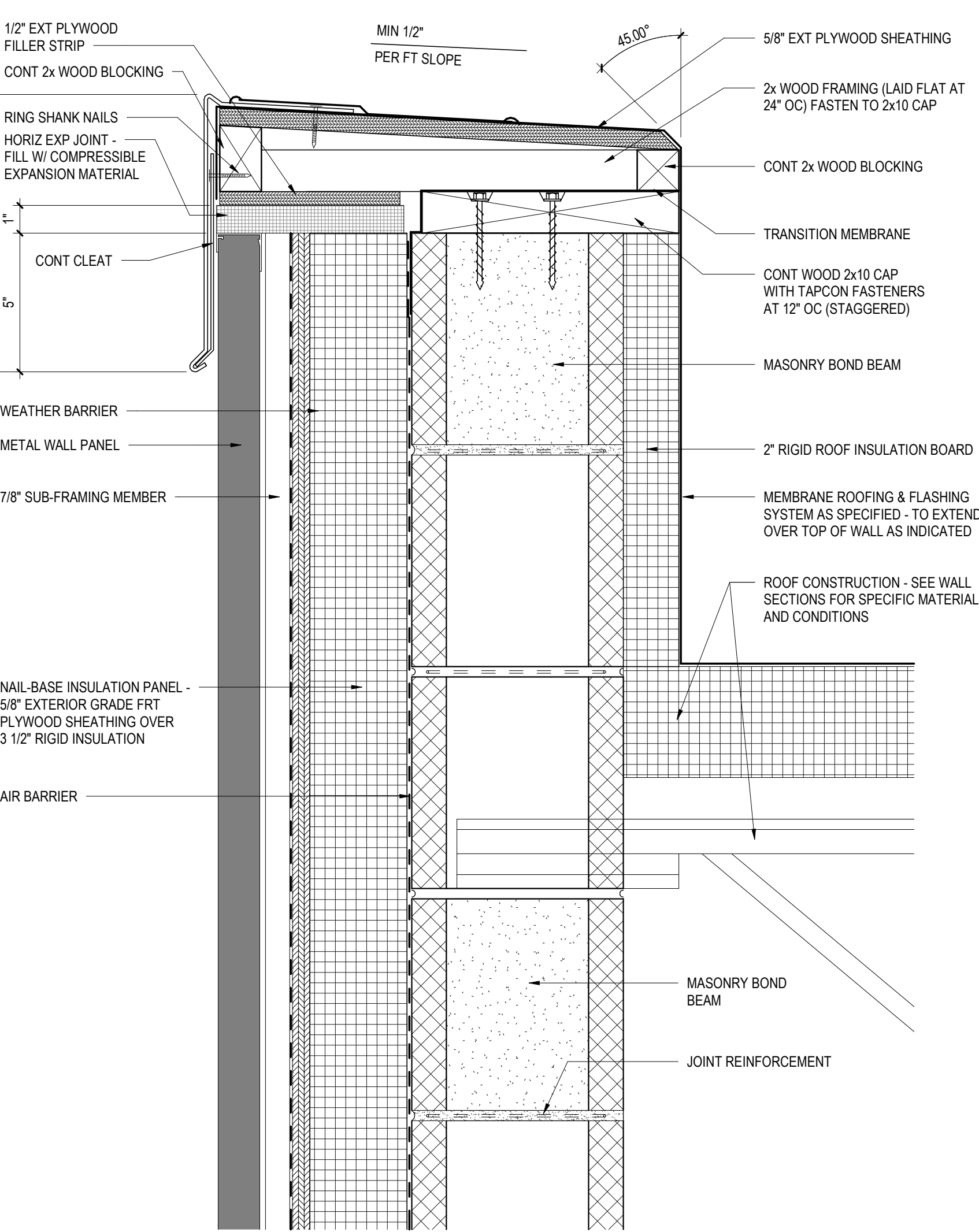
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A5.2 3" = 1'-0"



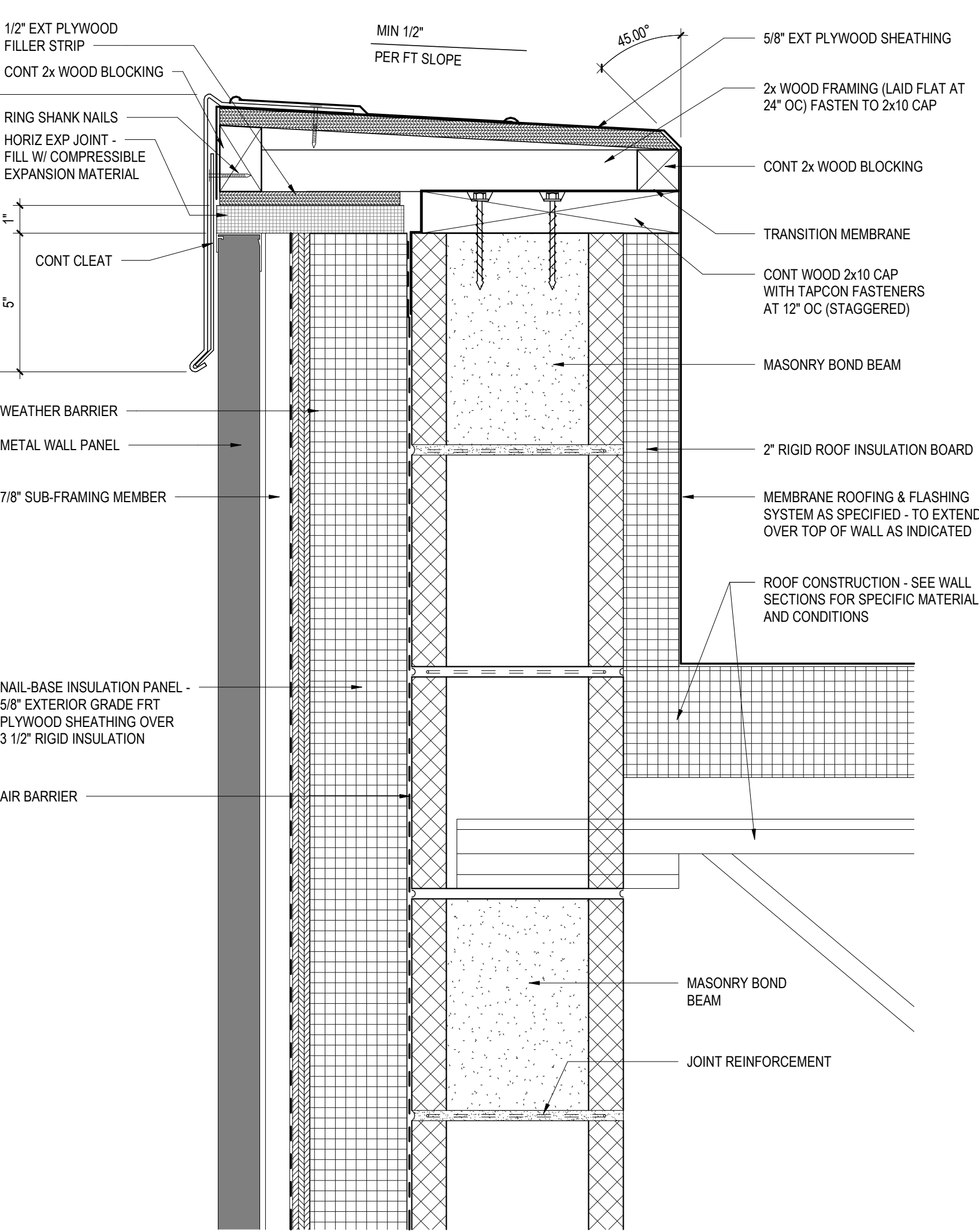
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A5.2 3" = 1'-0"



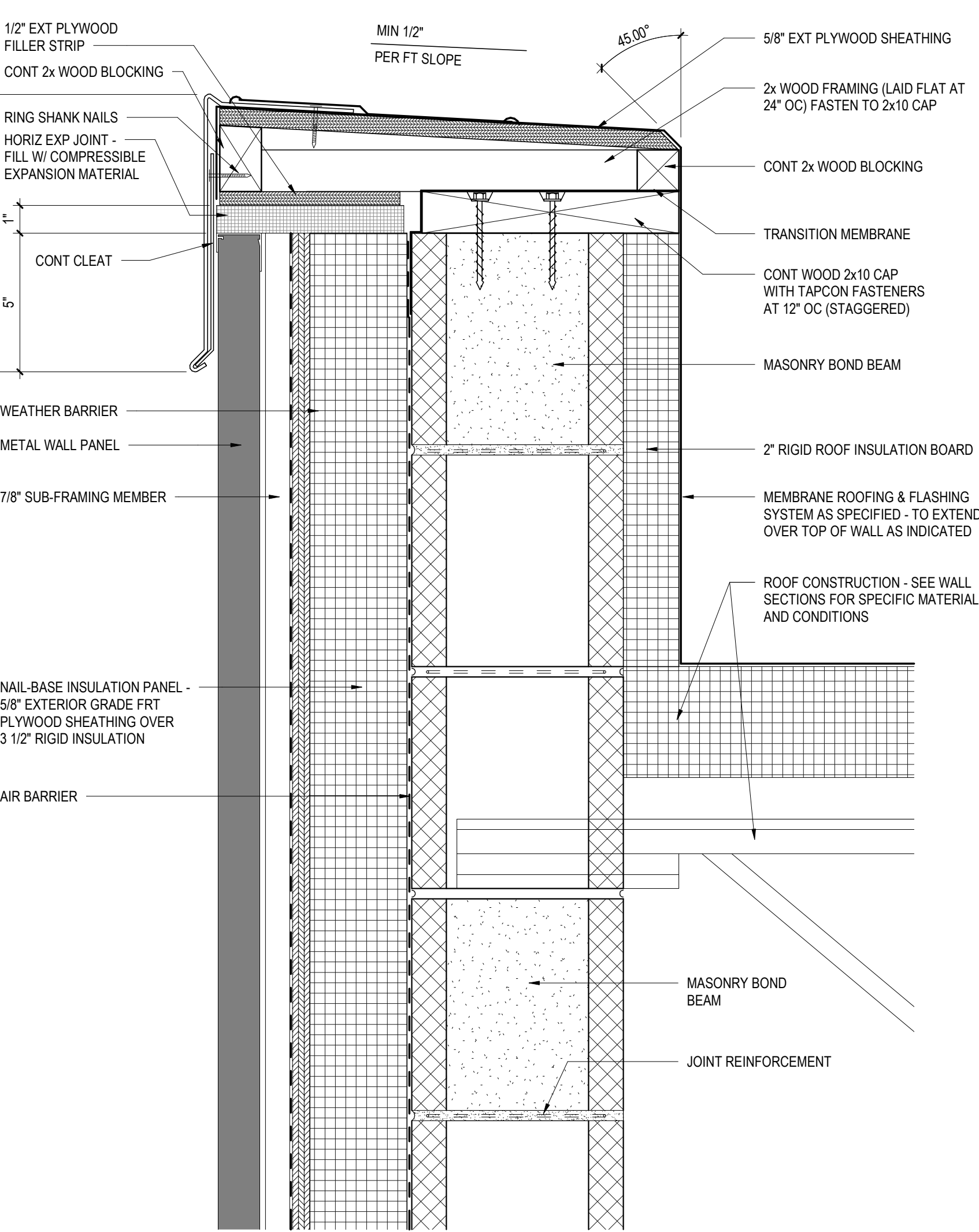
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A5.2 3" = 1'-0"



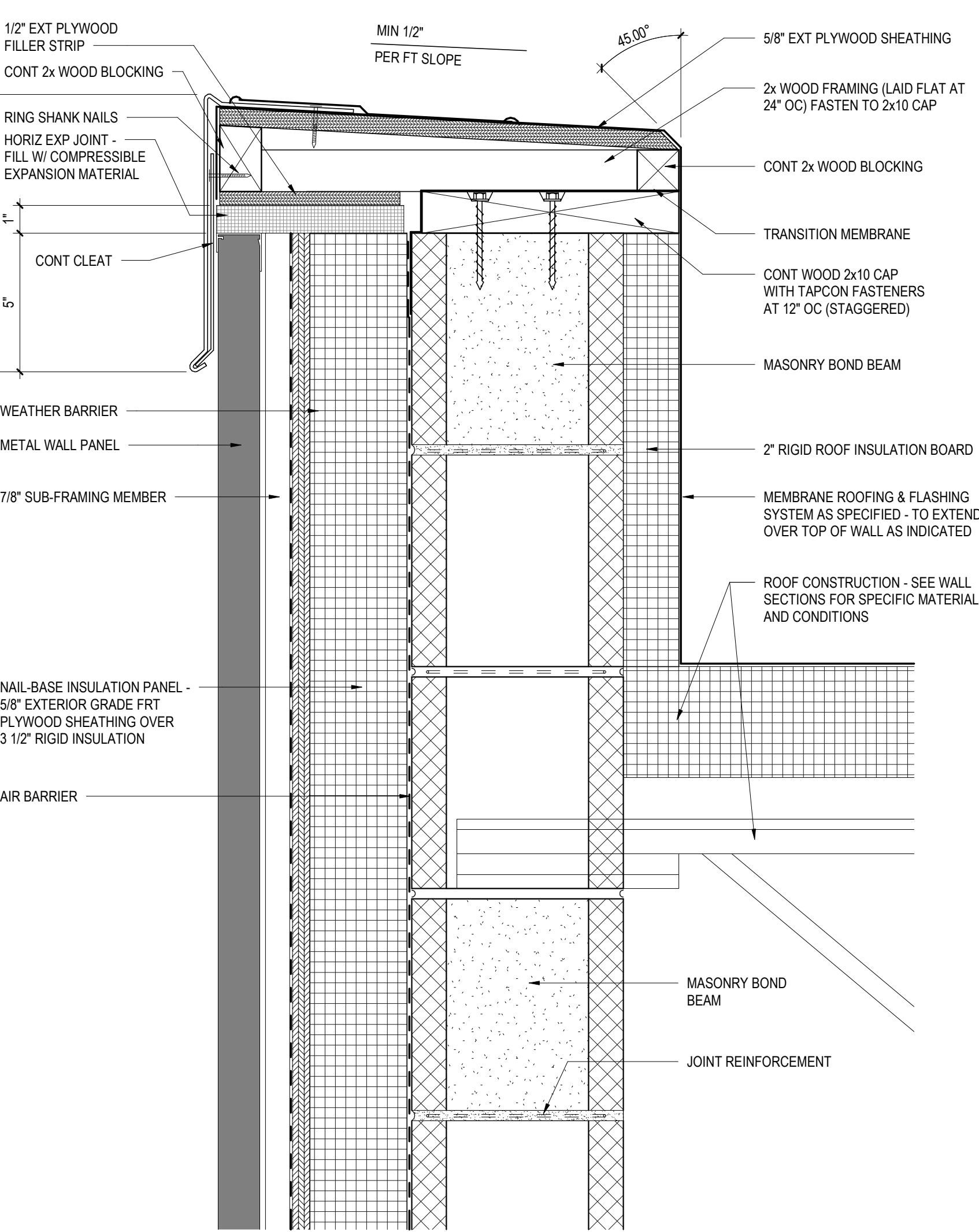
14 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



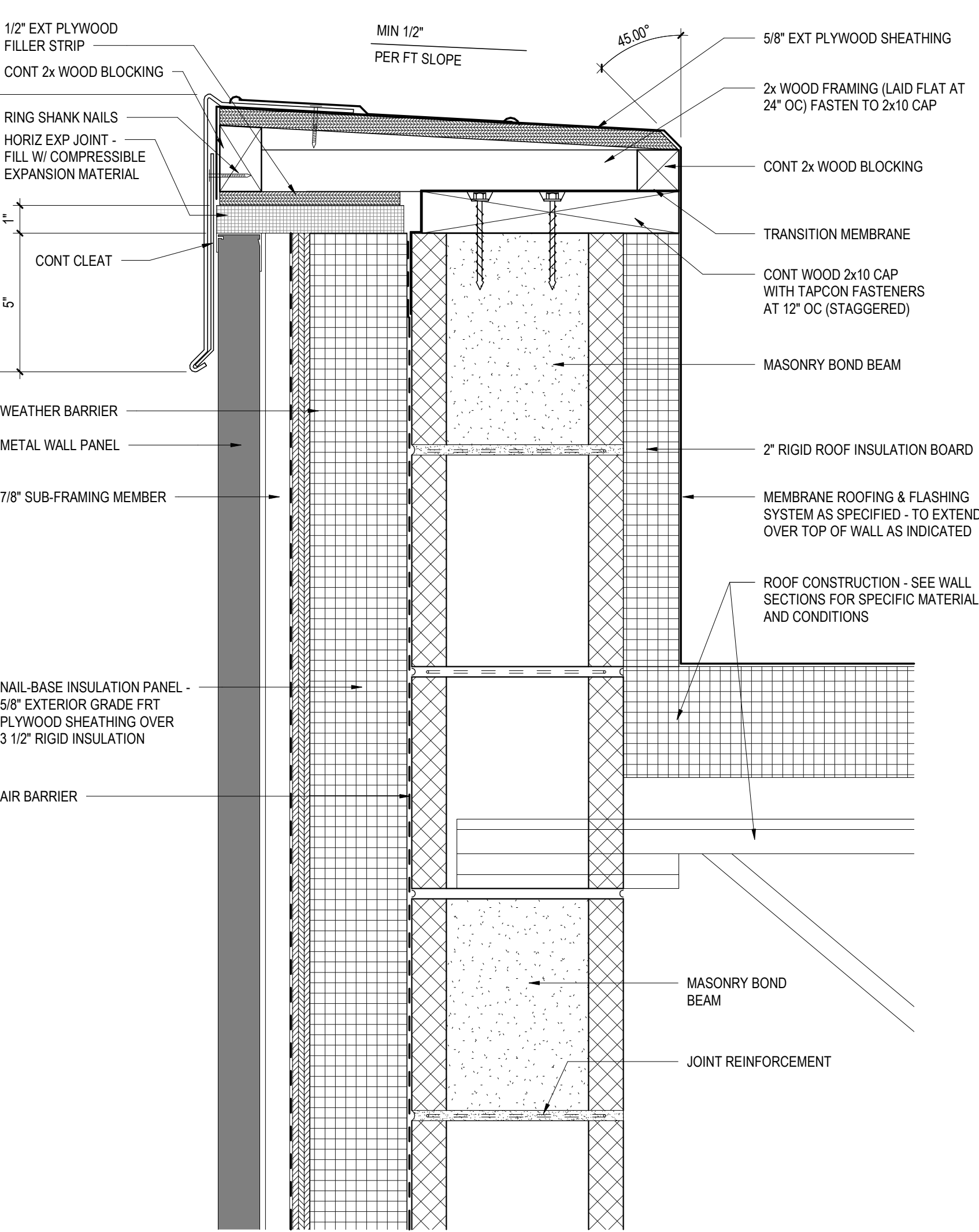
15 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



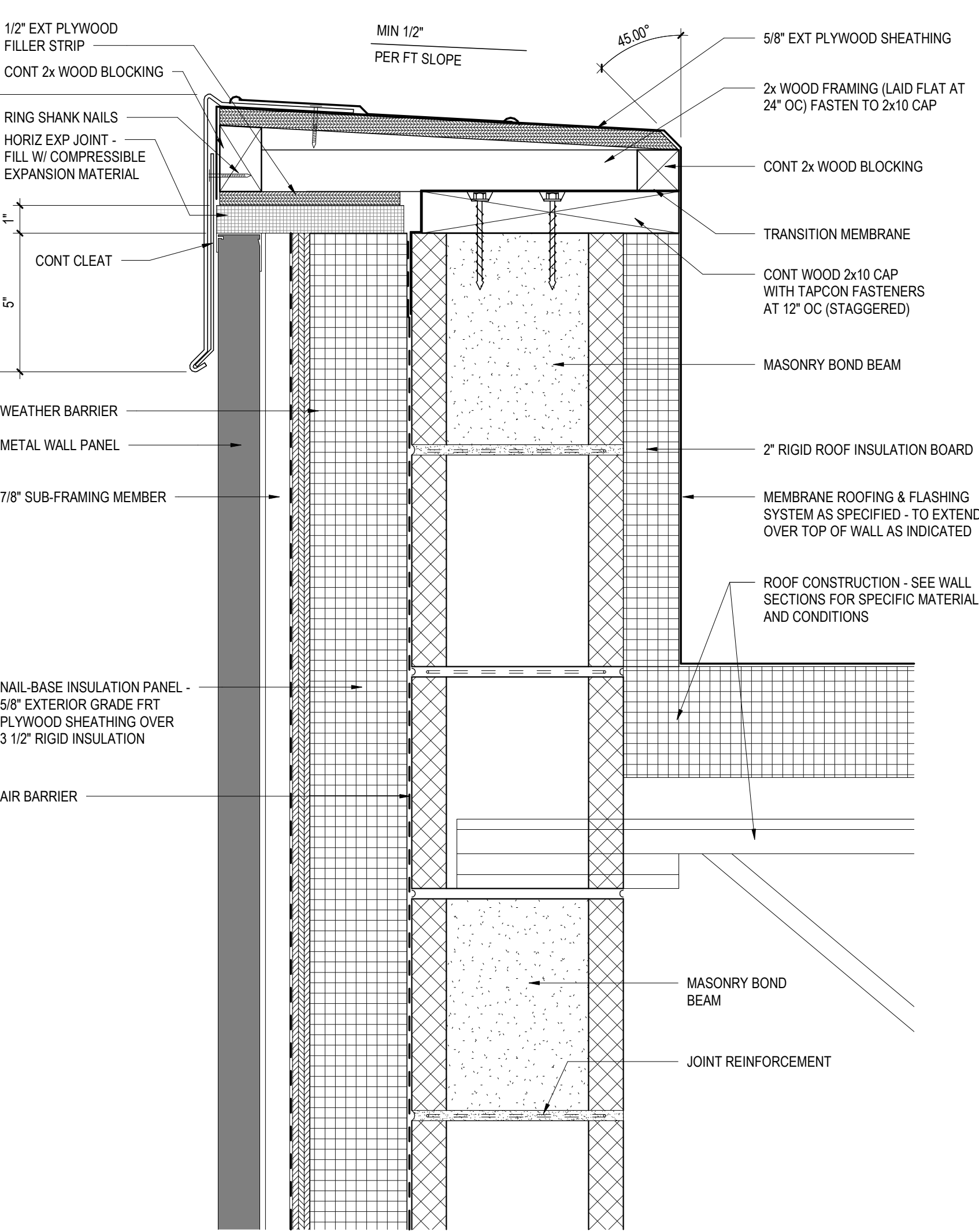
16 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



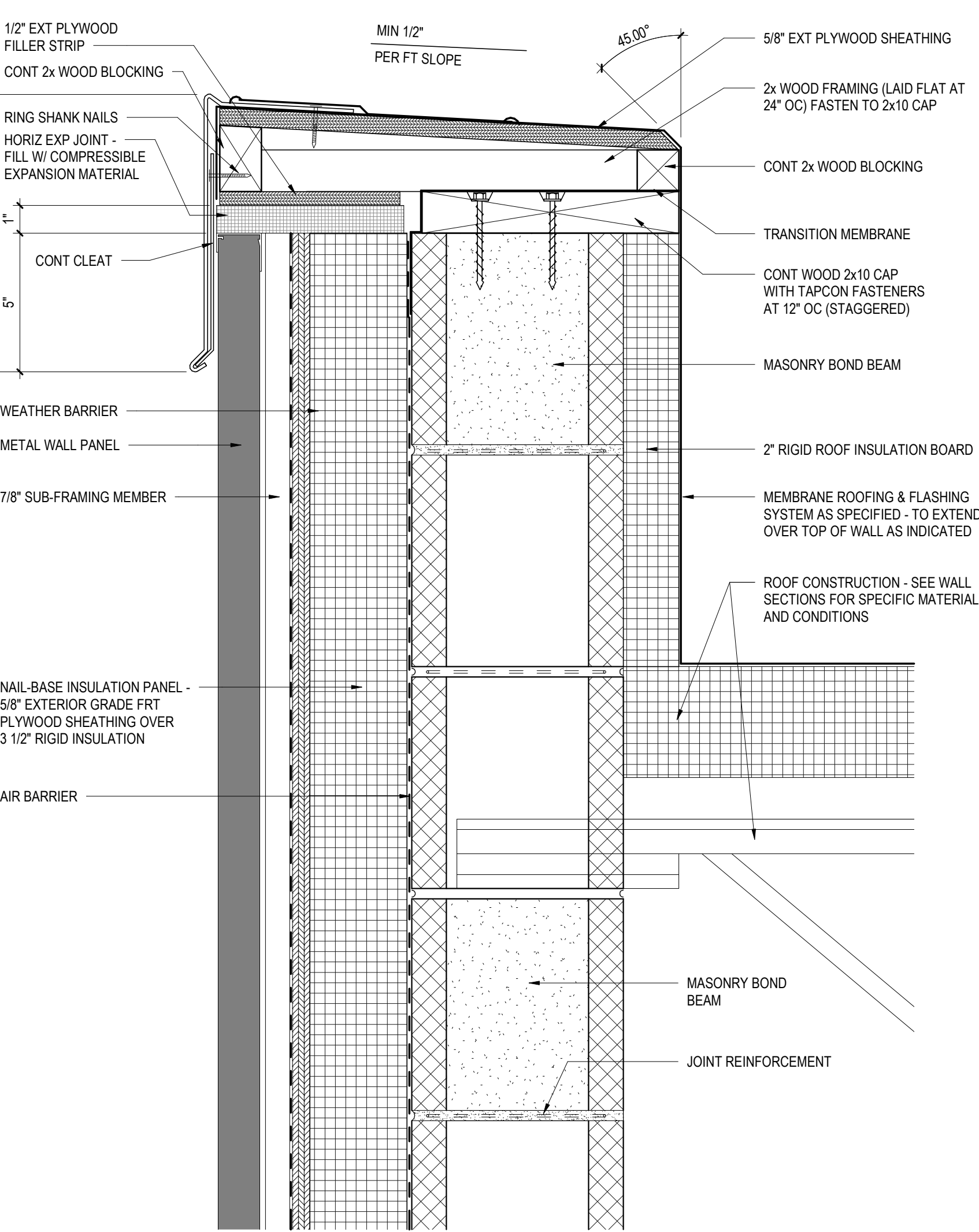
17 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



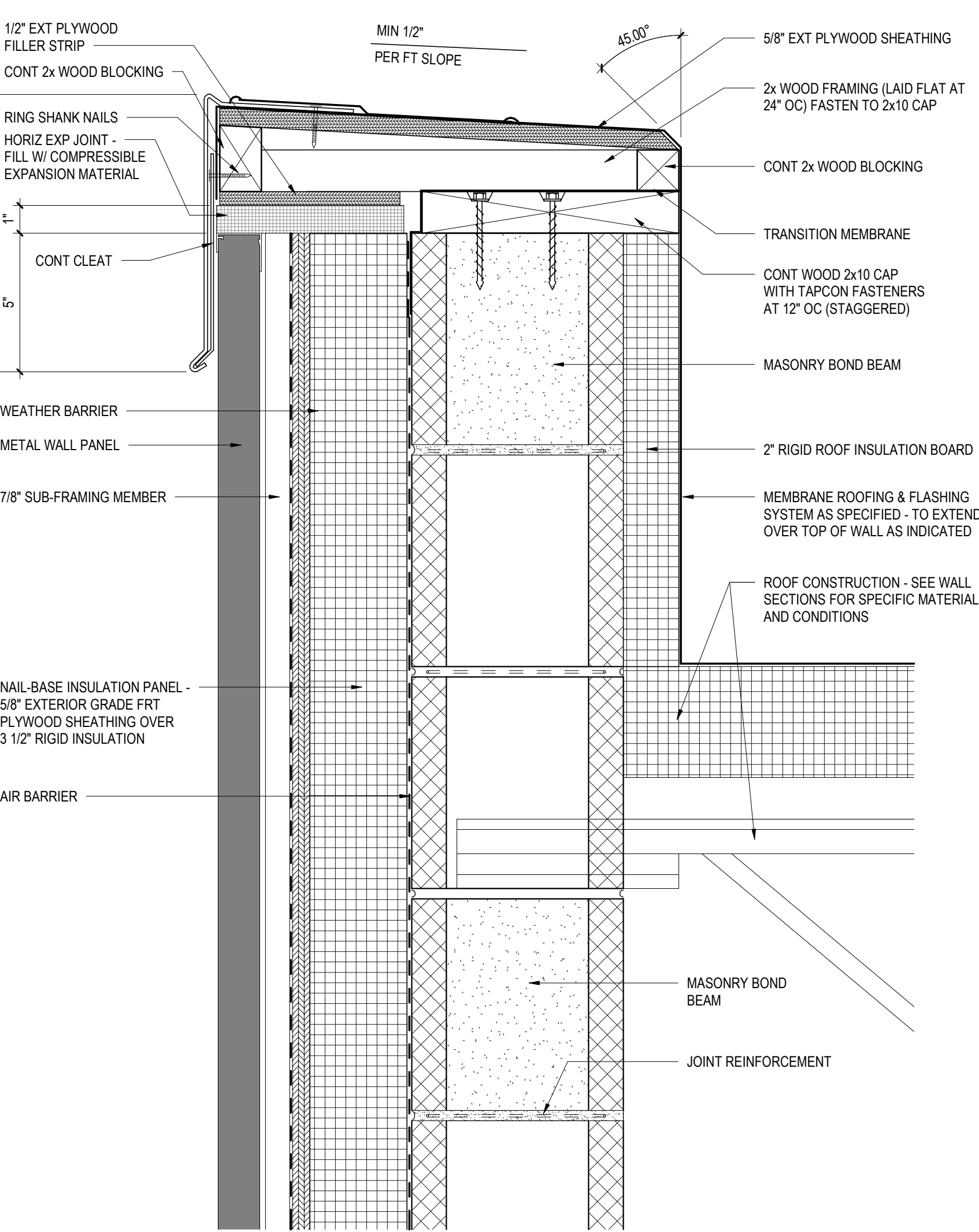
18 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
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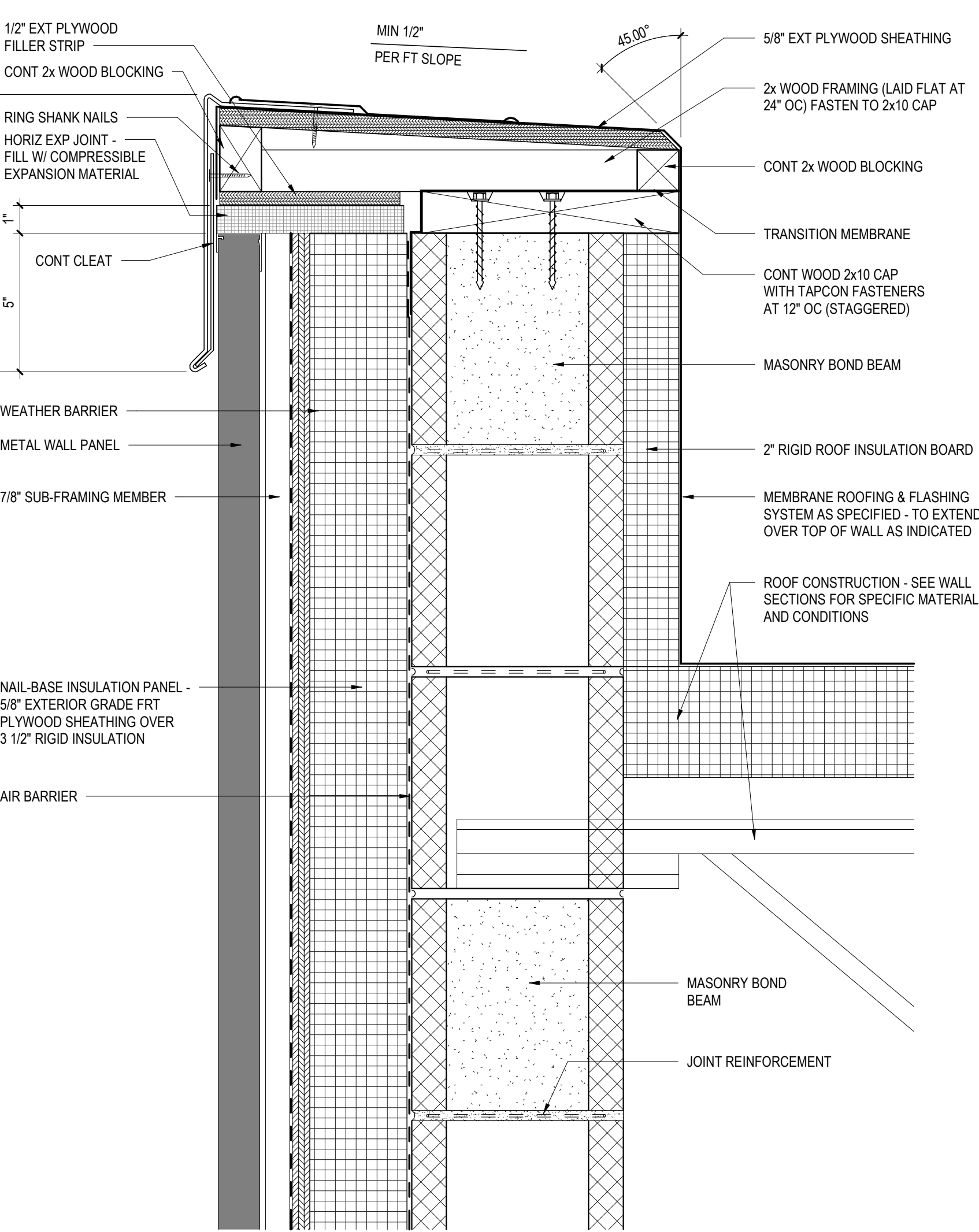
19 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
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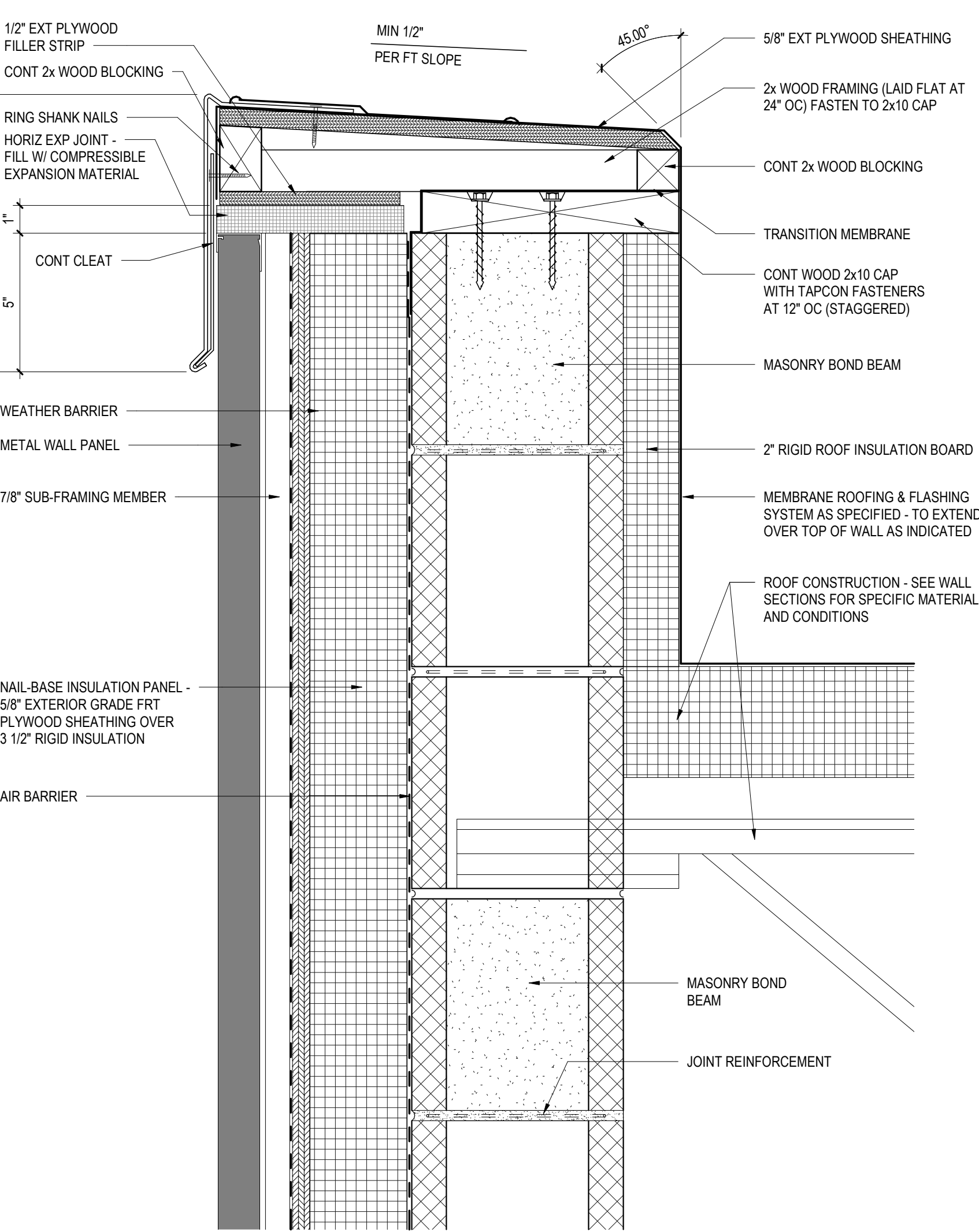
20 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



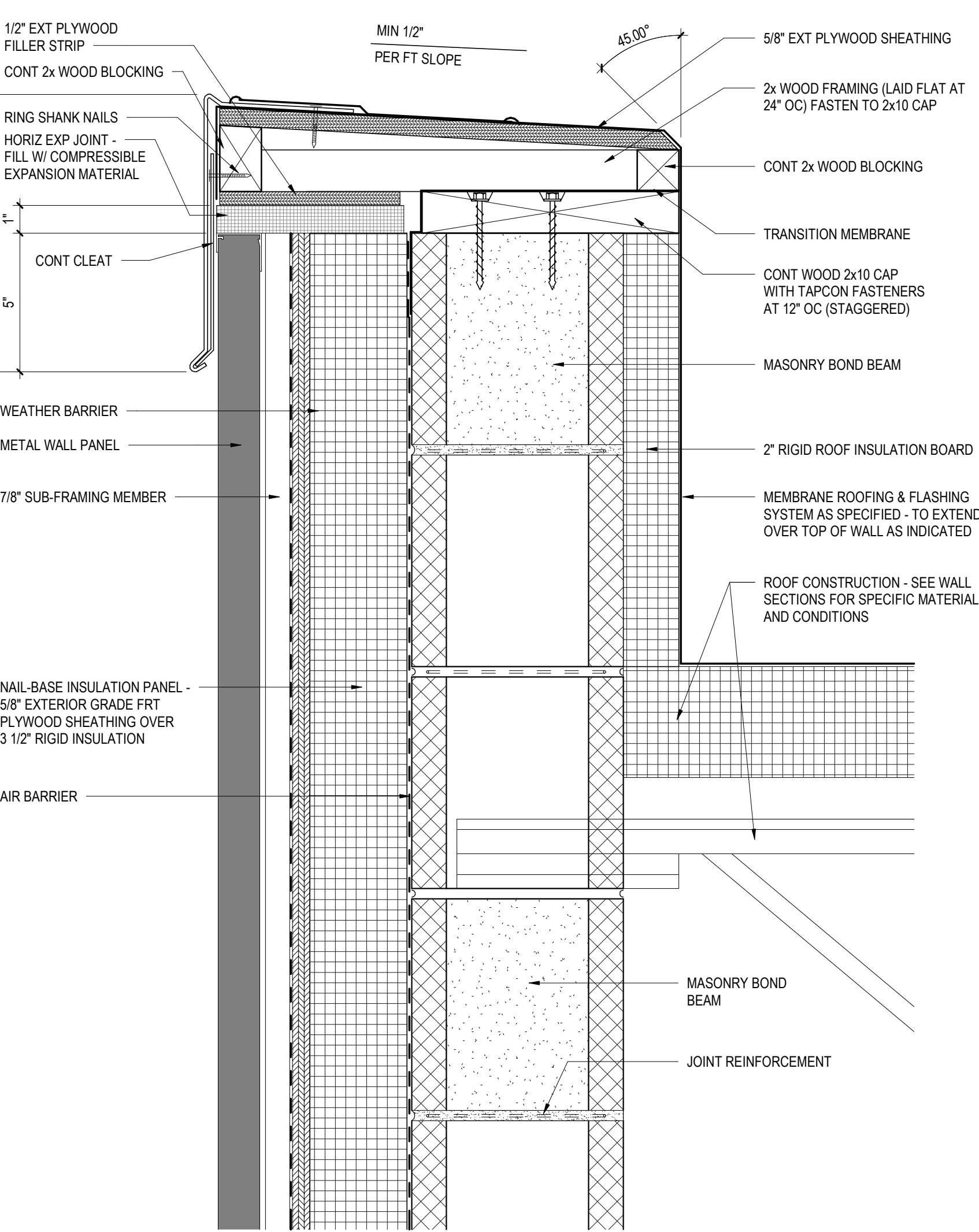
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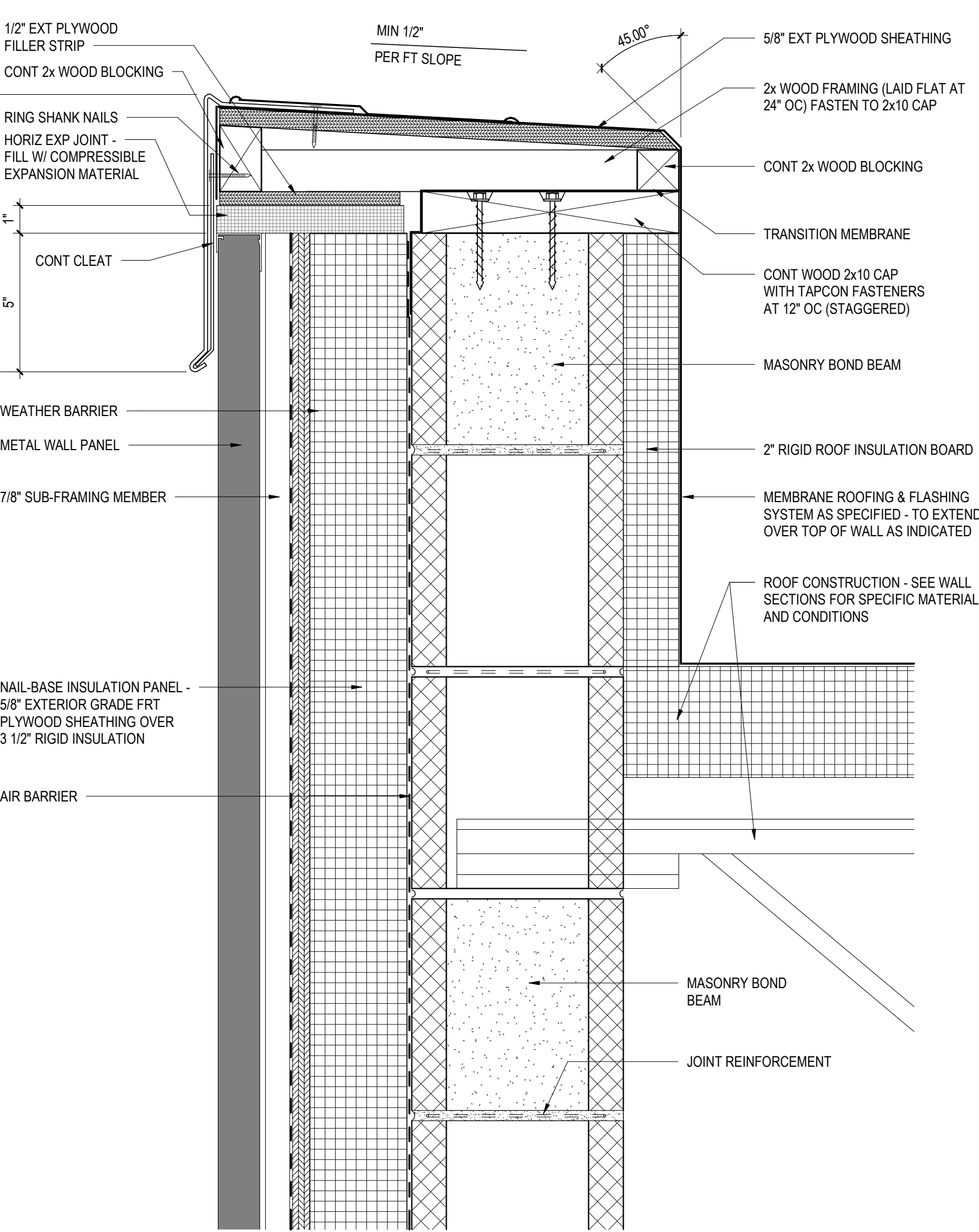
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A5.2 3" = 1'-0"



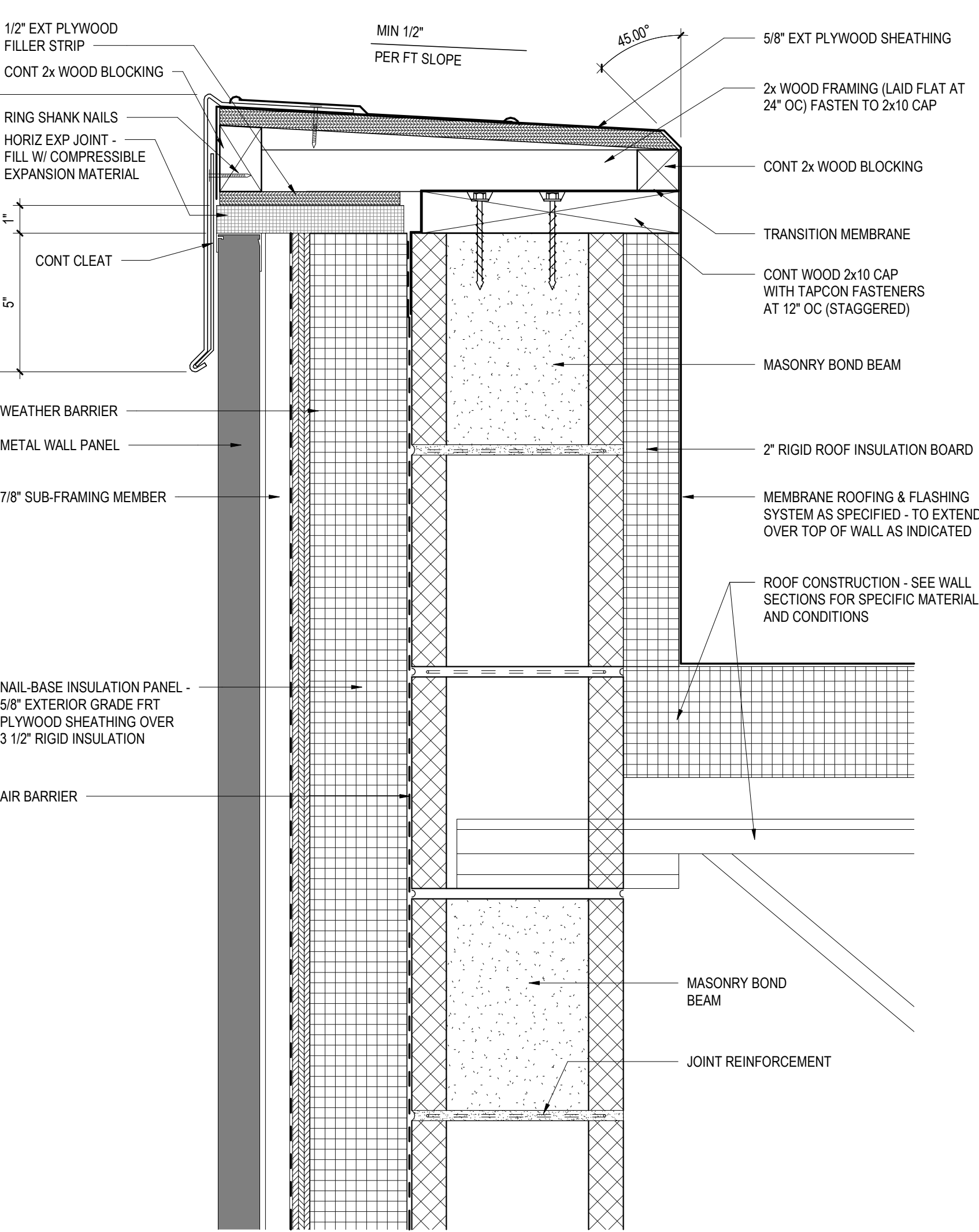
23 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



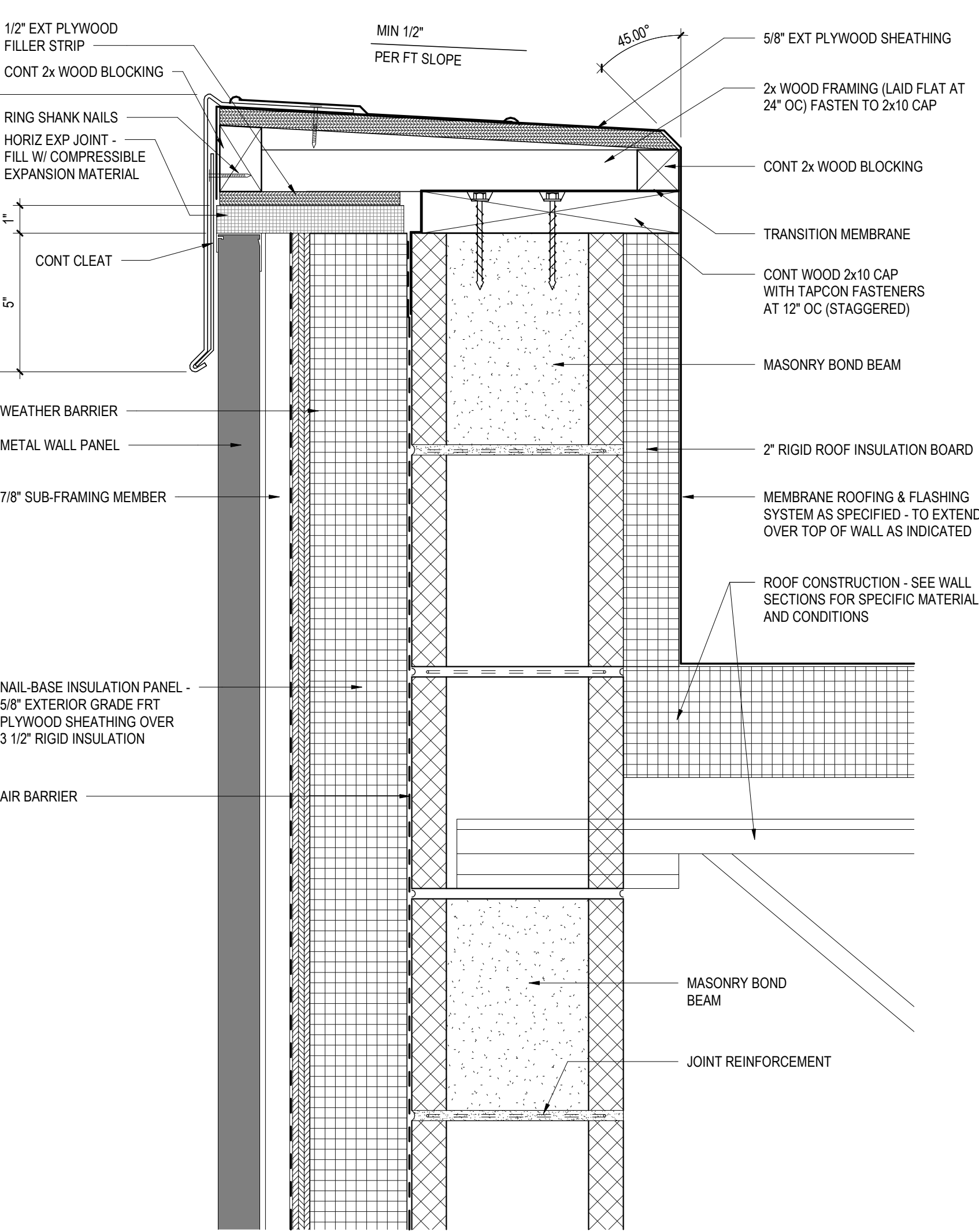
24 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
A5.2 3" = 1'-0"



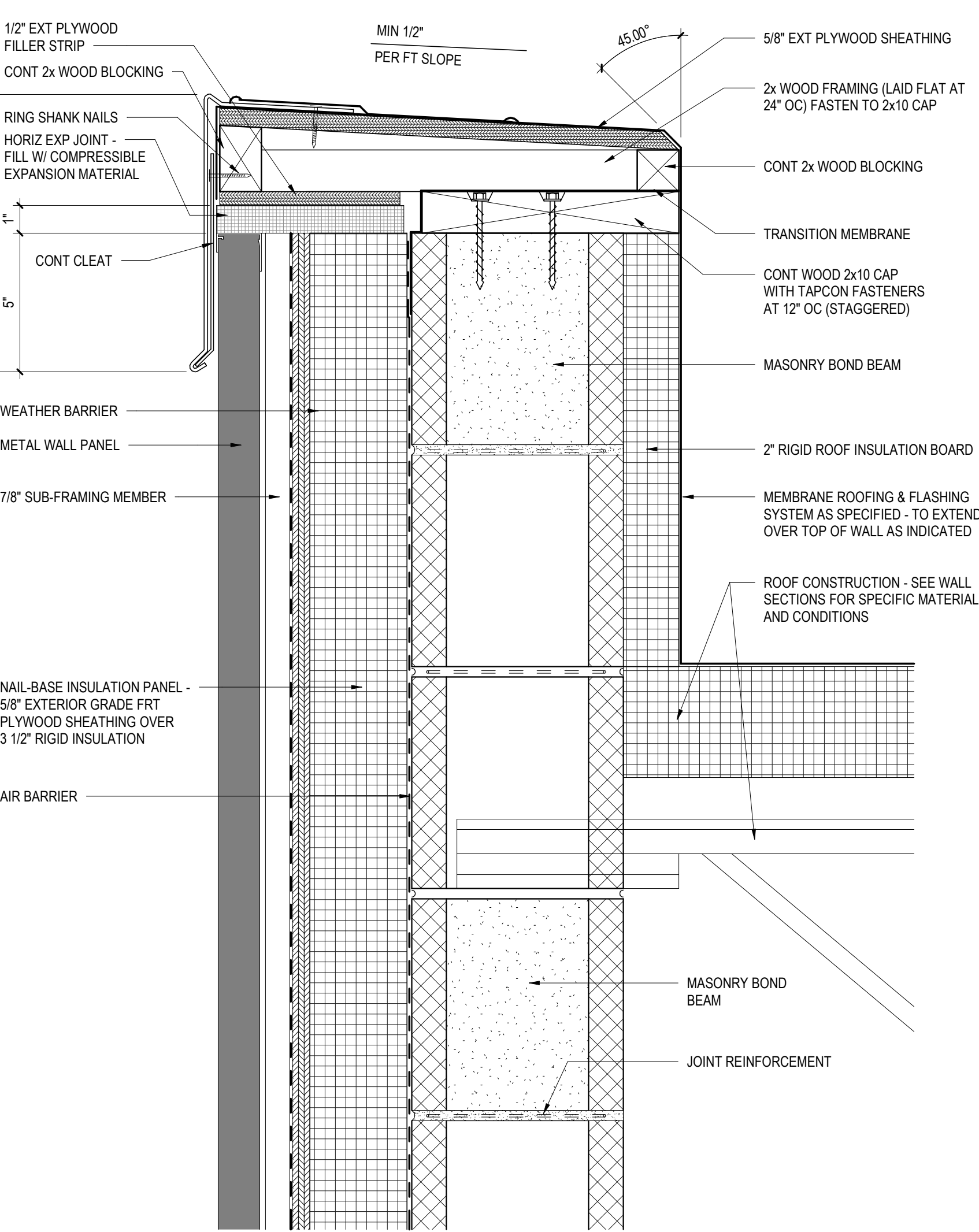
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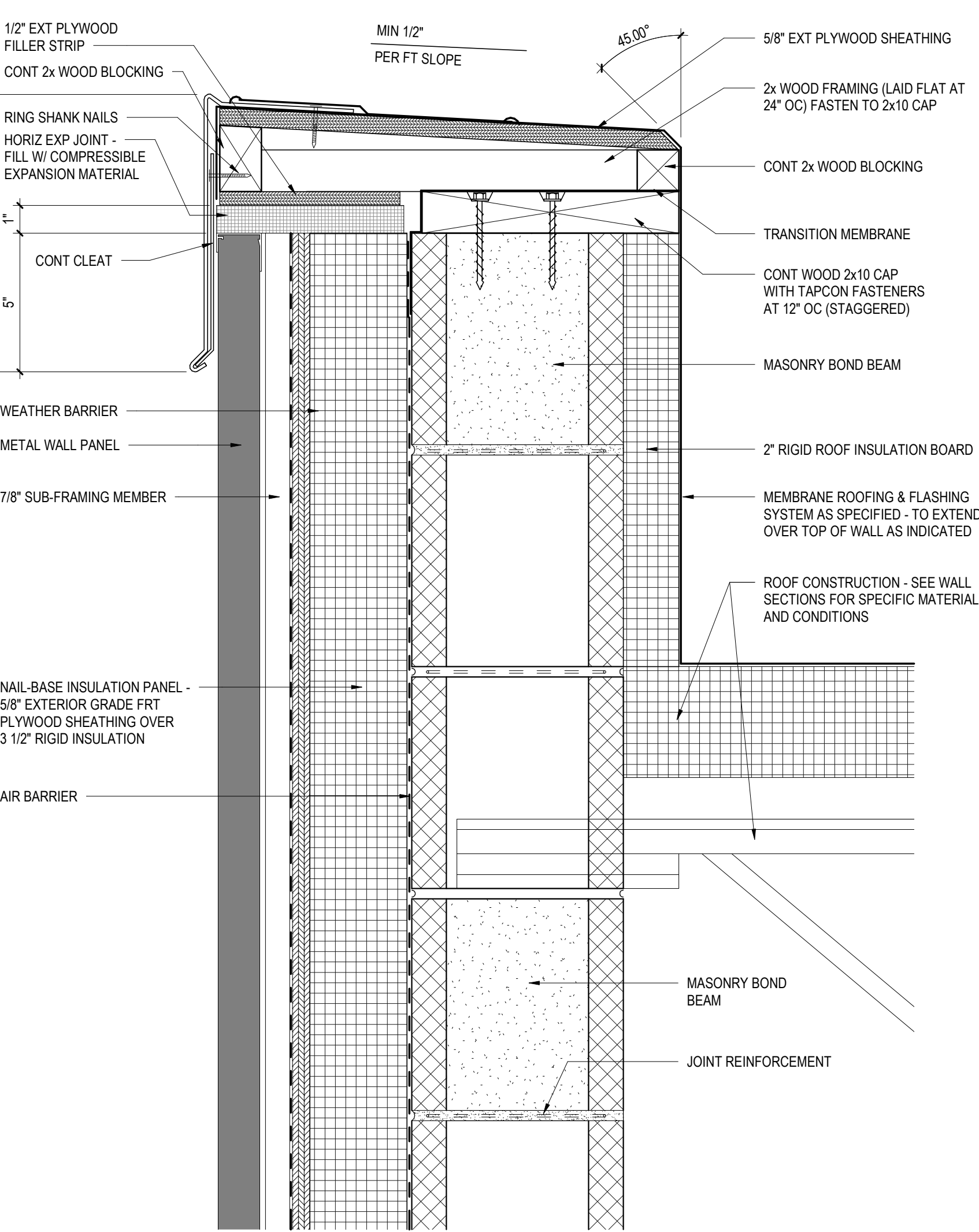
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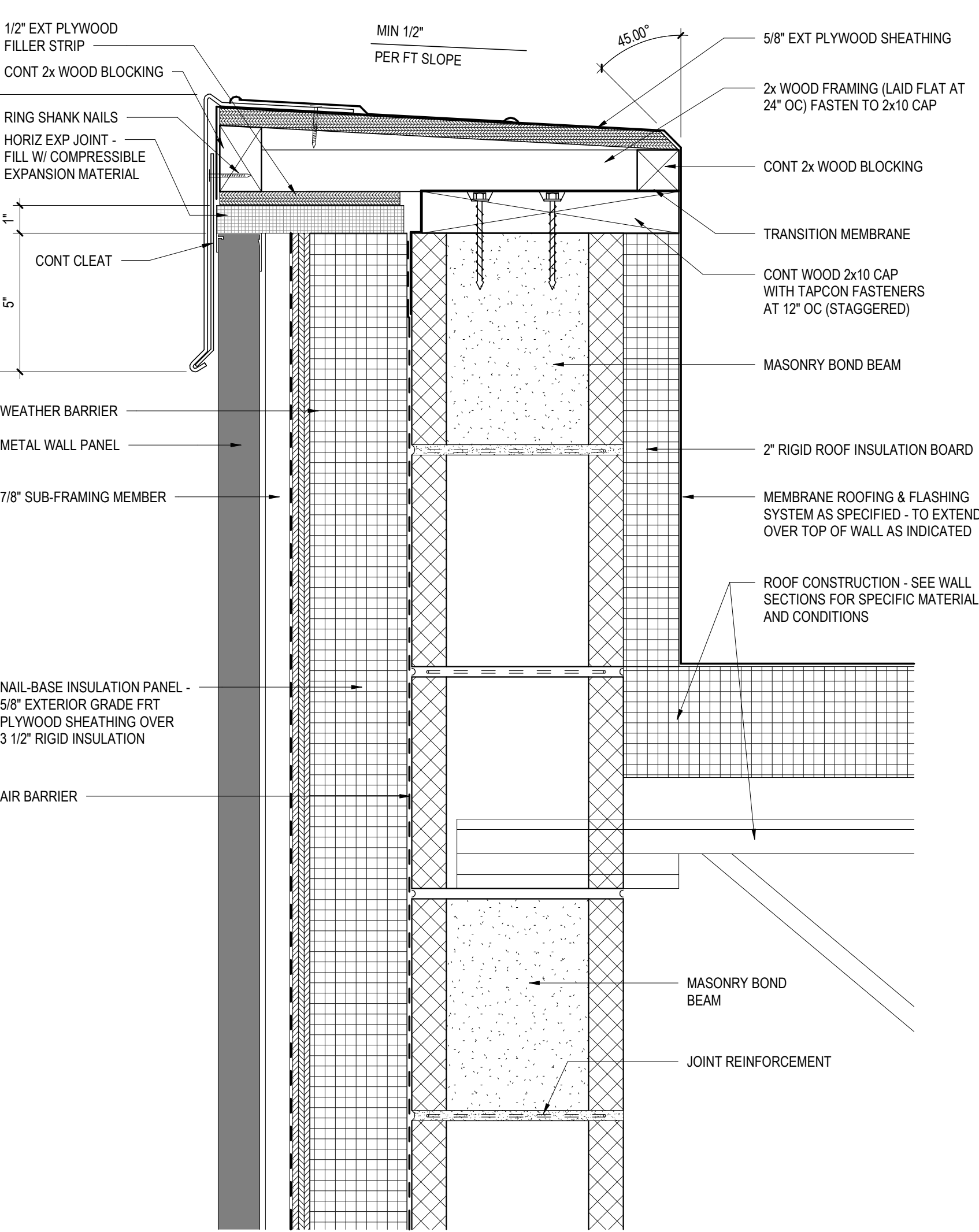
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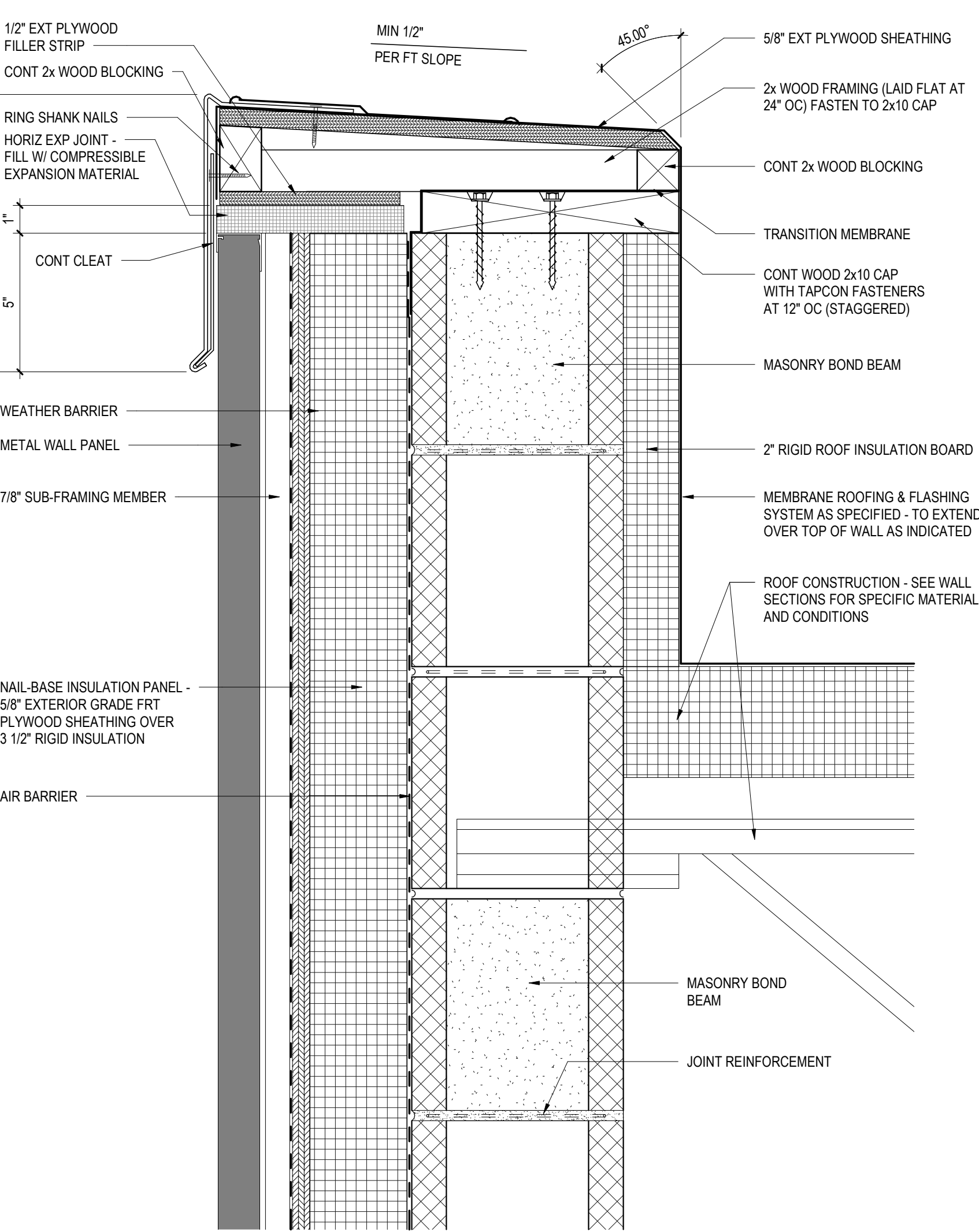
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A5.2 3" = 1'-0"



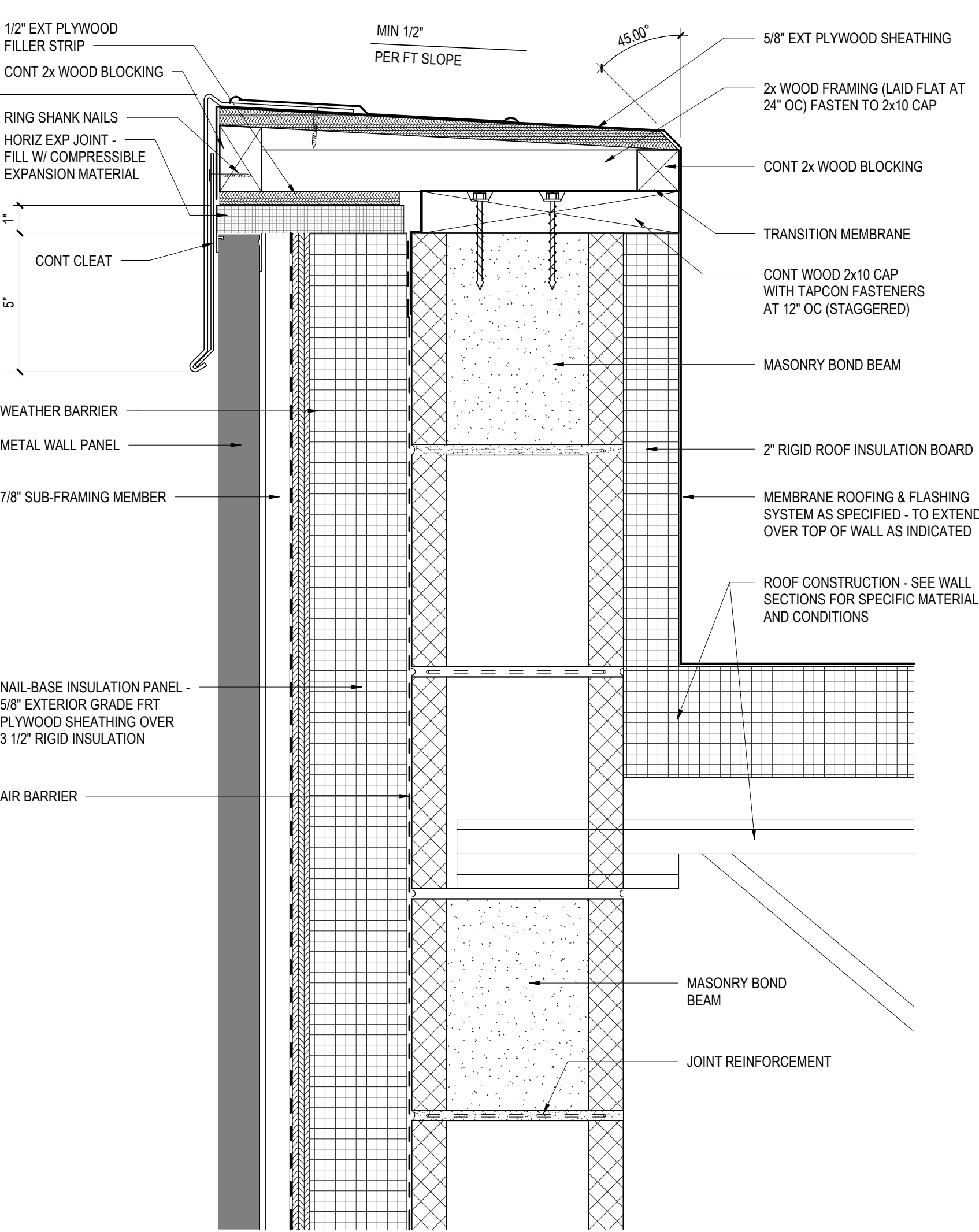
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A5.2 3" = 1'-0"



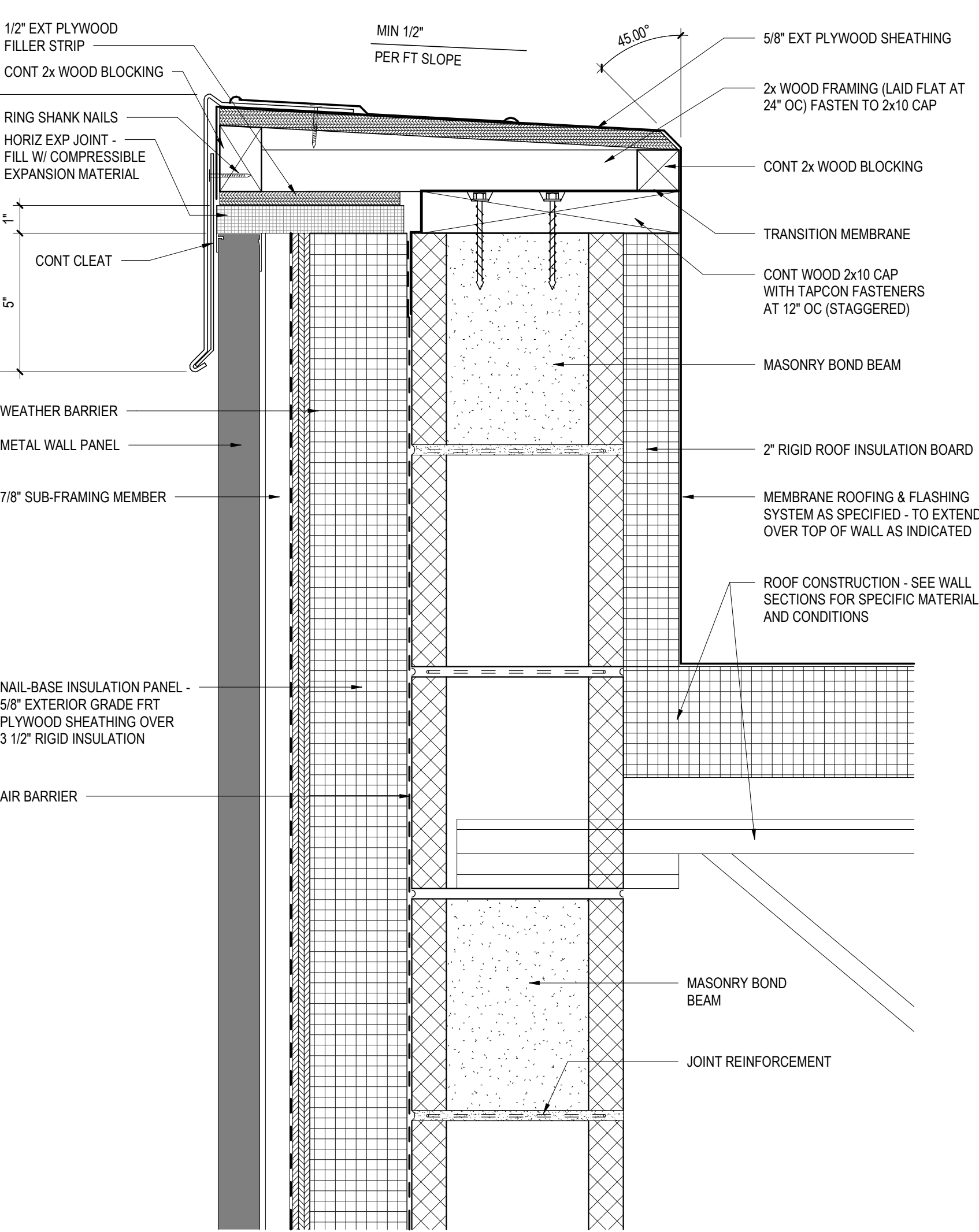
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A5.2 3" = 1'-0"

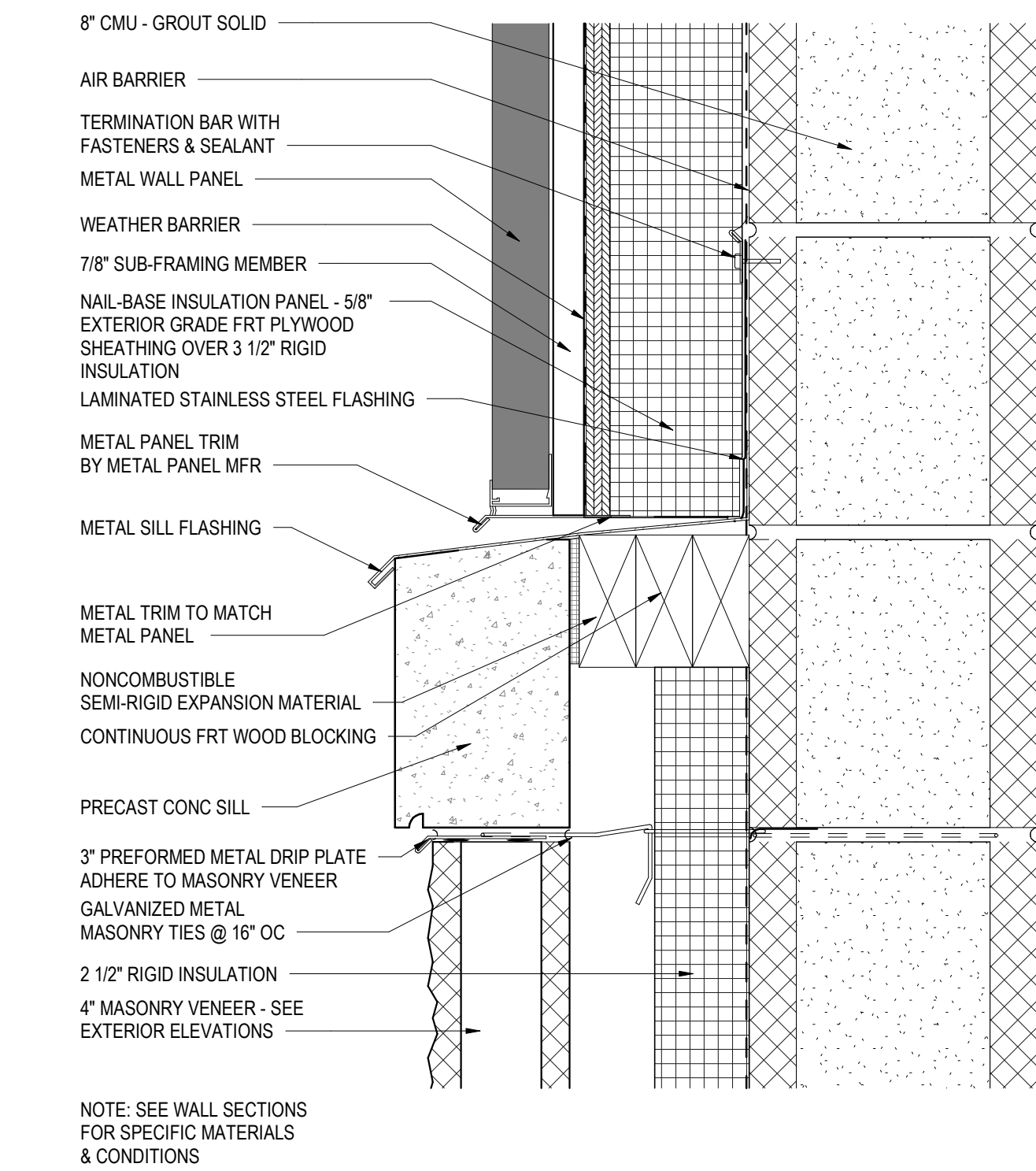


31 TYPICAL WATERPROOFING DETAIL W/ INSULATION  
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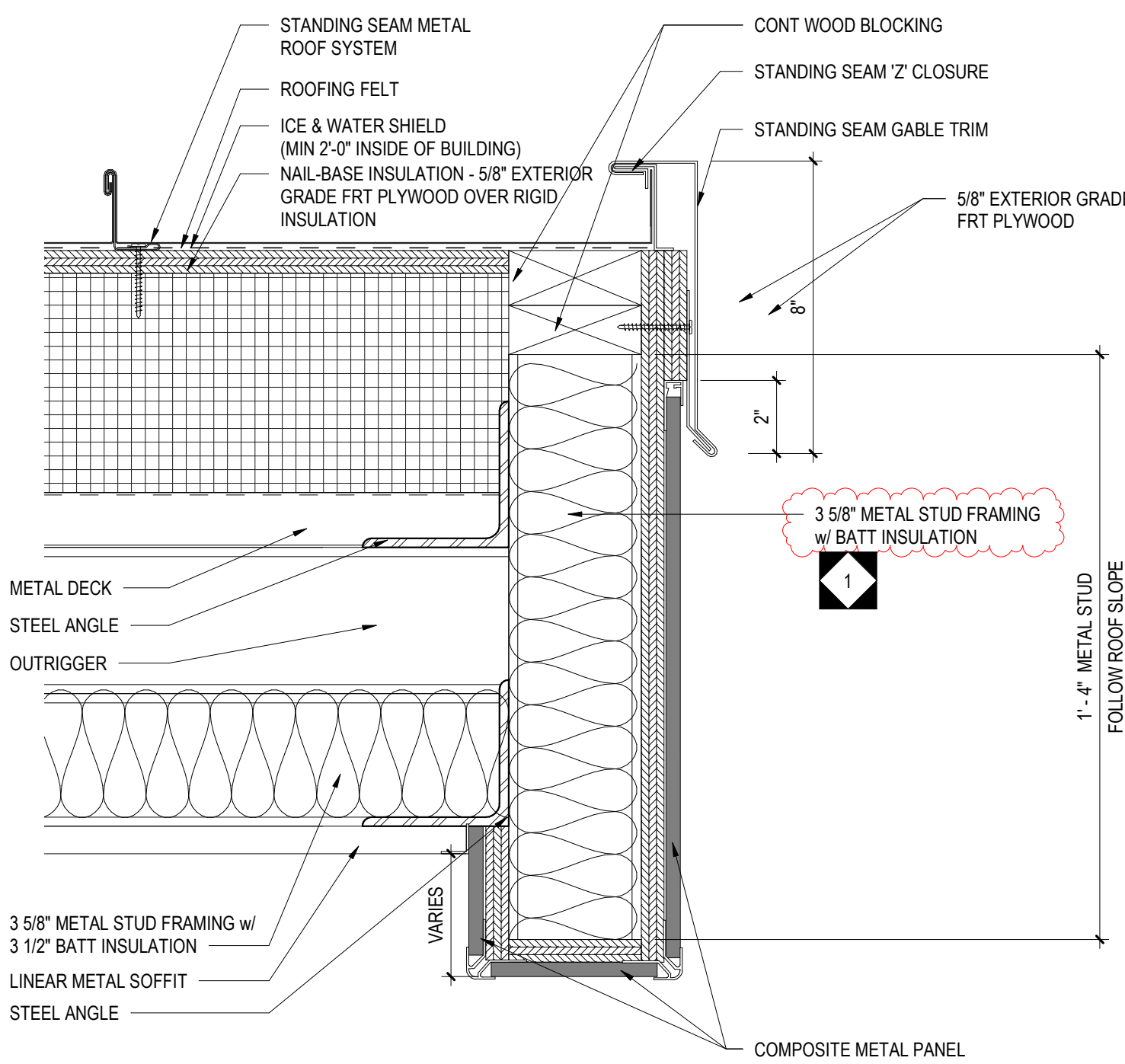


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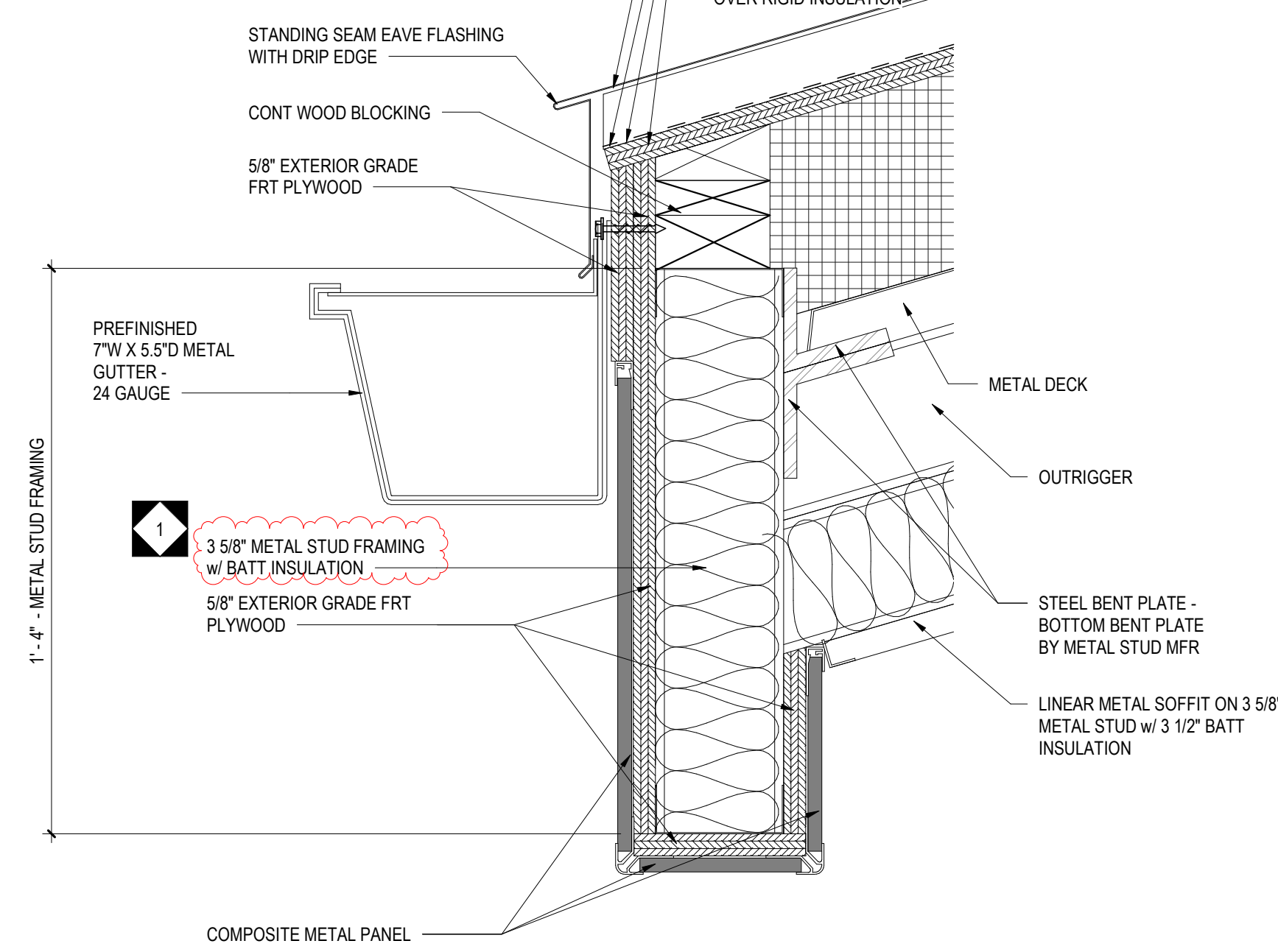




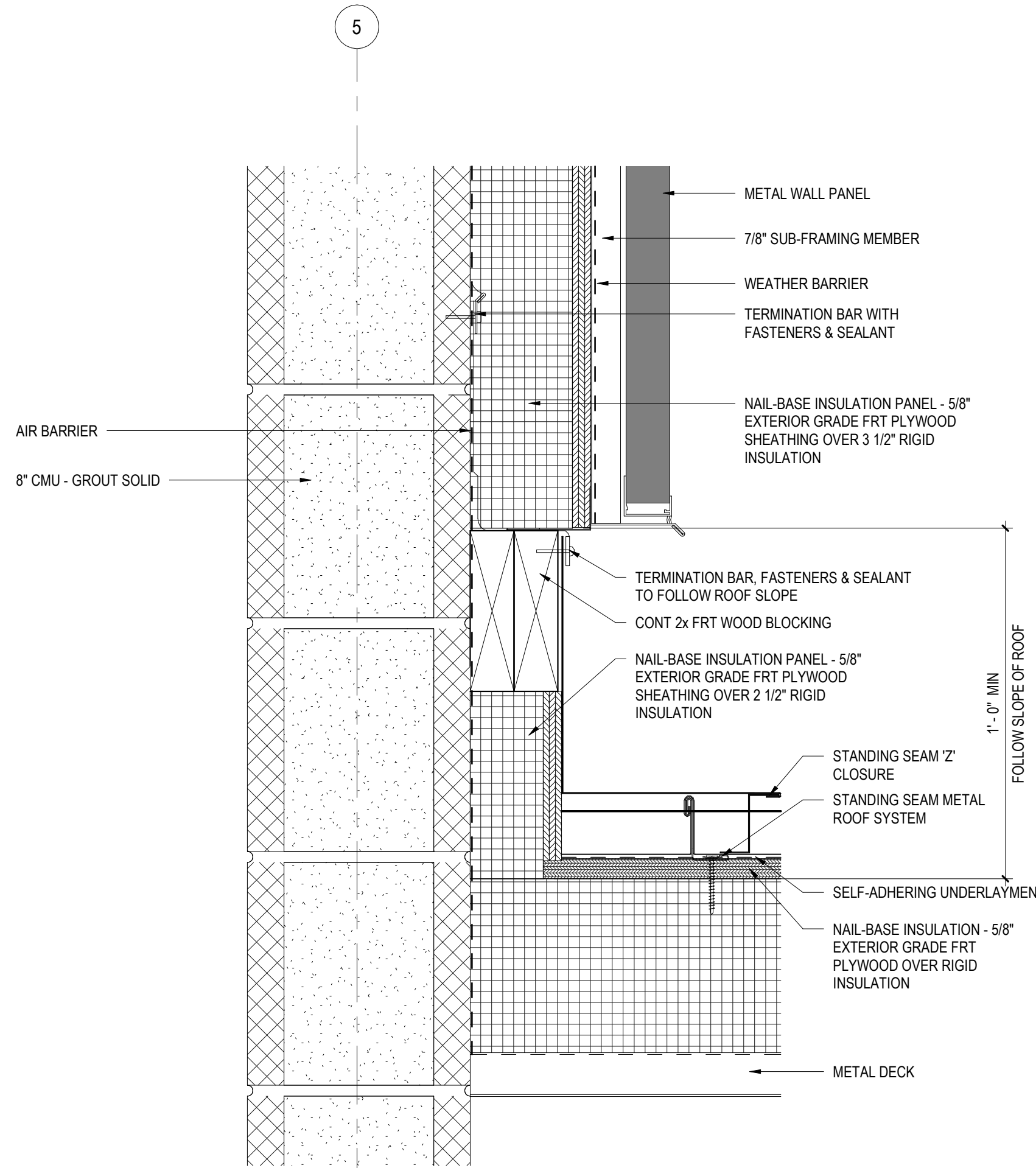
1 METAL WALL TO PRECAST  
A5.3 3" = 1'-0"



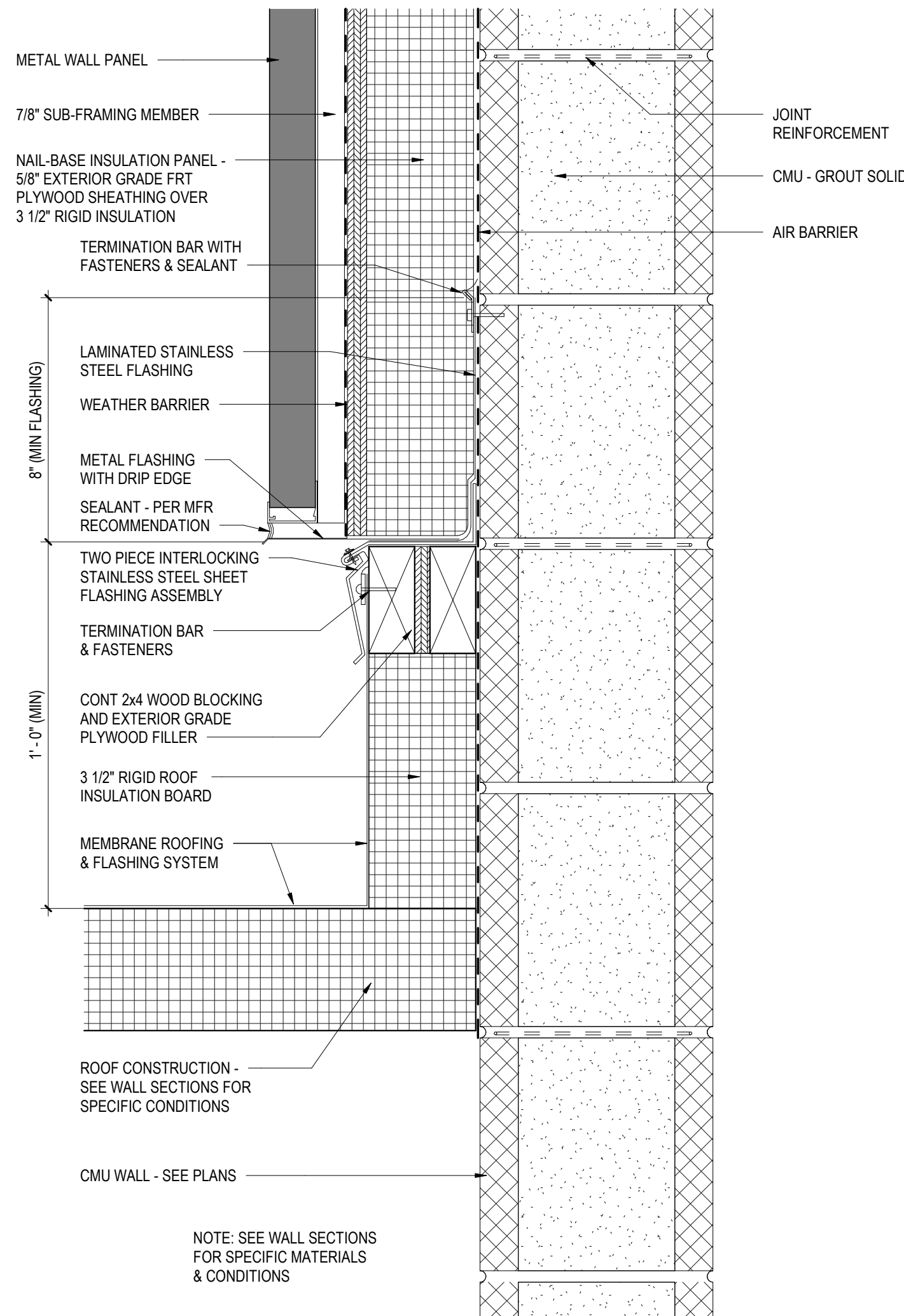
2 EDGE OF DECK - STANDING SEAM  
A5.3 3" = 1'-0"



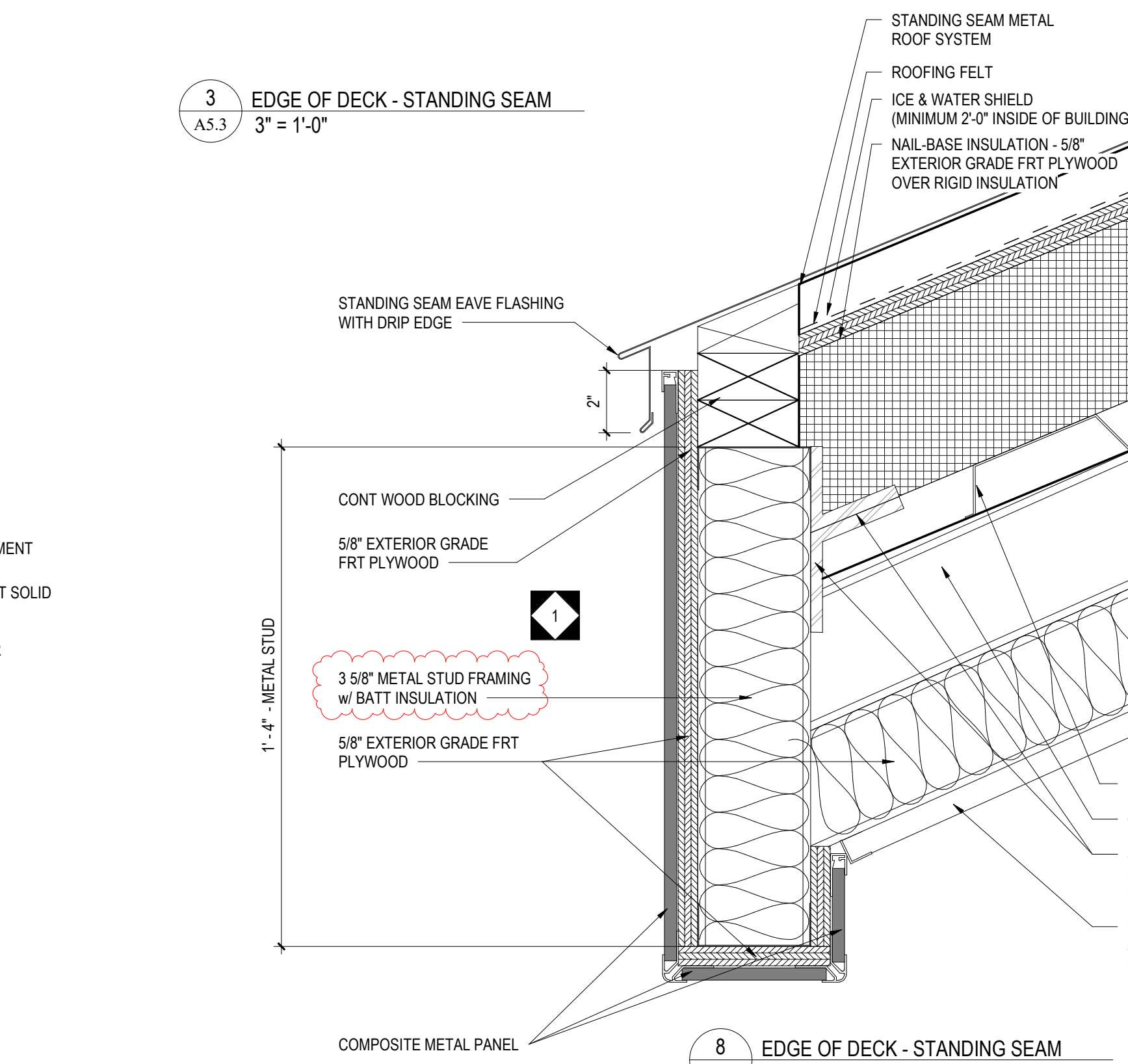
3 EDGE OF DECK - STANDING SEAM  
A5.3 3" = 1'-0"



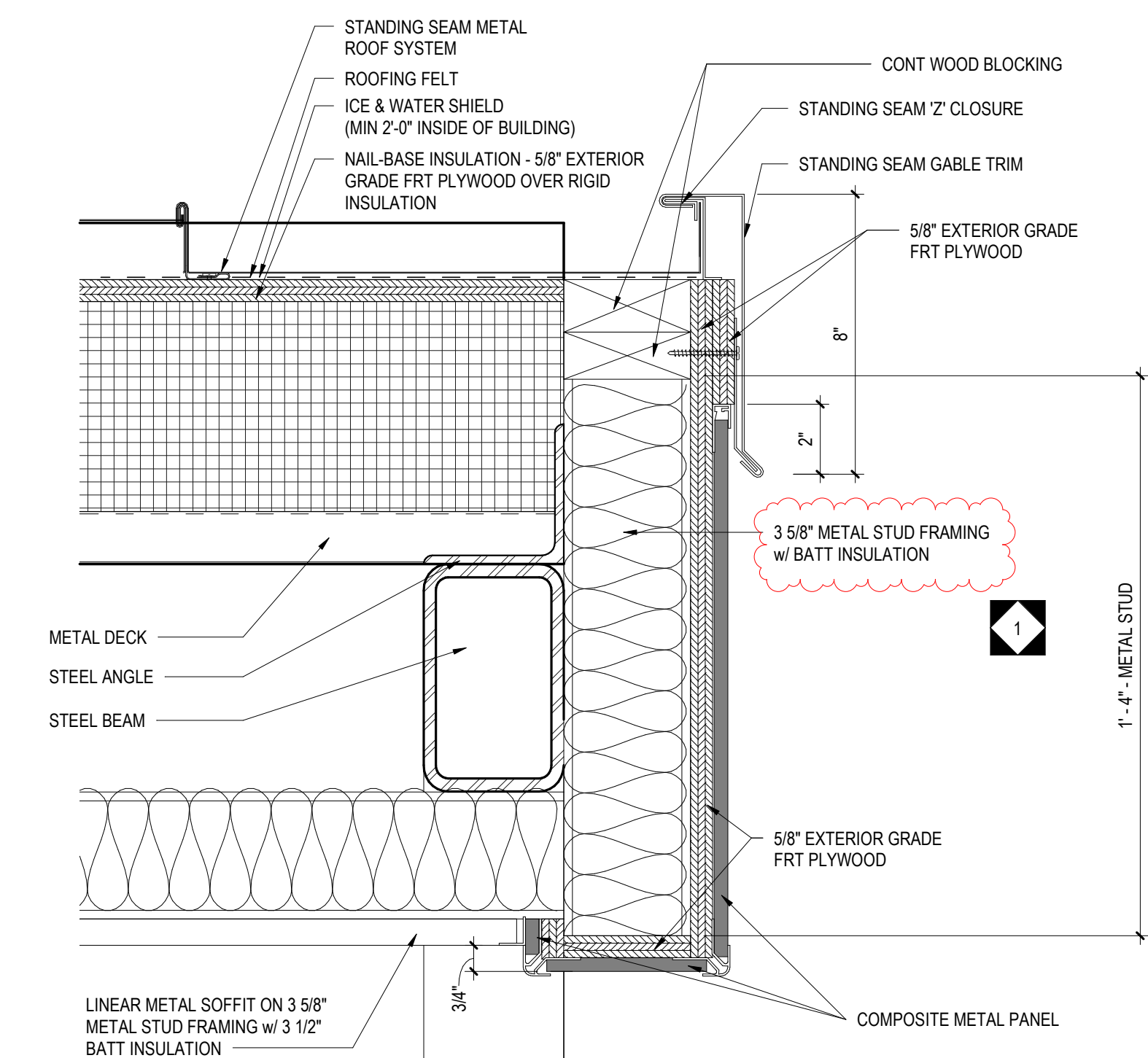
6 ROOF TO WALL FLASHING DETAIL  
A5.3 3" = 1'-0"



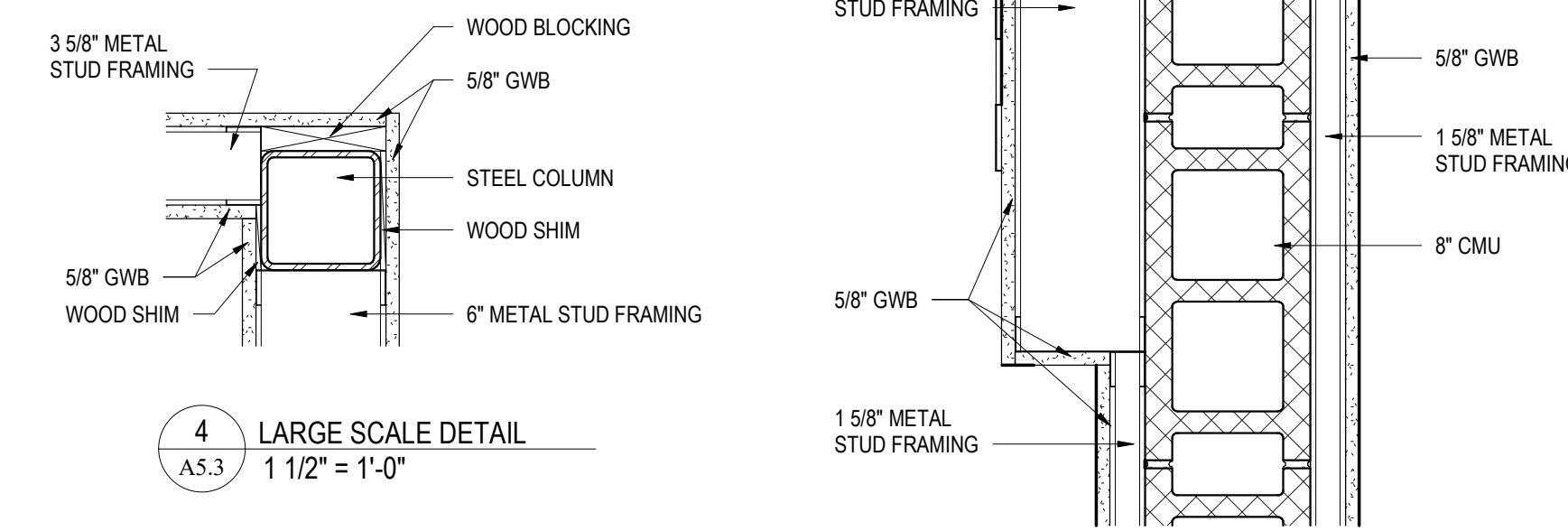
7 METAL PANEL ROOF TO WALL FLASHING DETAIL  
A5.3 3" = 1'-0"



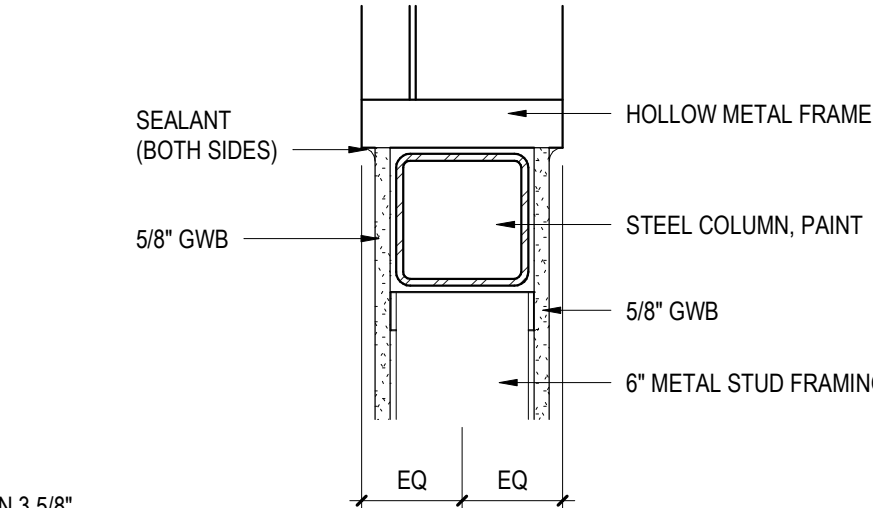
8 EDGE OF DECK - STANDING SEAM  
A5.3 3" = 1'-0"



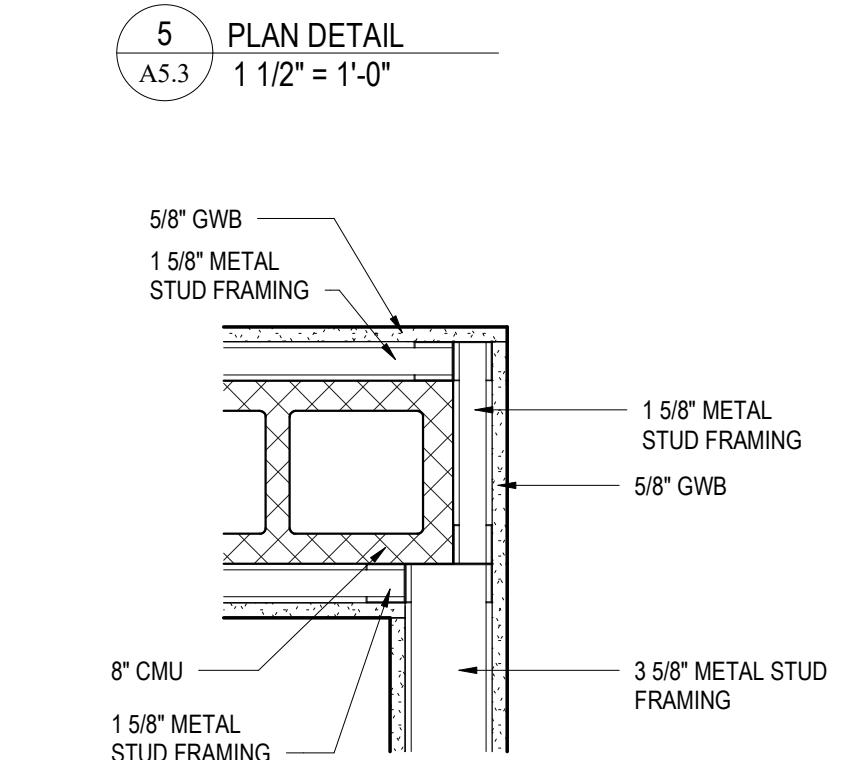
11 EDGE OF DECK - STANDING SEAM  
A5.3 3" = 1'-0"



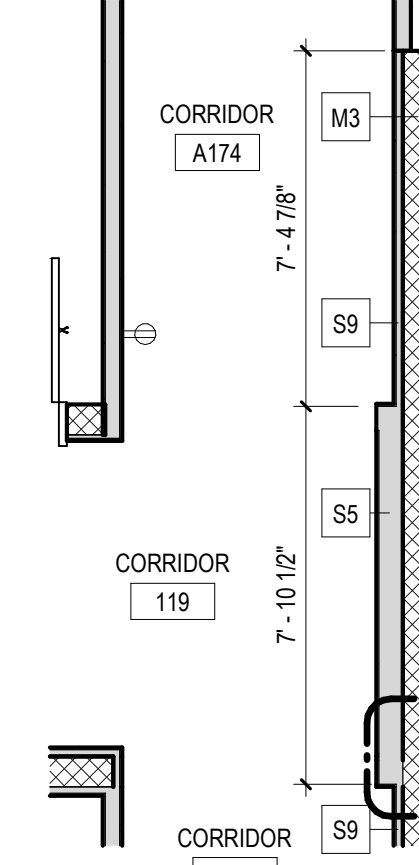
4 LARGE SCALE DETAIL  
A5.3 1 1/2" = 1'-0"



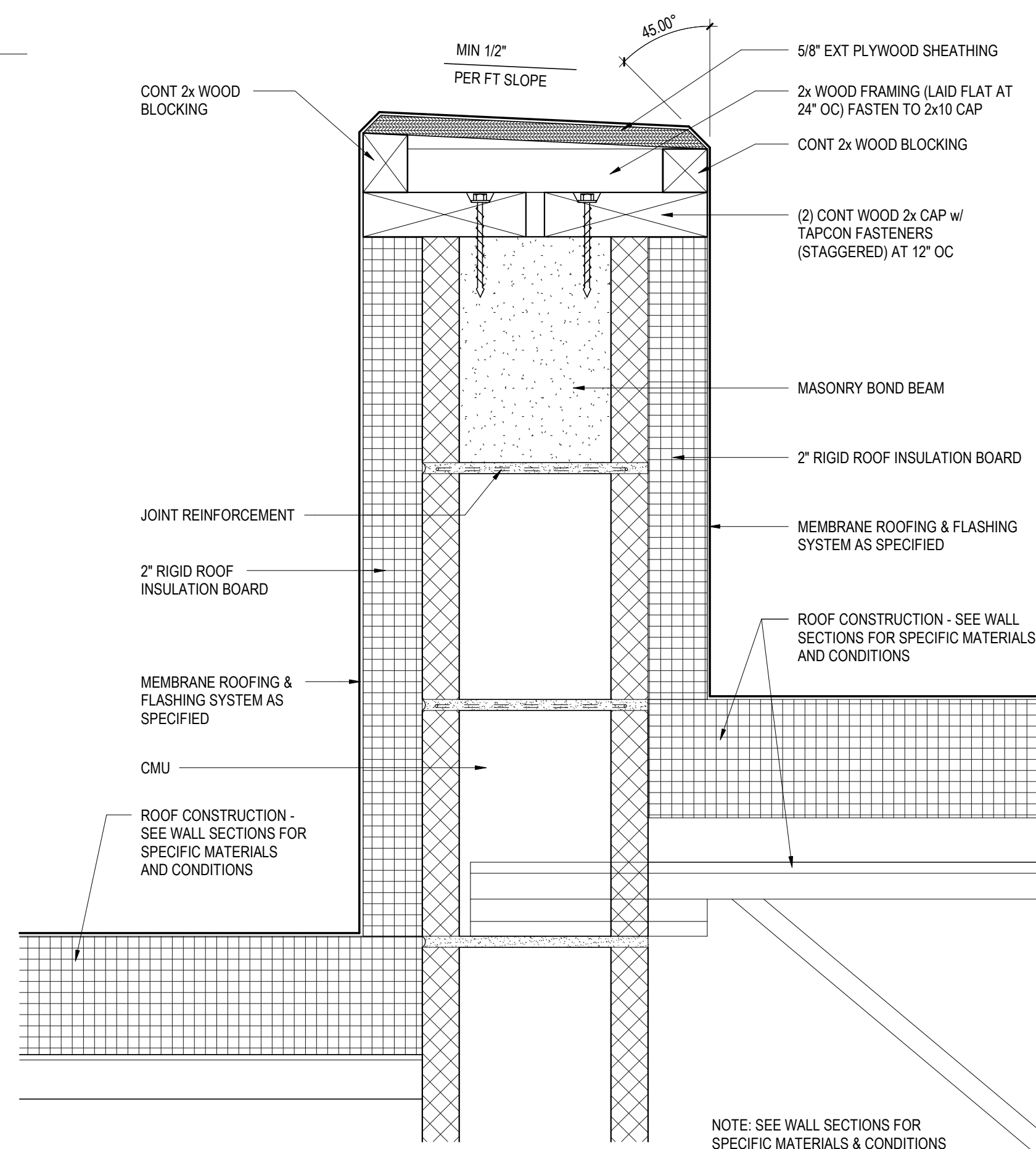
9 PLAN DETAIL  
A5.3 1 1/2" = 1'-0"



10 PLAN DETAIL  
A5.3 1 1/2" = 1'-0"



12 PLAN DETAIL  
A5.3 1/4" = 1'-0"



13 TYPICAL MASONRY PARAPET DETAIL  
A5.3 3" = 1'-0"

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| NO. | DATE      | BY | DESCRIPTION OF CHANGES |
|-----|-----------|----|------------------------|
| 1   | 7/23/2026 |    | ADDENDUM #1            |
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NEW DISTRICT ADMINISTRATION OFFICES  
THE SOLANCO SCHOOL DISTRICT  
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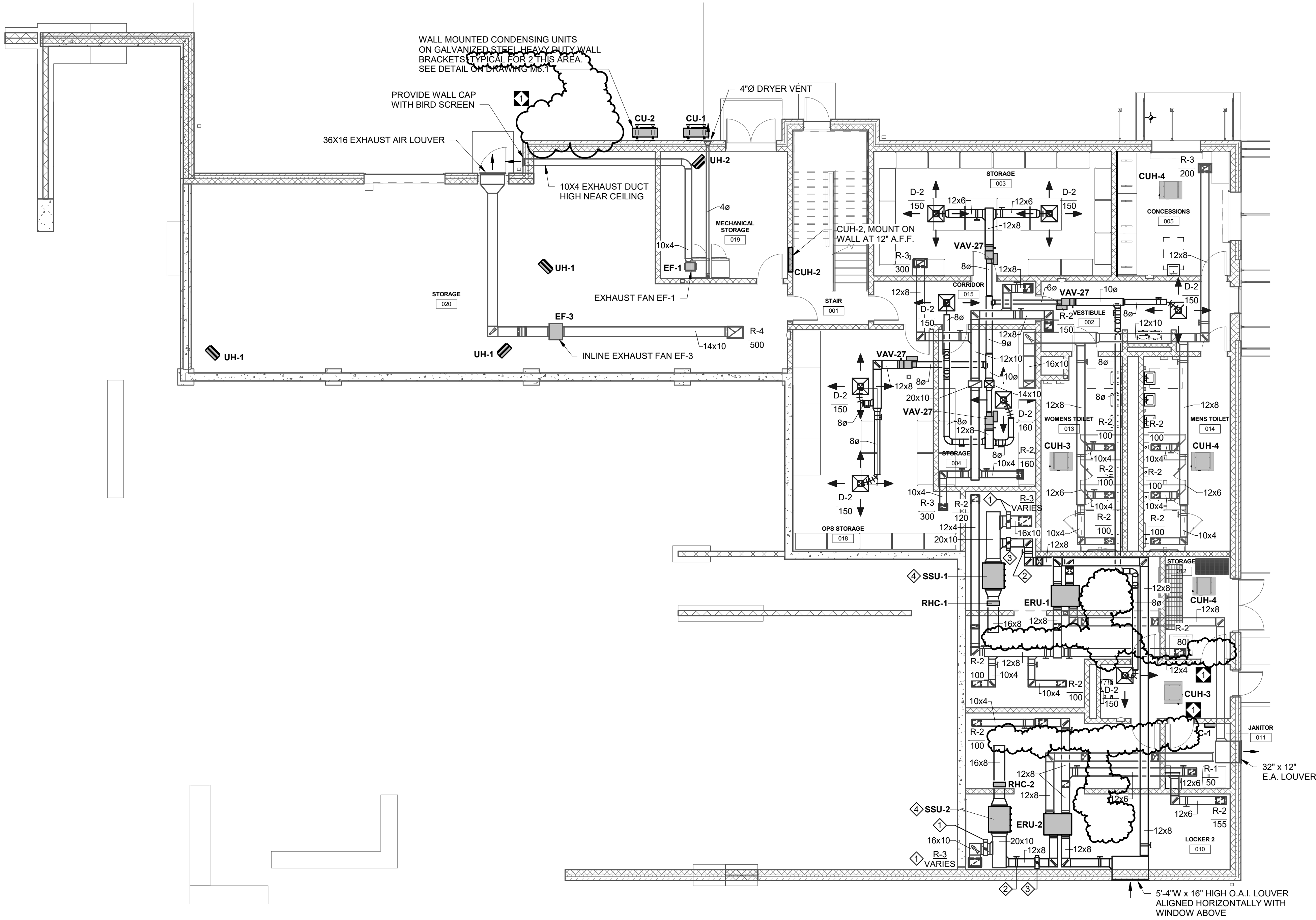


### DETAILS

PLOT SCALE:  
As indicated  
FILENAME:  
DATE:  
JULY 8, 2026

### PROJECT 3706

A5.3



1 GROUND FLOOR HVAC  
1/8" = 1'-0"

#### DRAWING NOTES:

1. ADJUST TO 200 CFM DURING OCCUPIED MODE AND 600 CFM DURING UNOCCUPIED MODE.
2. ADJUST TO 400 CFM.
3. MOTOR OPERATED DAMPER INTERLOCKED WITH SSU.
4. ADJUST SSU TO 600 CFM.

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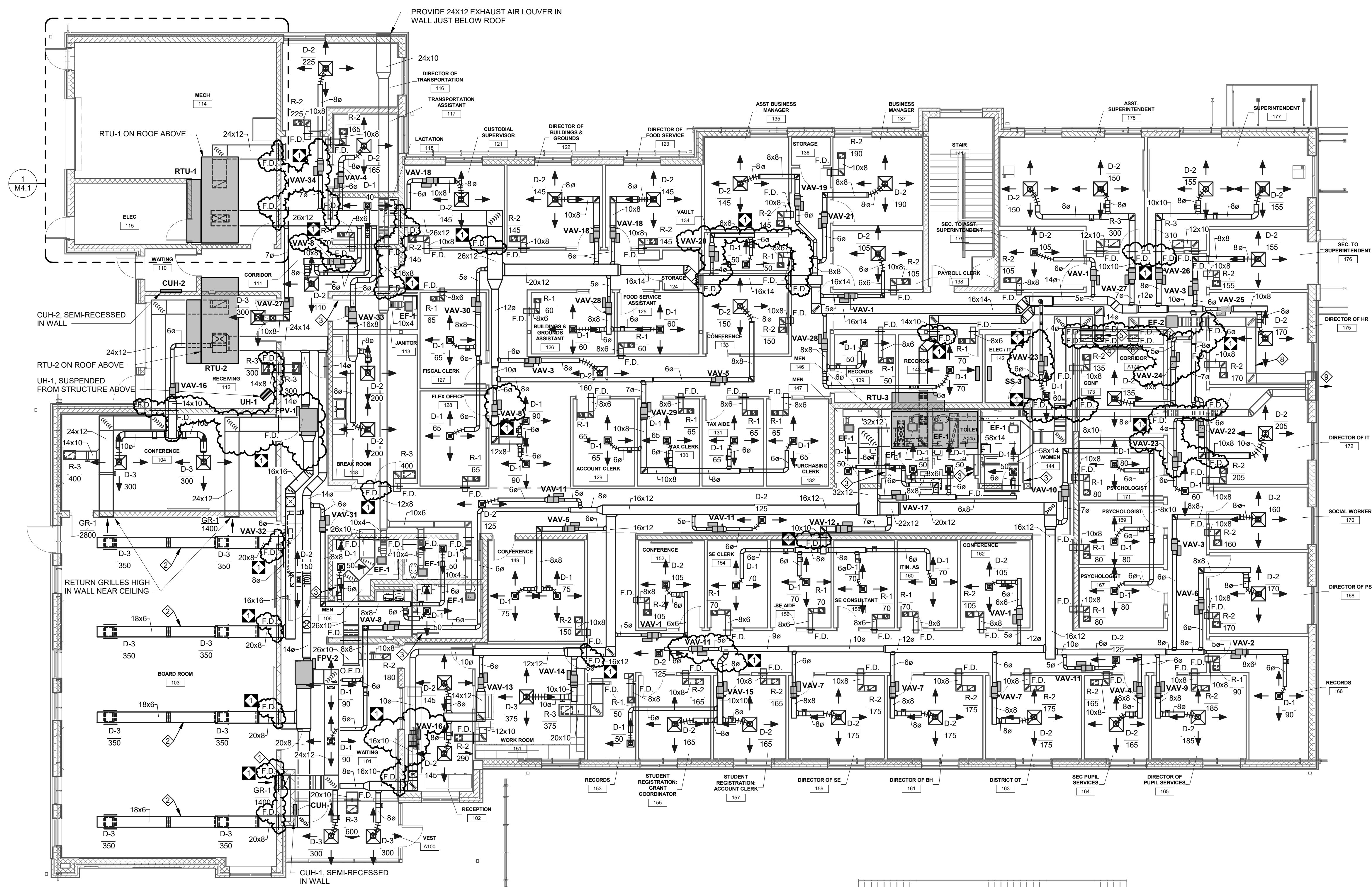
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GROUND FLOOR HVAC

PLOT SCALE:  
1/8" = 1'-0"  
FILENAME:  
DATE:  
JULY 8, 2026

PROJECT  
3706

M2.1



1 FIRST FLOOR HVAC  
1/8" = 1'-0"

DRAWING NOTES:

- M.C. SHALL RUN RETURN AIR DUCT DOWN IN MASONARY CHASE WALL TO LOW RETURN AT 12" A.F.F.
- RUN DUCT IN JOISTS SPACE.
- ARCHITECT TO PROVIDE DOOR UNDERCUT THIS DOOR.
- 20X10 RETURN AIR DUCT DOWN, PROVIDE FIRE DAMPER AT FLOOR.
- 14X10 SUPPLY AIR DUCT DOWN, PROVIDE FIRE DAMPER AT FLOOR.
- 16X10 EXHAUST DUCT DOWN, PROVIDE FIRE DAMPER AT FLOOR.
- INLINE EXHAUST FAN EF-2.
- 16X0 EXHAUST DUCT ABOVE CEILING.
- PROVIDE 48X12 EXHAUST AIR LOUVER IN WALL JUST BELOW ROOF.

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FIRST FLOOR HVAC PLAN

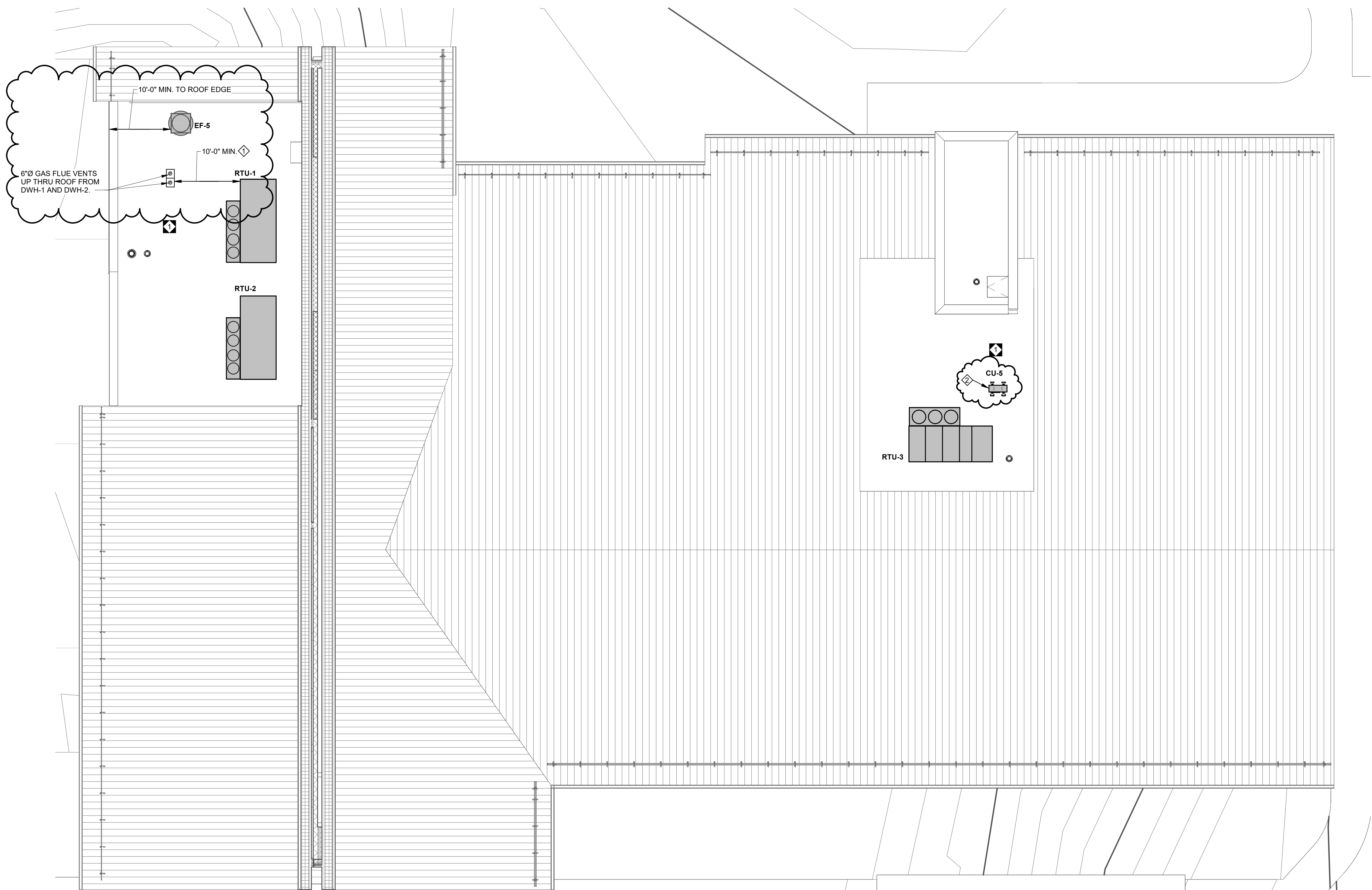
PLOT SCALE:  
1/8" = 1'-0"

FILENAME:

DATE:  
JULY 8, 2026

PROJECT  
3706

M2.2



1 MECHANICAL ROOF PLAN  
1/8" = 1'-0"

**DRAWING NOTES:**

1. MAINTAIN 10'-0" MINIMUM DISTANCE FROM EXHAUST FAN AND DWH-1 AND DWH-2 GAS FLUES TO INTAKE ON RTU-1.
2. MOUNT CU-5 ON 24" HIGH EQUIPMENT SUPPORT CURBS ON ROOF.

**BID SET**

**MOORE**  
ENGINEERING COMPANY

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| MECHANICAL ROOF PLAN        |
| PLOT SCALE:<br>1/8" = 1'-0" |
| FILENAME:                   |
| DATE:<br>JULY 8, 2026       |

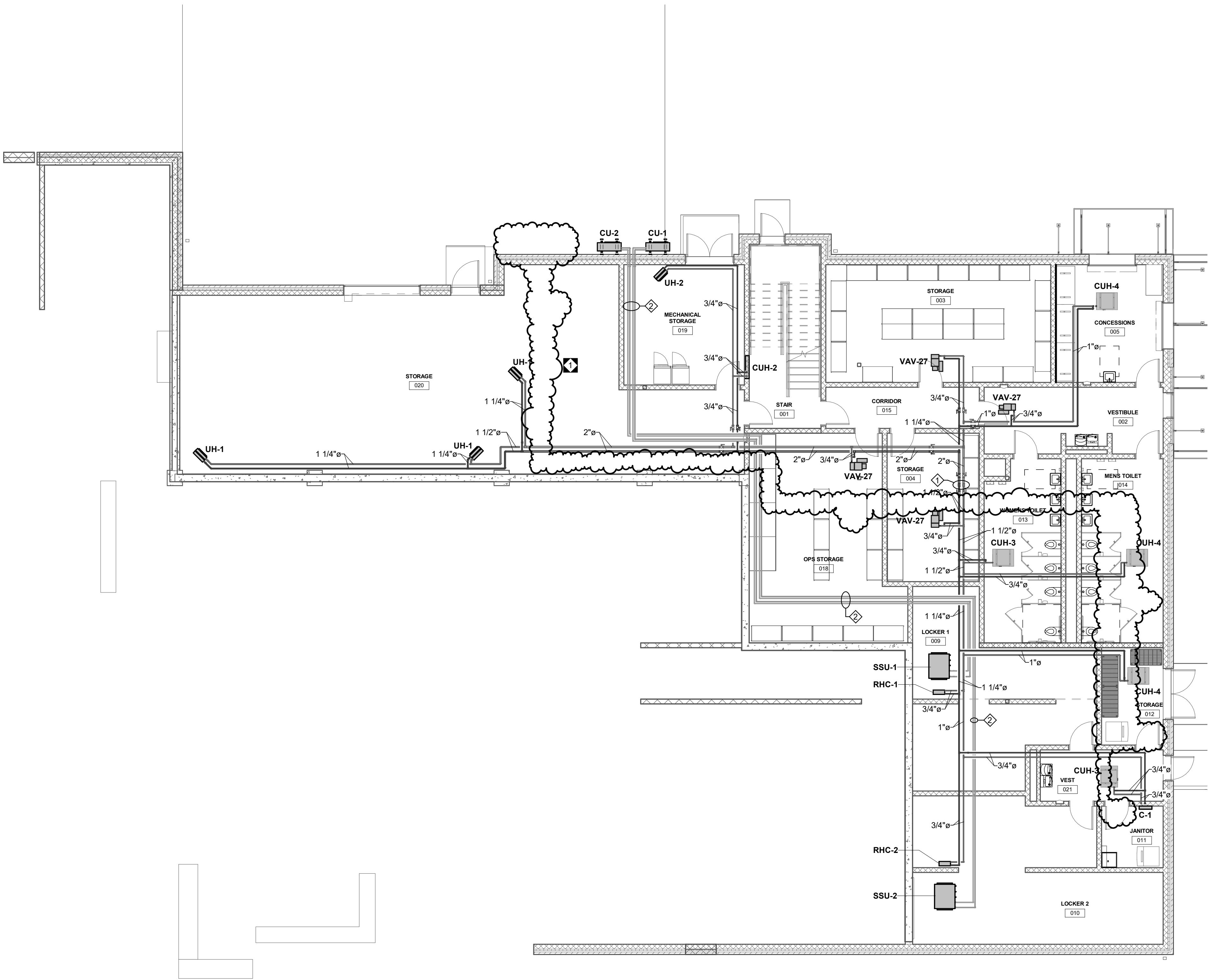
**PROJECT**  
3706

**M2.3**

**DRAWING NOTES:**

- 2-1/2" HWS AND HWR PIPING UP INTO CHASE ABOVE.
- PROVIDE REFRIGERANT PIPING AS HIGH AS POSSIBLE.

① GROUND FLOOR HVAC PIPING  
1/8" = 1'-0"



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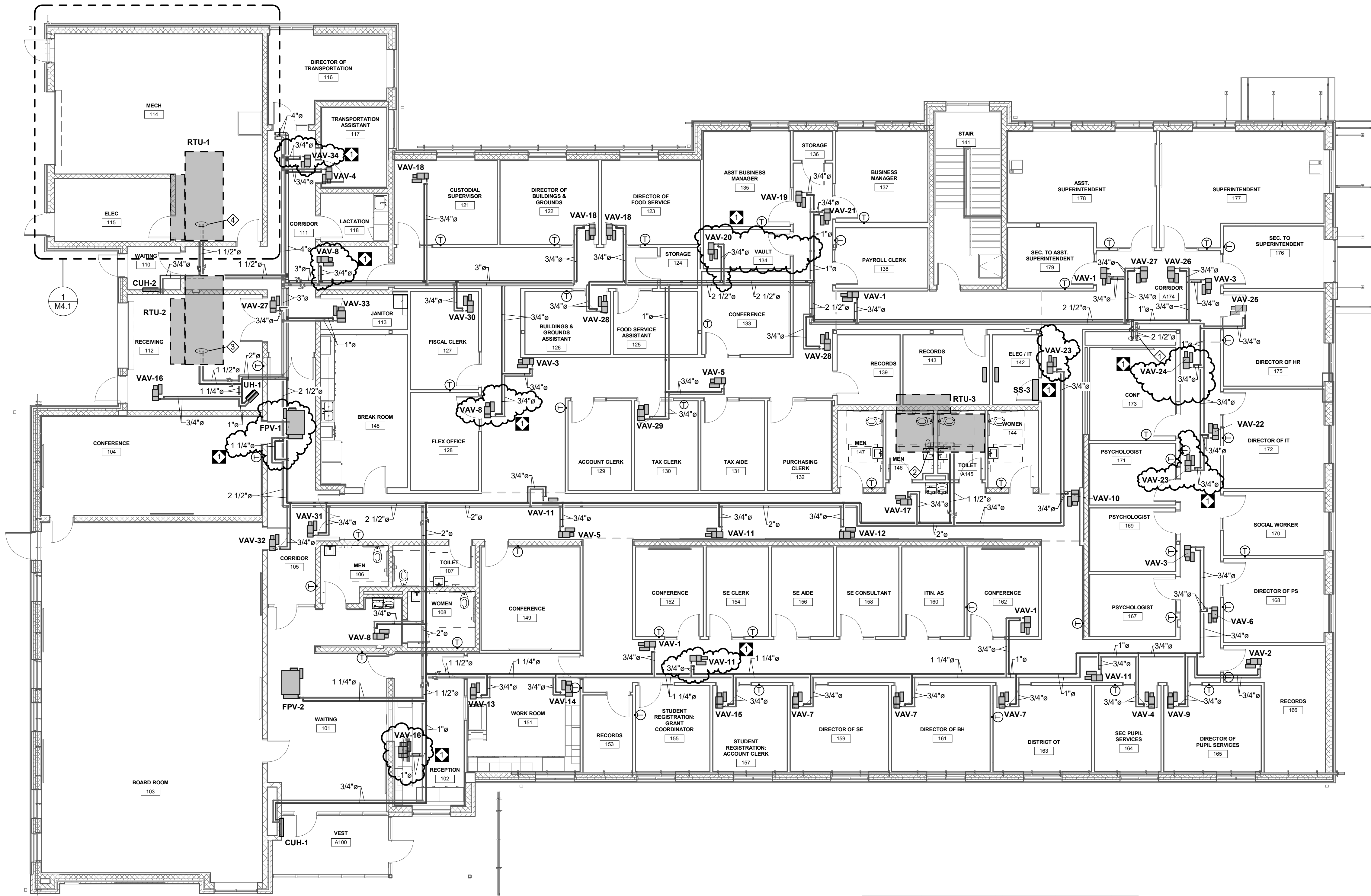


GROUND FLOOR HVAC  
PIPING PLAN

PLOT SCALE:  
1/8" = 1'-0"  
FILENAME:  
DATE:  
JULY 8, 2026

PROJECT  
3706

M3.1



1 FIRST FLOOR HVAC PIPING  
1/8" = 1'-0"

DRAWING NOTES:

1.

2-1/2" HWS AND HWR PIPING DOWN IN CHASE.

2.

1-1/2" HWS AND HWR PIPING UP TO RTU-3.

3.

1-1/2" HWS AND HWR PIPING UP TO RTU-2.

4.

1-1/2" HWS AND HWR PIPING UP TO RTU-1.

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FIRST FLOOR HVAC PIPING  
PLAN

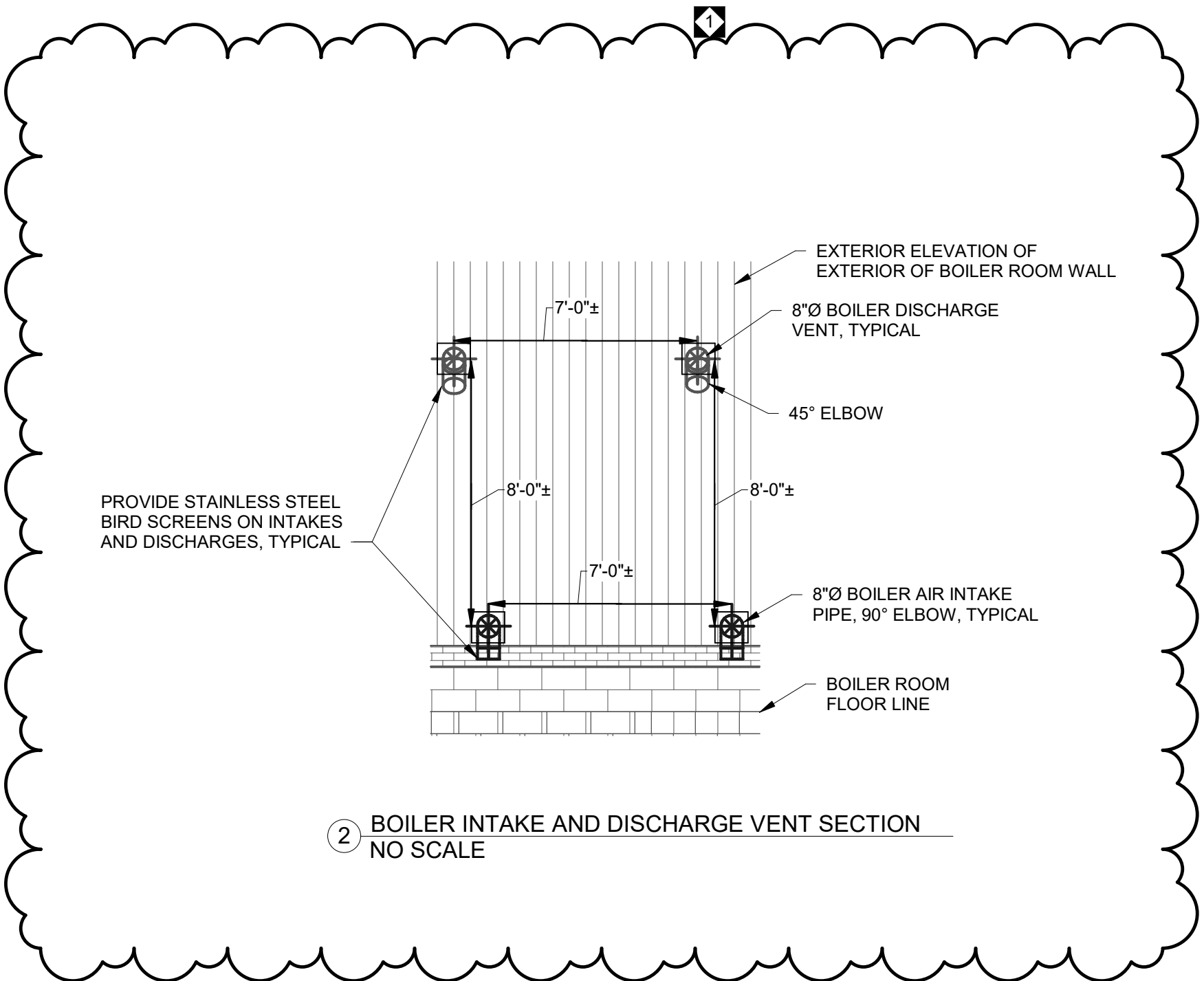
PROJECT  
3706

M3.2

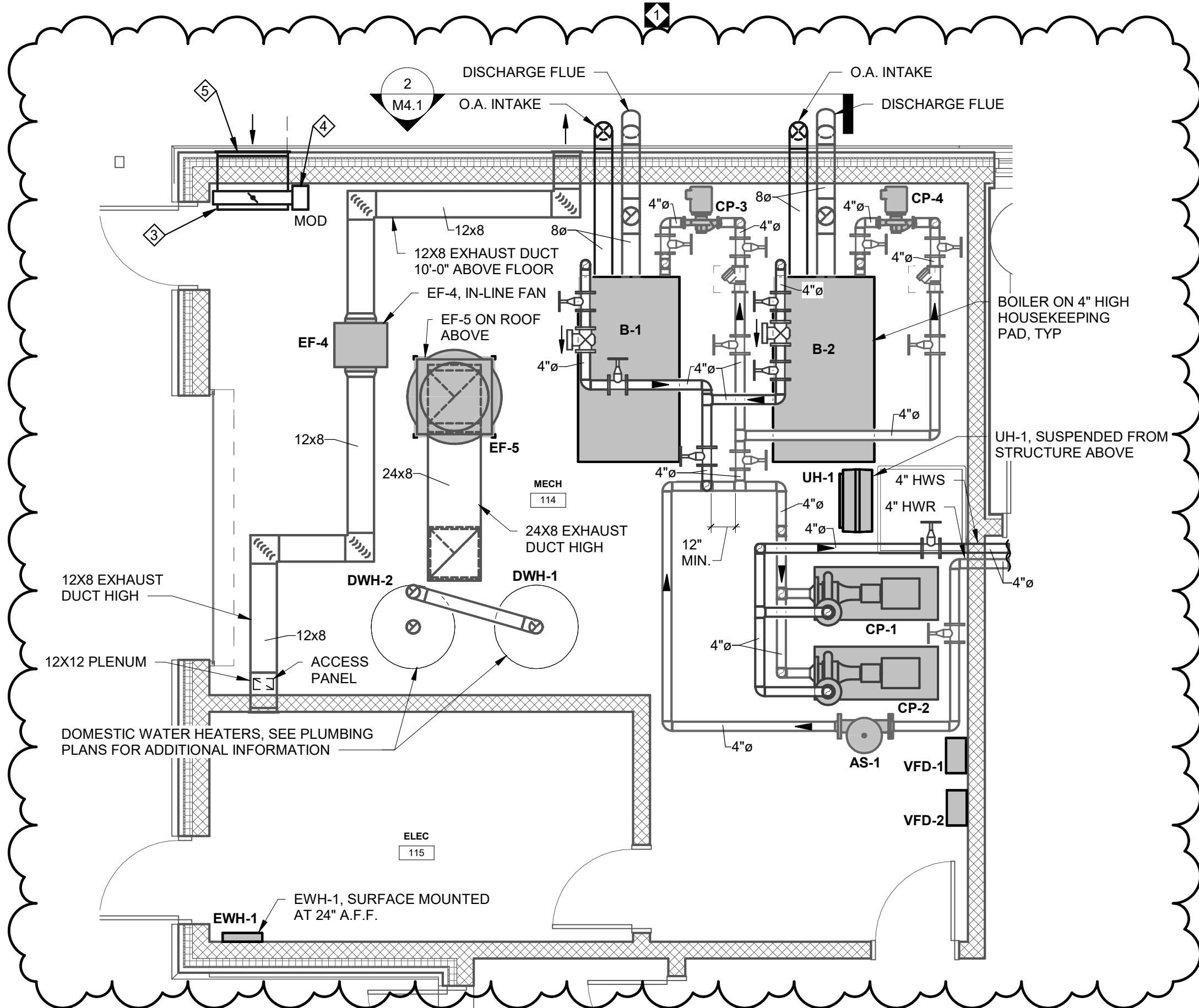
PLOT SCALE:  
1/8" = 1'-0"

FILENAME:

DATE:  
JULY 8, 2026



2 BOILER INTAKE AND DISCHARGE VENT SECTION  
NO SCALE



1 ENLARGED MECHANICAL ROOM  
1/4" = 1'-0"

DRAWING NOTES:

- CP-4 SUSPENDED FROM STRUCTURE ABOVE, MONUT ABOVE FLOOR AT 12" HIGHER THAN HEIGHT OF BOILER, TYPICAL FOR 2.
- AIR SEPERATOR WITH HIGH CAPACITY AIRVENT, BLOWDOWN CONNECTIONS, SEE DETAIL.
- PROVIDE TWO 32X32 X8 DEEP PLENUMS ON THE BACKS OF THE OUTSIDE AIR INTAKE LOUVERS.
- PROVIDE MOTOR OPERATED DAMPERS IN EACH OF THE TWO 32X32X8 PLENUMS.
- PROVIDE TWO 32X32 OUTSIDE AIR INTAKE LOUVERS AT 6" A.F.F. AND AT 10'-0" A.F.F.

BID SET



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REVISIONS

| NO | DATE     | NAME | DESCRIPTION OF CHANGES |
|----|----------|------|------------------------|
| 1  | 07/23/26 |      | Addendum #1            |
|    |          |      |                        |
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CR

ENLARGED MECHANICAL  
ROOM PLAN

PLOT SCALE:  
NO SCALE  
FILENAME:  
DATE:

JULY 8, 2026

PROJECT  
3706

M4.1

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| SPLIT SYSTEM UNIT SCHEDULE                                                                                                                        |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----|-------------------|--------|--------------|--------------|------|-----|-----|-----|----------------------|------------|-------------|------------|---------|
| SYMBOL                                                                                                                                            | CFM | TOTAL COOLING MBH | E.S.P. | O/A MIN. CFM | HEATING COIL |      |     |     |     | HEATING CAPACITY MBH | MOTORS     |             |            | REMARKS |
|                                                                                                                                                   |     |                   |        |              | EAT          | LAT  | EWT | LWT | GPM |                      | INDOOR FAN | OUTDOOR FAN | COMPRESSOR |         |
| SSU-1/CU-1 & RHC-1                                                                                                                                | 600 | 18.0              | 0.7"   | 360          | 60.0         | 85.0 | 180 | 150 | 1.1 | 16.2                 | 1/2 HP     | 1/4 HP      |            |         |
| SSU-2/CU-2 & RHC-2                                                                                                                                | 600 | 18.0              | 0.7"   | 360          | 60.0         | 85.0 | 180 | 150 | 1.1 | 16.2                 | 1/2 HP     | 1/4 HP      |            |         |
|                                                                                                                                                   |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |
|                                                                                                                                                   |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |
|                                                                                                                                                   |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |
| NOTES:                                                                                                                                            |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |
| 1. PROVIDE GALVANIZED STEEL WALL BRACKETS TO SUPPORT THE CONDENSING UNITS ON EXTERIOR WALL AT 24" ABOVE FINISHED GRADE LEVELS, FOR CU-1 AND CU-2. |     |                   |        |              |              |      |     |     |     |                      |            |             |            |         |

[illegible]

## 1

| SYMBOL | CFM RANGE<br>SEE NOTE 1 | NECK SIZE<br>INCHES | FACE SIZE<br>INCHES | MATERIAL<br>SEE NOTE 2 | BASIS OF DESIGN<br>MANUFACTURER AND<br>MODEL NO. | REMARKS              |
|--------|-------------------------|---------------------|---------------------|------------------------|--------------------------------------------------|----------------------|
| R-1    | 0 - 200                 | 6X6                 | 23-3/4"X 23-3/4"    | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 2, 3, 4        |
| R-2    | 201 - 300               | 9X9                 | 23-3/4"X 23-3/4"    | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 2, 3, 4        |
| R-3    | 701 - 800               | 12X12               | 17-3/4"X17-3/4"     | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 2, 3, 4        |
| R-4    | 1501 - 2000             | 15X15               | 23-3/4"X 23-3/4"    | STEEL                  | TUTTLE & BAILEY                                  | NOTES 2, 4           |
| R-5    | 801 - 1000              | 18X18               | 19-3/4"X 19-3/4"    | STEEL                  | TUTTLE & BAILEY                                  | NOTES 3              |
| GR-1   | 3000                    | 36X48               | 37-3/4"X 49-3/4"    | STEEL                  | TUTTLE & BAILEY                                  | HEAVY DUTY GYM USAGE |
| GR-2   | 5000                    | 48X48               | 49-3/4"X 49-3/4"    | STEEL                  | TUTTLE & BAILEY                                  | HEAVY DUTY GYM USAGE |
| GR-3   | 1400 - 2800             | 24W X 36H           | 25-3/4"X 37-3/4"    | STEEL                  | TUTTLE & BAILEY                                  | HEAVY DUTY GYM USAGE |

NOTES:

1. REGISTERS WITHOUT SPECIFIC SYMBOLS (R-1, R-2, ETC.) ON THE PLANS, SHALL BE SIZED IN ACCORDANCE WITH THE CFM RANGES AS SHOWN IN THIS SCHEDULE.
2. FOR REGISTERS WHERE ALUMINUM IS SHOWN FOR THE MATERIAL, IF REGISTER IS PART OF A FIRE RATED CEILING SYSTEM, THEN SUBSTITUTE COMPARABLE FIRE RATED STEEL REGISTERS FOR THAT AREA, IF IN A SIDEWALL, THEN SUBSTITUTE HEAVY DUTY STEEL.
3. PROVIDE PLASTER FRAMES FOR ALL REGISTERS LOCATED IN GYPSUM, PLASTER, OR HARD (NON-LAYIN) SURFACE/CEILINGS.
5. PROVIDE VOLUME DAMPERS IN NECKS OF ALL REGISTERS.

---

| SUPPLY AIR DIFFUSER SCHEDULE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                         |                     |                     |                 |                        |                                                  |                         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------------|---------------------|-----------------|------------------------|--------------------------------------------------|-------------------------|
| SYMBOL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | CFM RANGE<br>SEE NOTE 1 | NECK SIZE<br>INCHES | FACE SIZE<br>INCHES | BLOW<br>PATTERN | MATERIAL<br>SEE NOTE 3 | BASIS OF DESIGN<br>MANUFACTURER AND<br>MODEL NO. | REMARKS                 |
| D-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 0 - 125                 | 6X6                 | 12X12               | SEE NOTE 2      | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 1 THRU 5          |
| D-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 126 - 280               | 9X9                 | 24X24               | SEE NOTE 2      | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 1 THRU 5          |
| D-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 281 - 450               | 12X12               | 24X24               | SEE NOTE 2      | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 1 THRU 5          |
| D-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 451 - 700               | 15X15               | 24X24               | SEE NOTE 2      | ALUMINUM               | TUTTLE & BAILEY                                  | NOTES 1 THRU 5          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                     |                     |                 |                        |                                                  |                         |
| LD-1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 550                     | 10"Ø                | 8'-0" LONG          | LINEAR DIFF.    | STEEL                  | TUTTLE & BAILEY                                  | ADJUSTABLE BLOW PATTERN |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                         |                     |                     |                 |                        |                                                  |                         |
| <b>NOTES:</b><br>1. DIFFUSERS WITHOUT SPECIFIC SYMBOLS (D-1, D-2, ETC.) ON THE PLANS, SHALL BE SIZED IN ACCORDANCE WITH THE CFM RANGES AS SHOWN IN THIS SCHEDULE.<br>2. SEE FLOOR PLANS FOR BLOW PATTERNS OF ALL CEILING SUPPLY AIR DIFFUSERS.<br>3. FOR DIFFUSERS WHERE ALUMINUM IS SHOWN FOR THE MATERIAL, IF DIFFUSER IS PART OF A FIRE RATED CEILING SYSTEM, THEN SUBSTITUTE COMPARABLE FIRE RATED STEEL DIFFUSERS FOR THAT AREA.<br>4. PROVIDE PLASTER FRAMES FOR ALL DIFFUSERS LOCATED IN GYPSUM, PLASTER, OR HARD (NON-LAYIN) SURFACE/CEILINGS.<br>5. PROVIDE VOLUME DAMPERS IN NECKS OF ALL DIFFUSERS. |                         |                     |                     |                 |                        |                                                  |                         |

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| EXPANSION TANKS |                      |                           |          |                        |           |                                            |
|-----------------|----------------------|---------------------------|----------|------------------------|-----------|--------------------------------------------|
| SYMBOL          | TOTAL VOLUME GALLONS | ACCEPTANCE VOLUME GALLONS | PRESSURE | TYPE                   | SYSTEM    | BASIS OF DESIGN MANUFACTURER AND MODEL NO. |
| ET-1            |                      |                           |          | BLADDER TYPE, VERTICAL | HOT WATER | AMTROL #1400-L                             |
|                 |                      |                           |          |                        |           |                                            |

| DUCTLESS SPLIT SYSTEM A/C UNIT SCHEDULE                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |         |              |             |     |                 |      |     |            |     |       |                    |       |        |      |                                                  |          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|--------------|-------------|-----|-----------------|------|-----|------------|-----|-------|--------------------|-------|--------|------|--------------------------------------------------|----------|
| SYMBOL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | FAN CFM | COOLING      |             |     | HEATING (@47°F) |      |     | ELECTRICAL |     |       | REFRIGERANT PIPING |       |        |      | BASIS OF DESIGN MANUFACTURER AND MODEL NO.       | REMARKS  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         | NOM.CAP. MBH | AMB (db/wb) | KW  | CAP. MBH        | AMPS | KW  | V/PH       | MCA | MOC/P | SEER2              | HSPF2 | LIQUID | GAS  |                                                  |          |
| DSS-1/CU-3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |              | 95°/75"     |     |                 |      |     | 208/1Ø     |     |       |                    |       |        |      |                                                  | SIZE TBD |
| DSS-2/CU-4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |         |              | 95°/75"     |     |                 |      |     | 208/1Ø     |     |       |                    |       |        |      |                                                  | SIZE TBD |
| DSS-3/CU-5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 775     | 24.0         | 95°/75"     | 1.9 | 28.0            | 47   | 2.1 | 208/1Ø     | 22  | 37    | 21.1               | 9.2   | 1/4"   | 1/2" | MITSUBISHI - TRANE<br>PLU2-AH-24NL & PKA-AK-24NL |          |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |              |             |     |                 |      |     |            |     |       |                    |       |        |      |                                                  |          |
| <b>NOTES:</b><br>1. DSS-1, DSS-2, AND DSS-3 SPLITSYSTEMS SHALL BE CAPABLE OF PROVIDING COOLING DOWN TO A NEGATIVE 5 DEGREES BELOW ZERO OUTDOOR AMBIENT TEMPERATURE.<br>2. PROVIDE GALVANIZED STEEL BRACKETS TO SUPPORT THE CONDENSING UNITS ON EXTERIOR WALL AT 24" ABOVE FINISHED GRADE LEVELS FOR CU-3 AND CU-4.<br>3. PROVIDE 24" HIGH EQUIPMENT MOUNTING RAILS WITH FLASHING AND COUNTER FLASHING TO SUPPORT CU-5 ABOVE ROOF. ADJUST ROOF EQUIPMENT MOUNTING RAILS TO MAINTAIN EQUIPMENT IN A LEVEL ORIENTATION. |         |              |             |     |                 |      |     |            |     |       |                    |       |        |      |                                                  |          |



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## MECHANICAL SCHEDULES

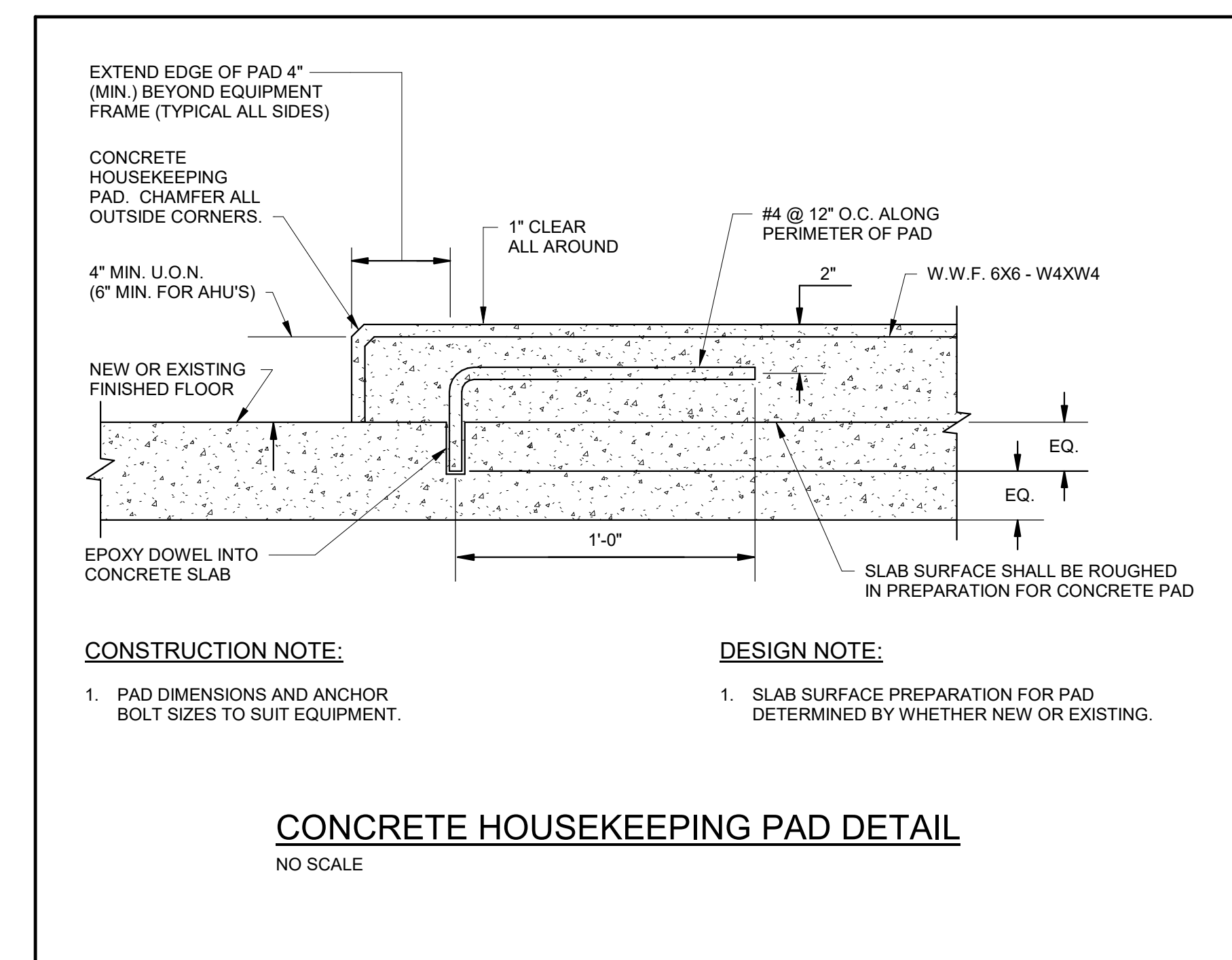
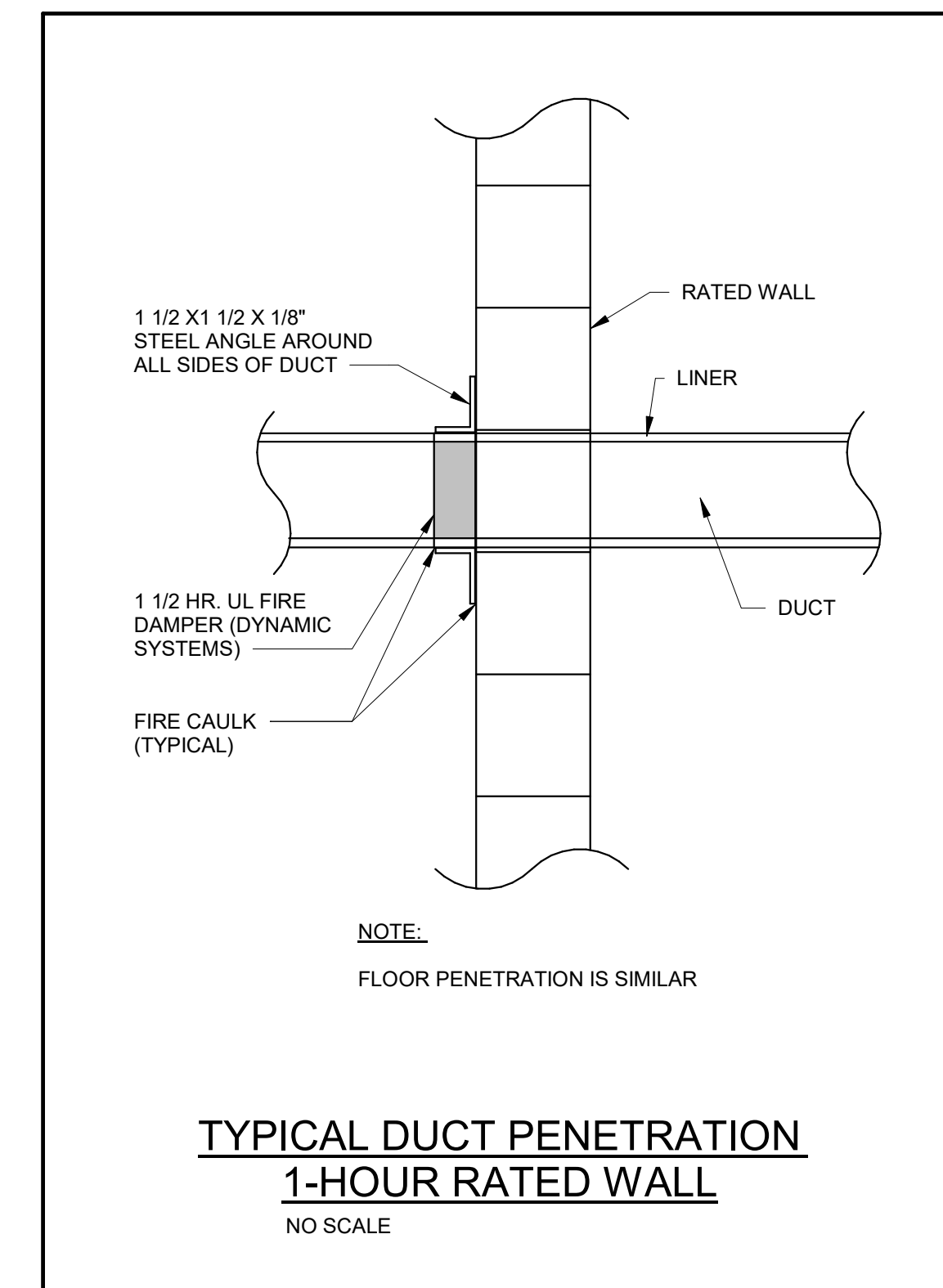
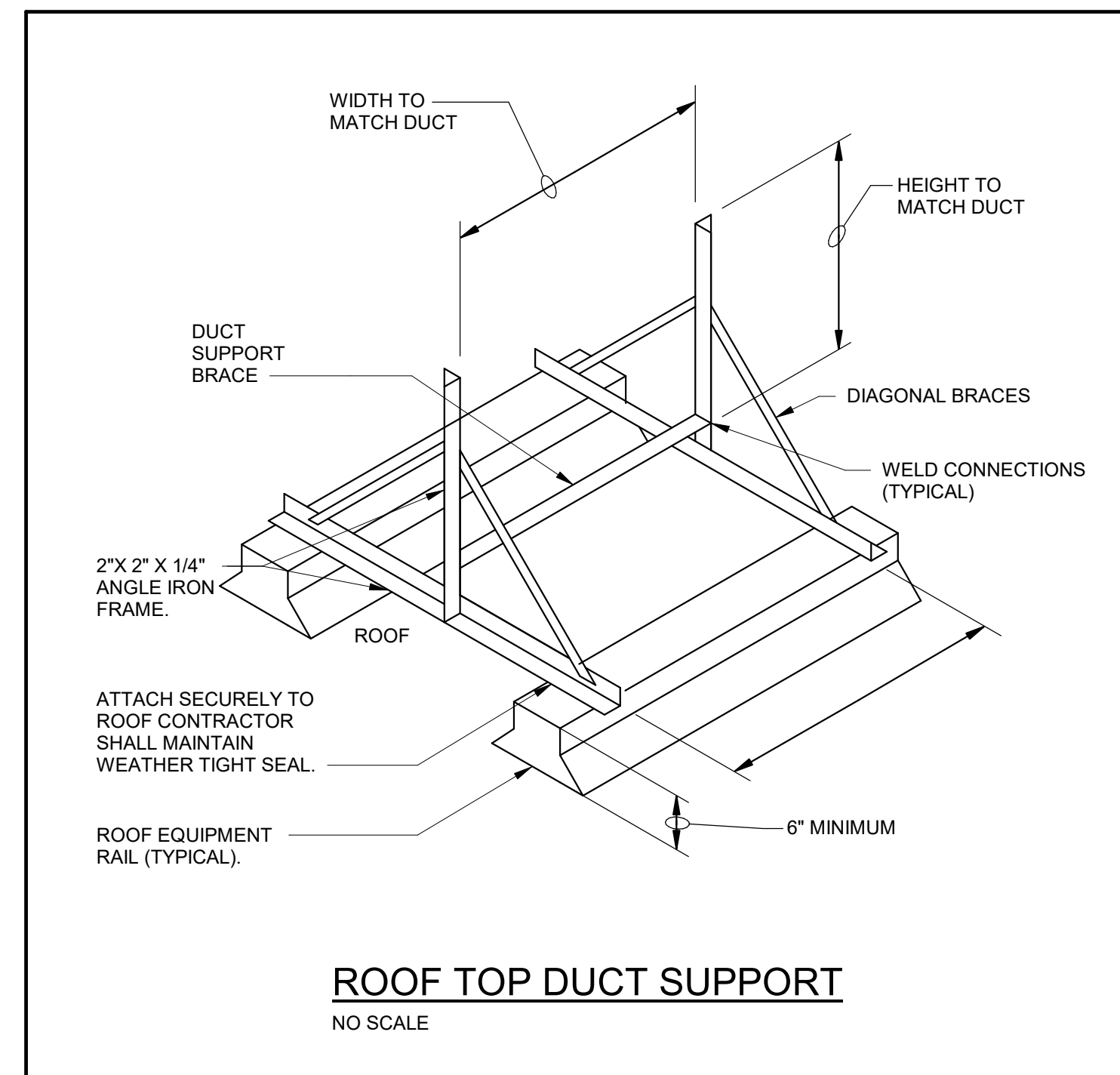
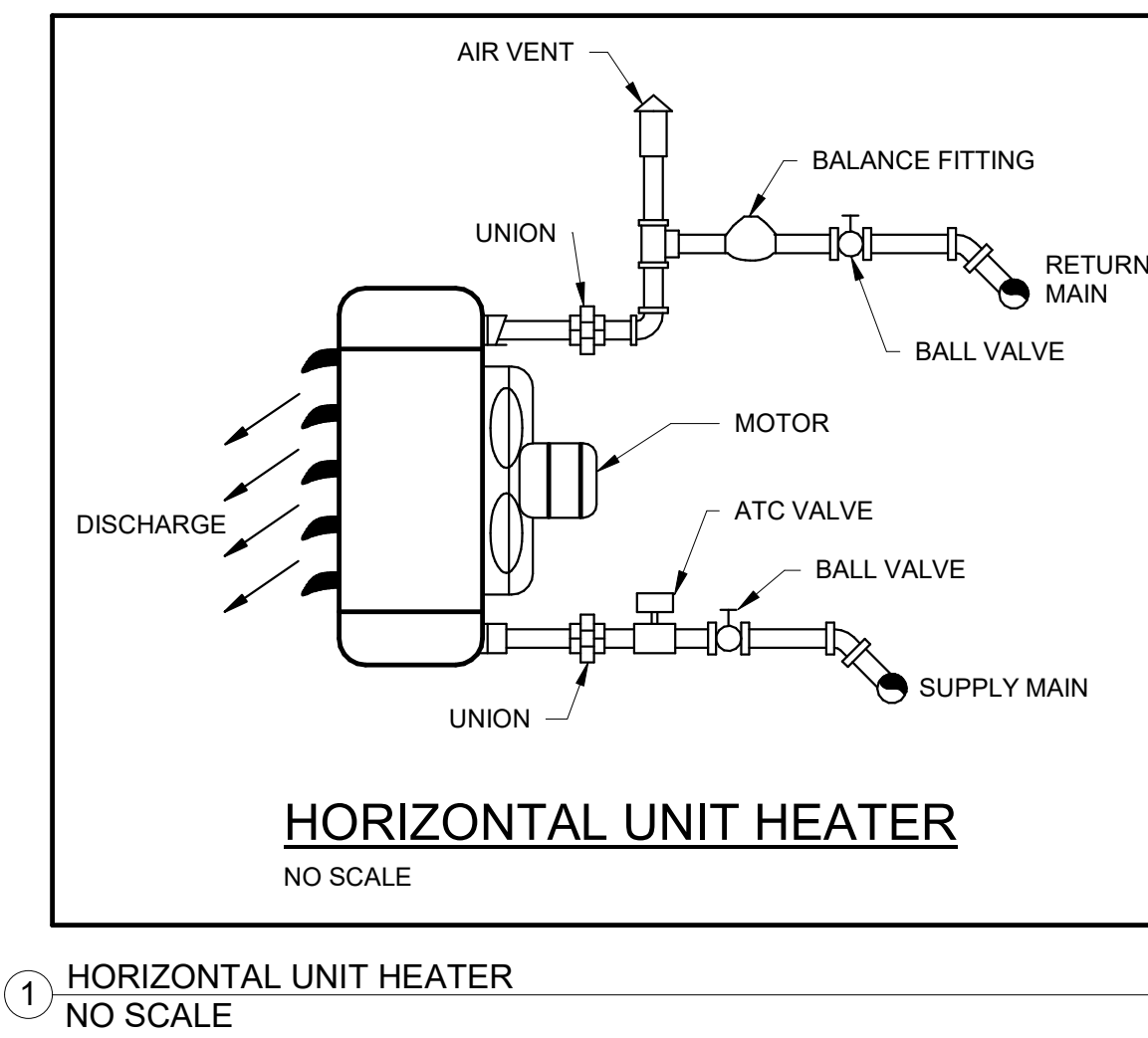
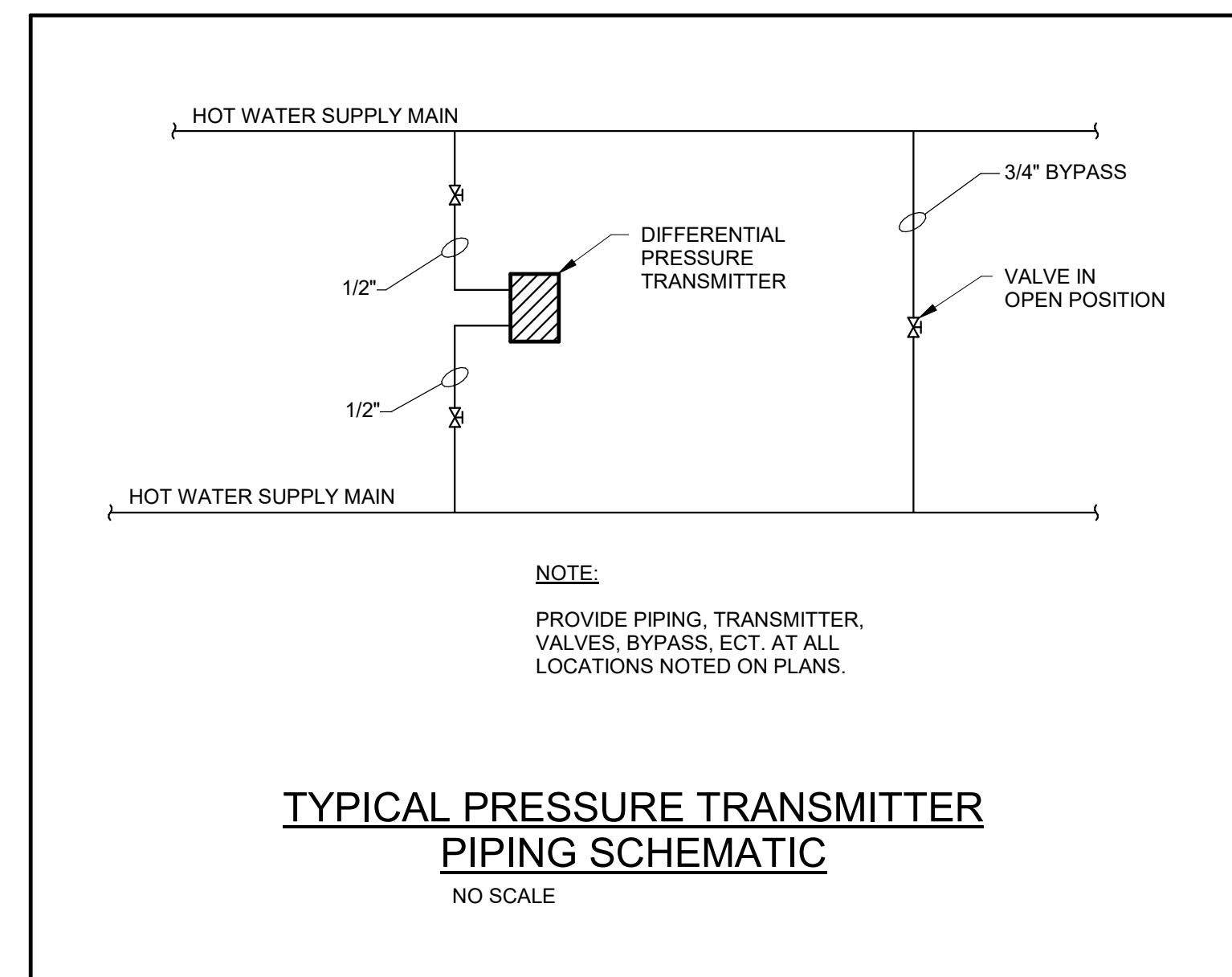
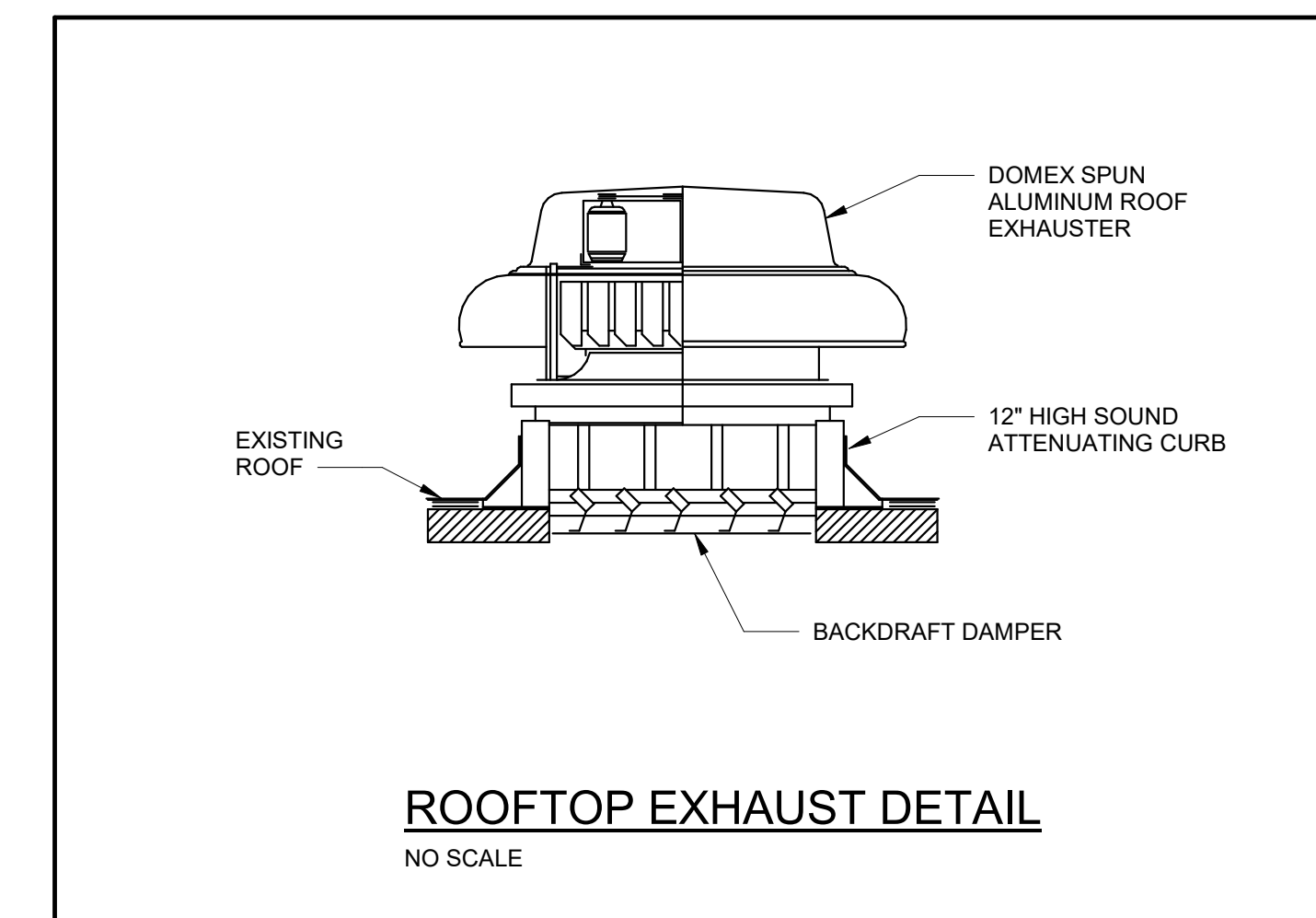
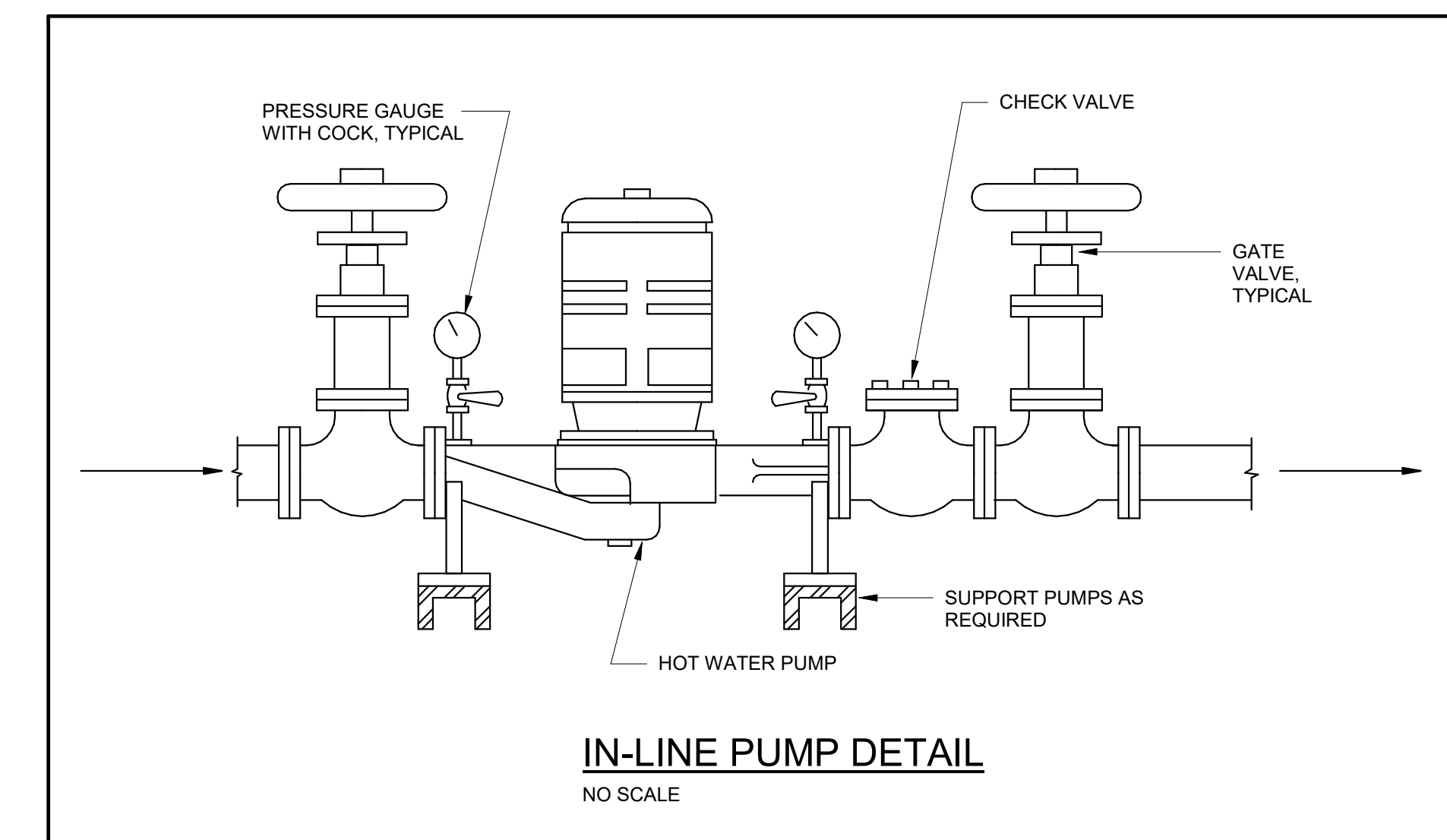
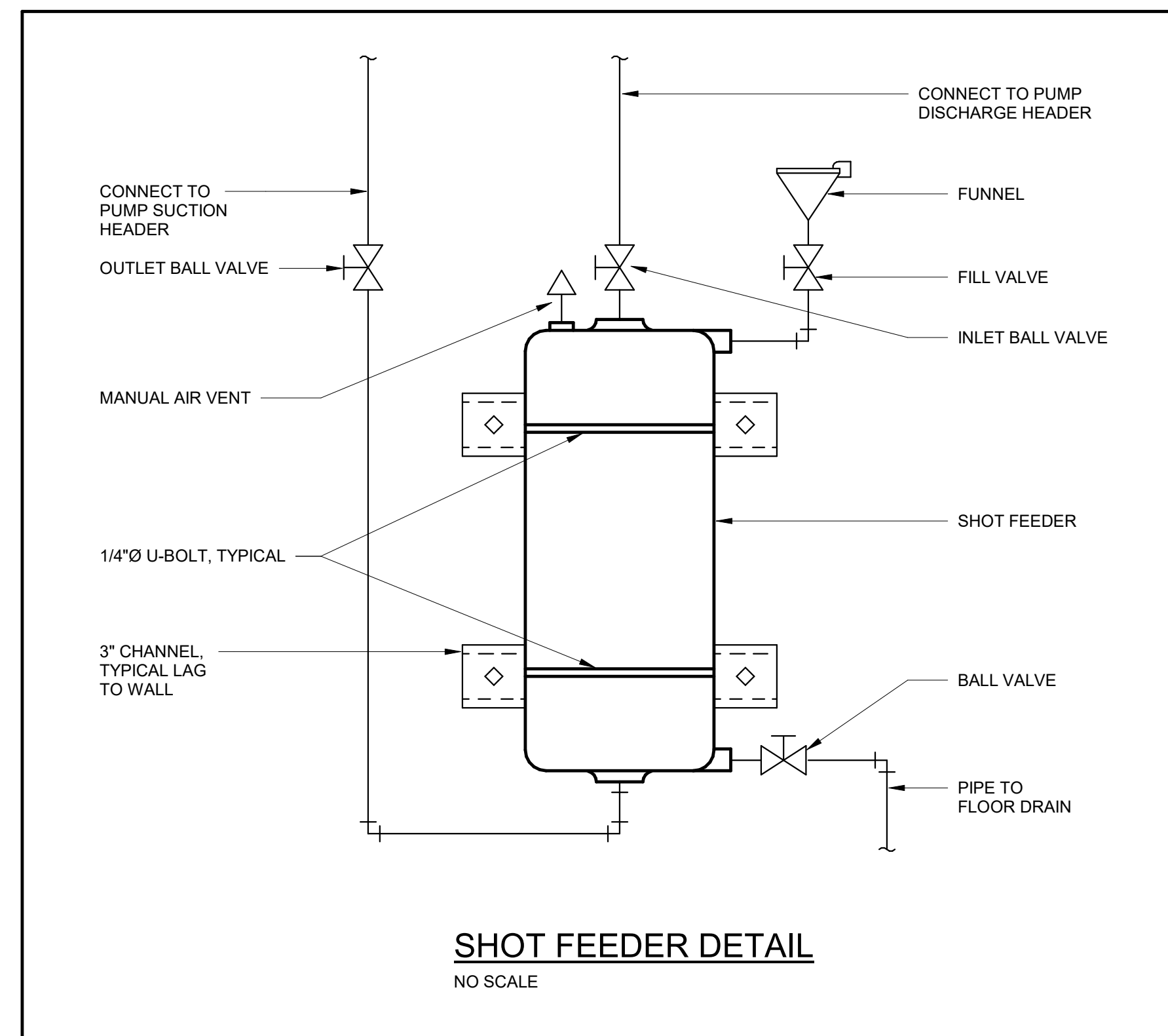
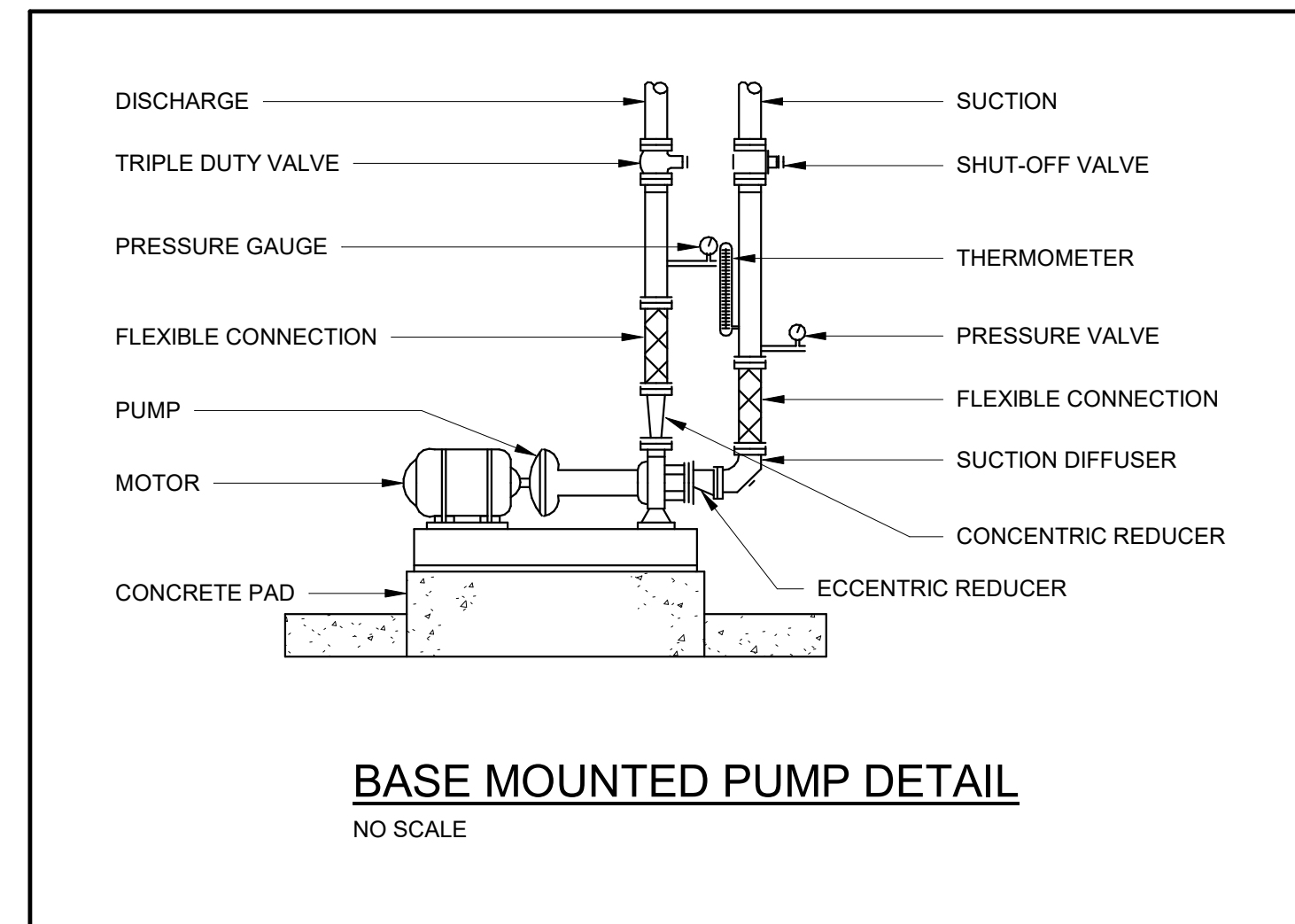
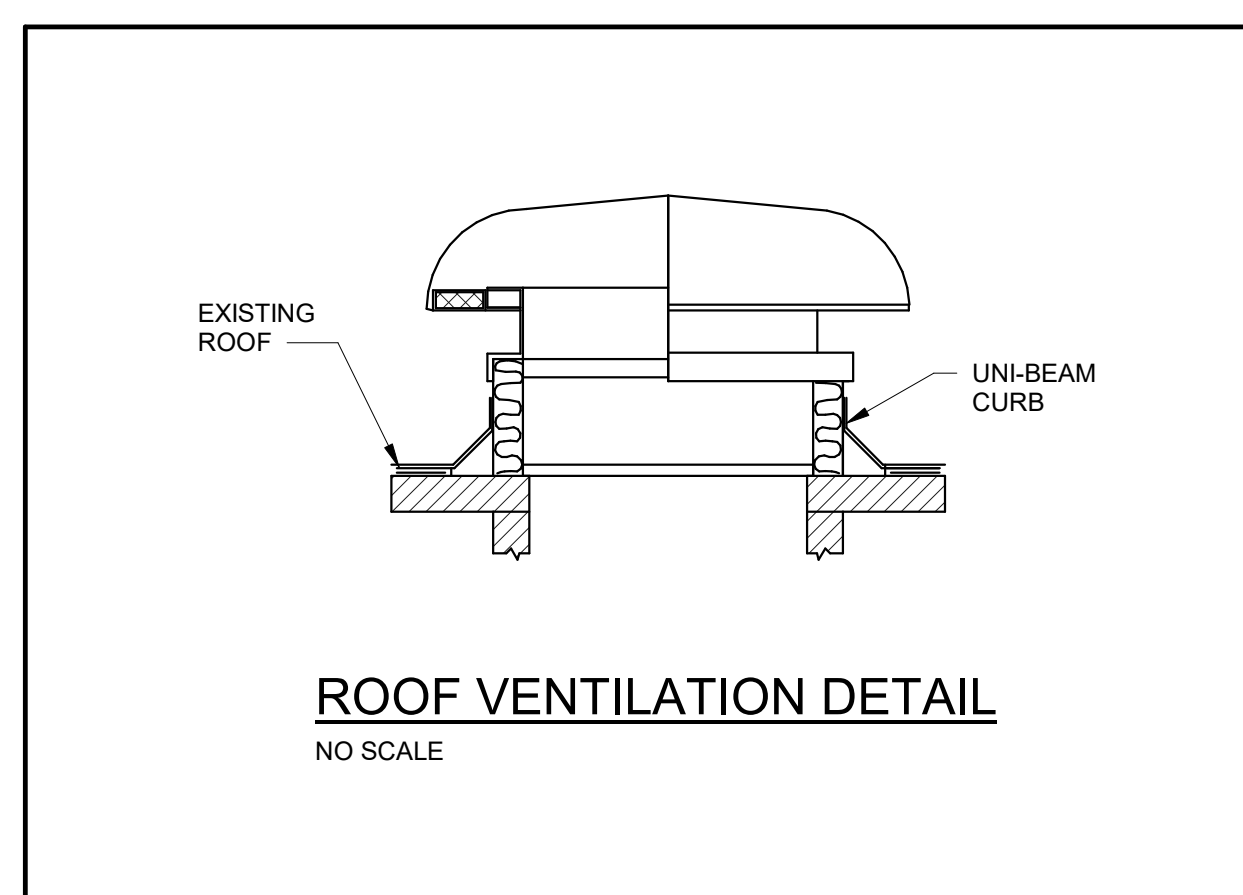
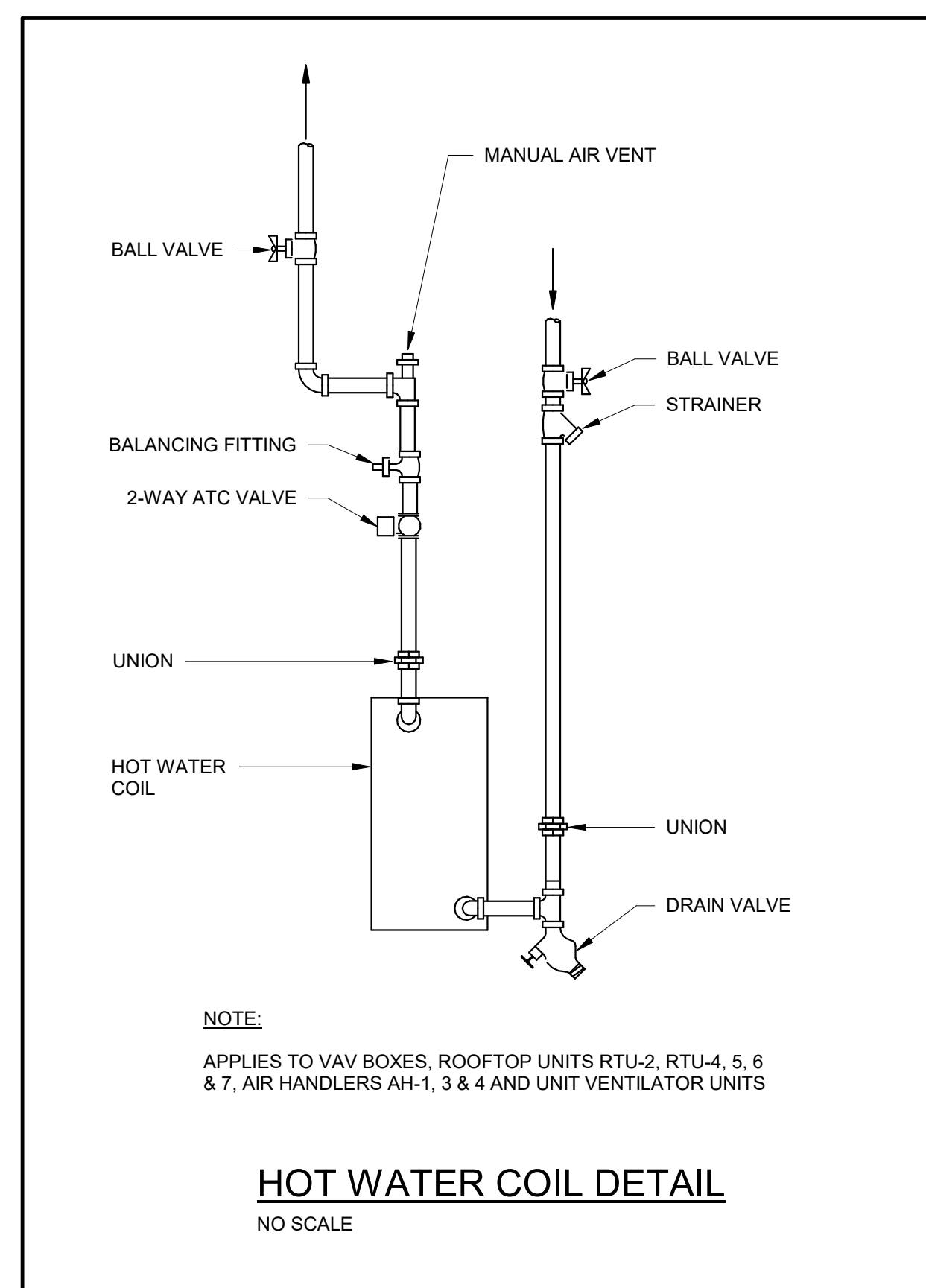
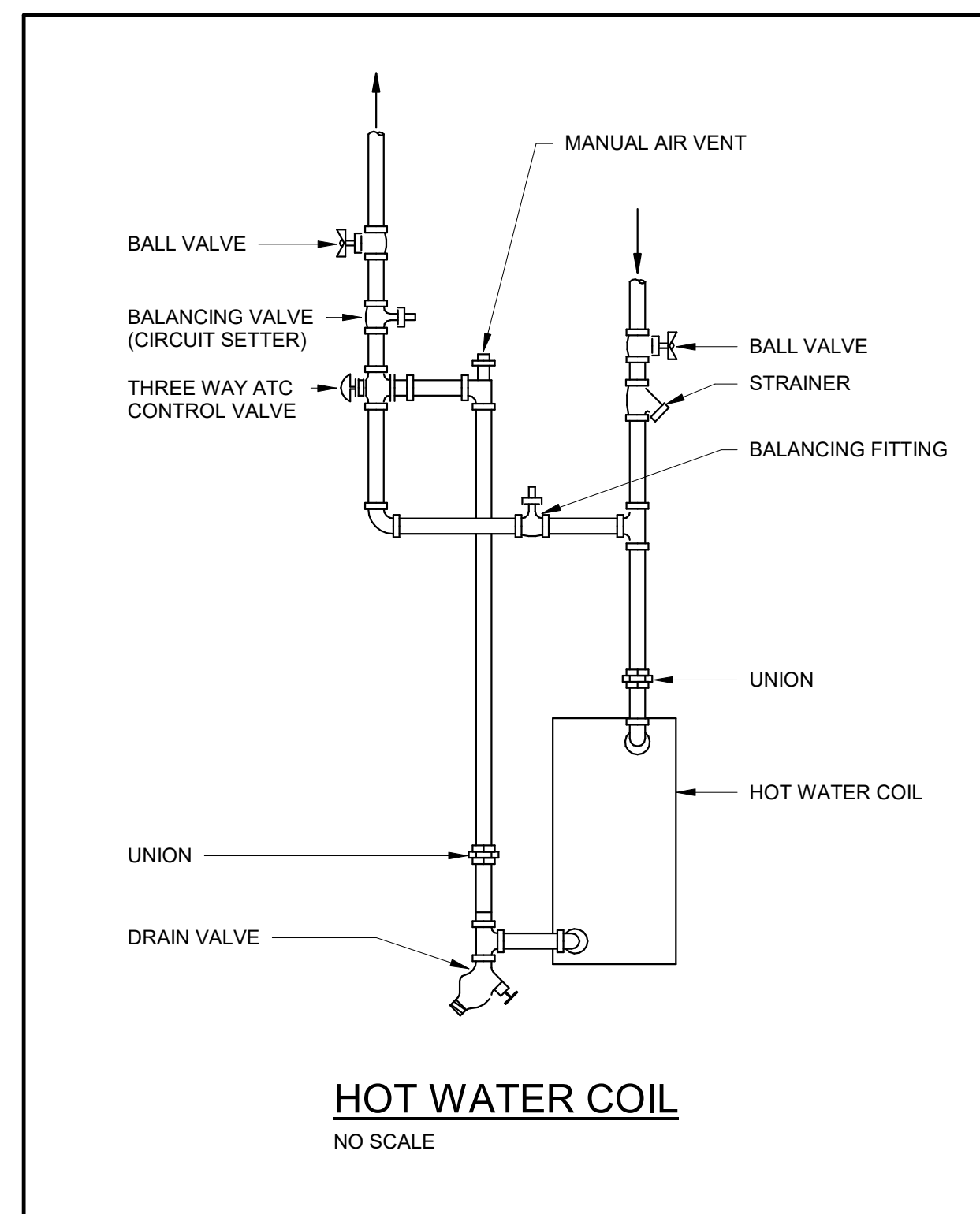
PLOT SCALE:

FILENAME

DATE: JULY 8, 2026

**PROJECT**  
3706

## M5.1

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The image shows the top portion of a technical drawing. On the left, there is a large, bold, white 'CR' logo on a dark gray background. To the right of the logo is a white rectangular title block. Inside the title block, the text 'MECHANICAL DETAILS' is centered. Below this, there are three rows of text: 'PLOT SCALE:', 'As indicated', 'FILENAME:', and 'DATE:'. The date 'JULY 8, 2026' is printed in a larger font below the 'DATE:' label.

**PROJECT**  
3706  
**M6.1**





1. ADJUST TO 200 CFM DURING OCCUPIED MODE AND 600 CFM DURING UNOCCUPIED MODE.
2. ADJUST TO 400 CFM.
3. MOTOR OPERATED DAMPER INTERLOCKED WITH SSU.
4. ADJUST SSU TO 600 CFM.

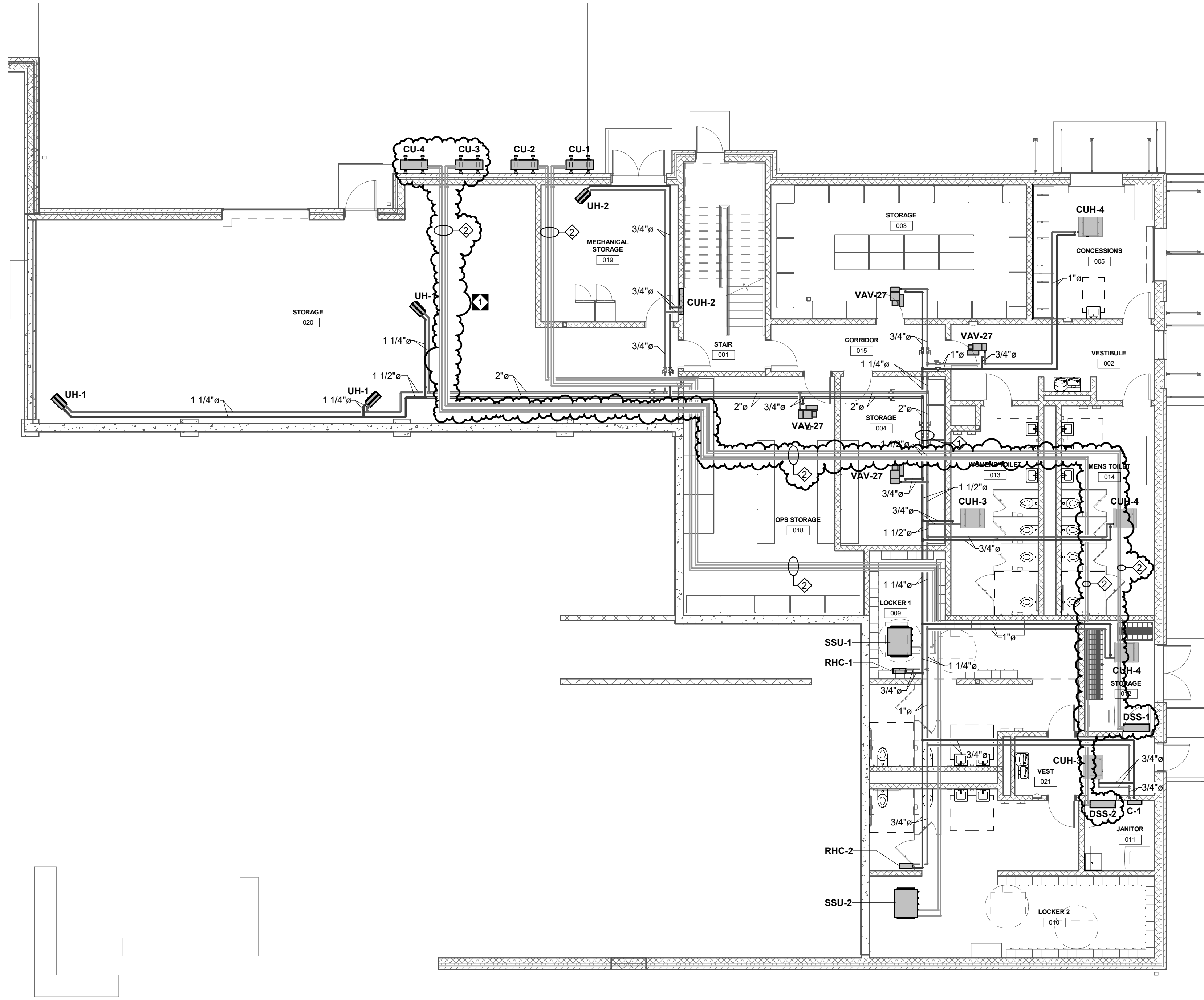
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M7.1

DATE: JULY 8, 2026



① GROUND FLOOR HVAC PIPING ALTERNATE  
1/8" = 1'-0"

- DRAWING NOTES:**
- 2-1/2" HWS AND HWR PIPING UP INTO CHASE ABOVE.
  - PROVIDE REFRIGERANT PIPING AS HIGH AS POSSIBLE.

**BID SET**

**MOORE**  
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| NO.       | DATE     | DESCRIPTION OF CHANGES |
| 1         | 07/23/26 | Addendum #1            |
|           |          |                        |
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GROUND FLOOR HVAC  
PIPING ALTERNATE PLAN

PLOT SCALE:  
1/8" = 1'-0"

FILENAME:

DATE:  
JULY 8, 2026

PROJECT  
3706  
**M7.2**