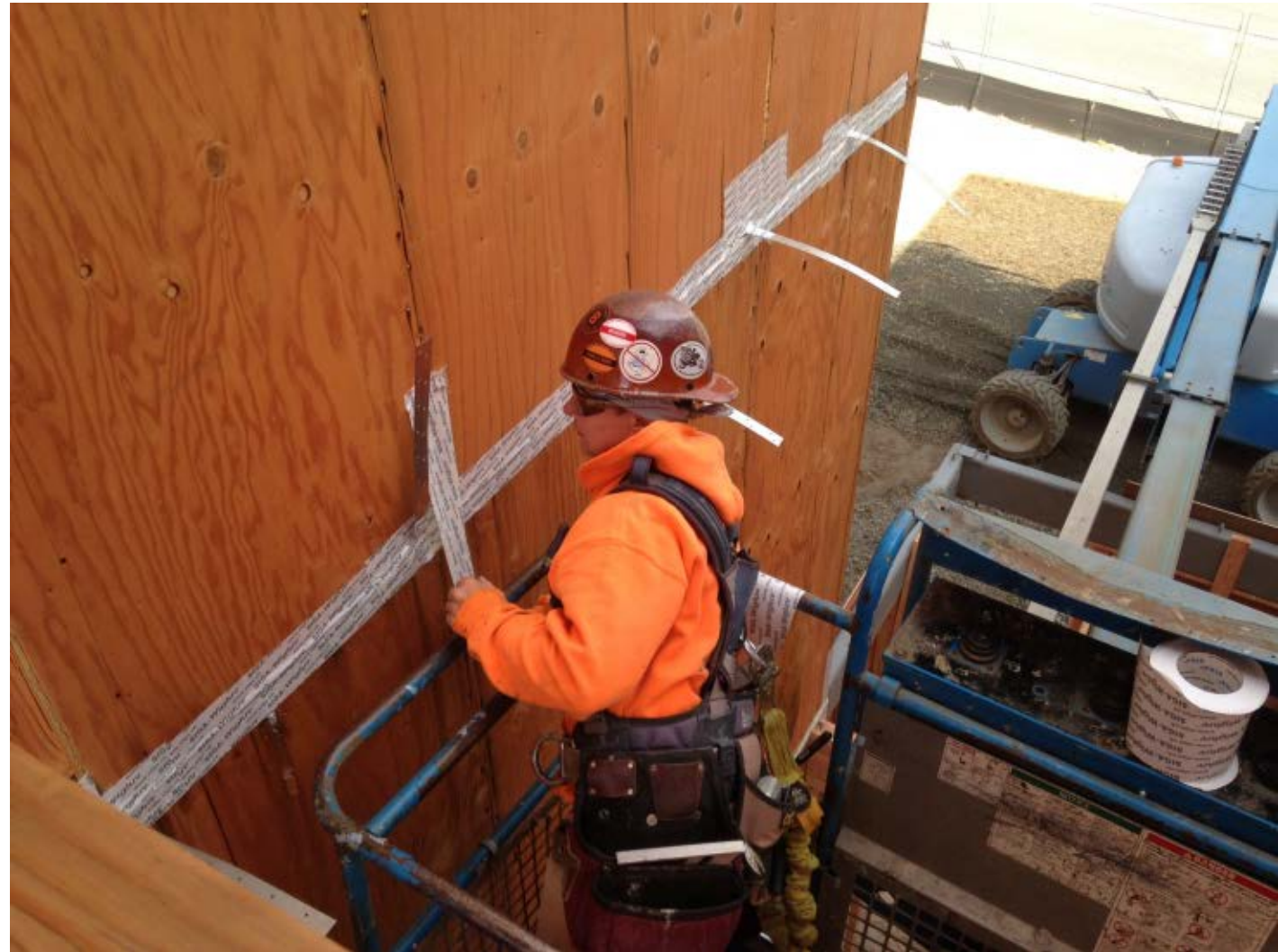


# Five Not So Easy Pieces

Designing and Constructing the Passive House Enclosure

Mike Steffen  
Walsh Construction Co.

BEST 4 Conference  
April 2015



# Outline

- Project Background & Context
- Building Design Overview
- Enclosure Design and Construction Process
- QA/QC / Commissioning
- **The Importance of Details**

# Project Team

- Owner: REACH Community Development
- Owner's Rep: Housing Development Center
- Architect: Ankrom Moisan Architects
- Contractor: Walsh Construction Co.
- PH Consultant: Green Hammer
- PHIUS+ Rater: Earth Advantage
- Mechanical Engineer: PAE Consulting Engineers
- Structural Engineer: Stonewood Structural Engineers
- Design Consultant: William Wilson Architects



Image courtesy of William Wilson Architects

# Design Overview





Aerial View from South

Image courtesy of Ankrom Moisan Architects



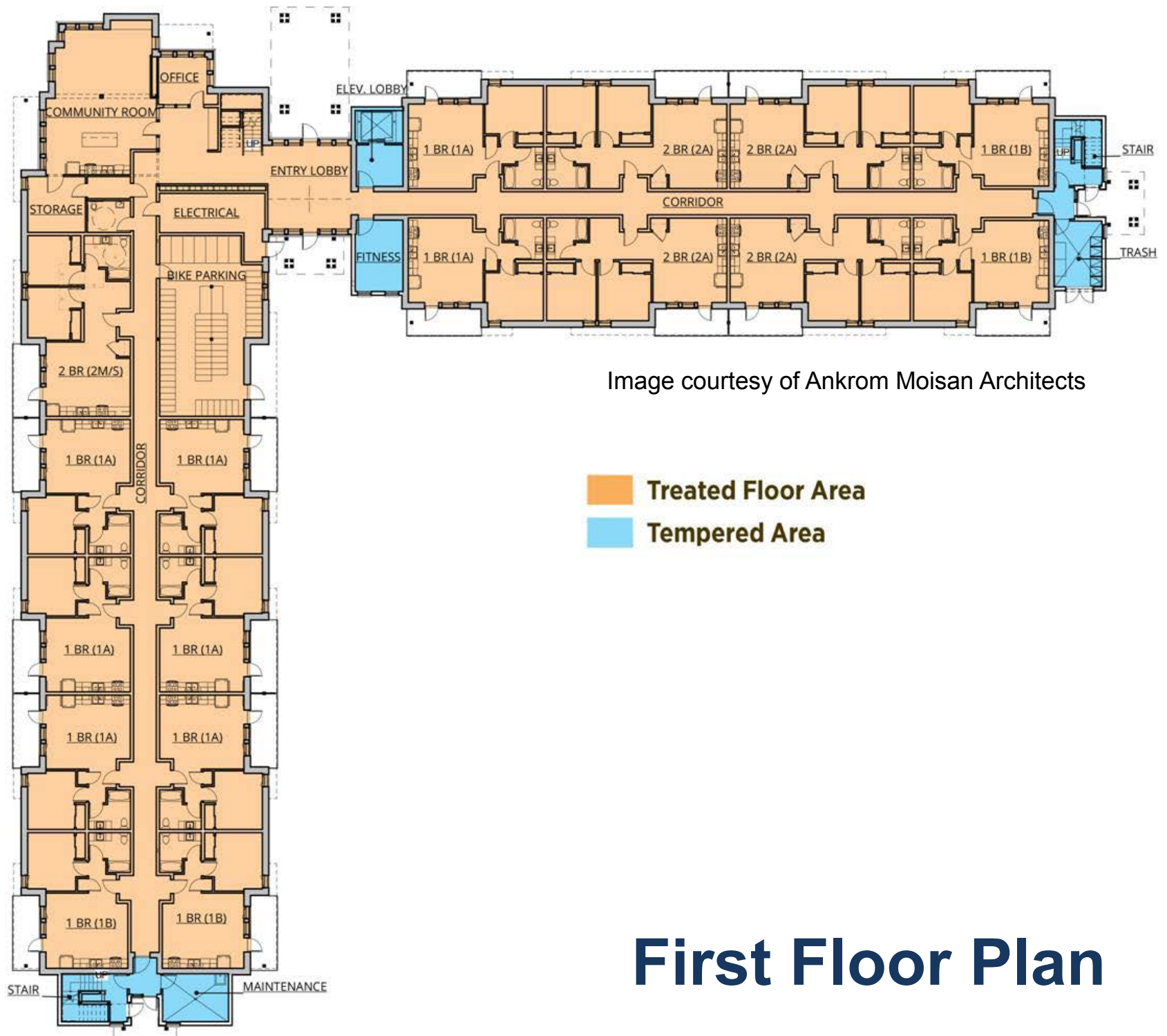
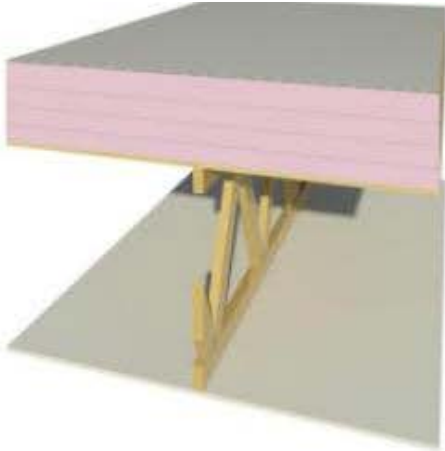


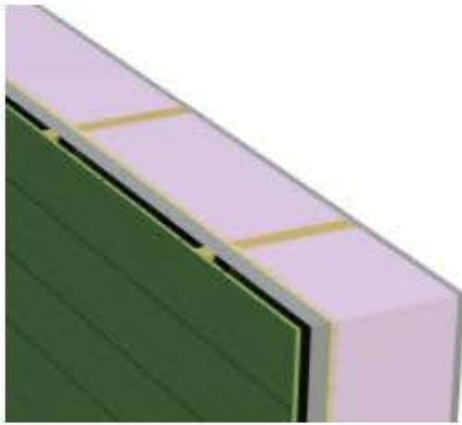
Image courtesy of Ankrom Moisan Architects

# First Floor Plan



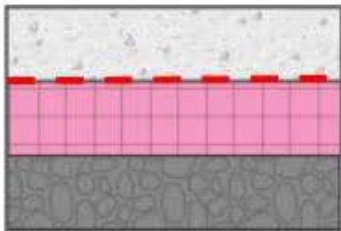
### Typical Roof Assembly: R-81

- 80 mil TPO roof membrane (fully adhered, white)
- 1/2" coverboard
- 12" polyisocyanurate insulation
- Self-adhered rubberized asphalt membrane vapor barrier (serves also as temp. roof)
- 3/4" plywood
- Prefabricated wood truss framing (trusses @ 24" o.c.)
- 5/8" gypsum wall board (2 layers)



### Typical Exterior Wall Assembly: R-39

- Fiber cement siding w/ treated 1x wood furring @ 24" o.c.
- 1-1/2" rigid mineral wool insulation (8 lb. density)
- Spun-bonded polyolefin sheet water-resistive barrier
- 1/2" plywood with air sealing tape at all seams
- 2x10 wood framing (studs at 24" o.c.)
- 9 1/4" blown fiberglass insulation at all framing cavities
- Polyamide sheet vapor barrier
- 5/8" gypsum wall board



### Typical Slab Assembly: R-19

- 4" concrete slab
- 15 mil polymer sheet vapor barrier
- 4" Type II expanded polystyrene insulation
- Gravel base with radon mitigation system piping

# Enclosure Assemblies



Balconies

Eyebrows

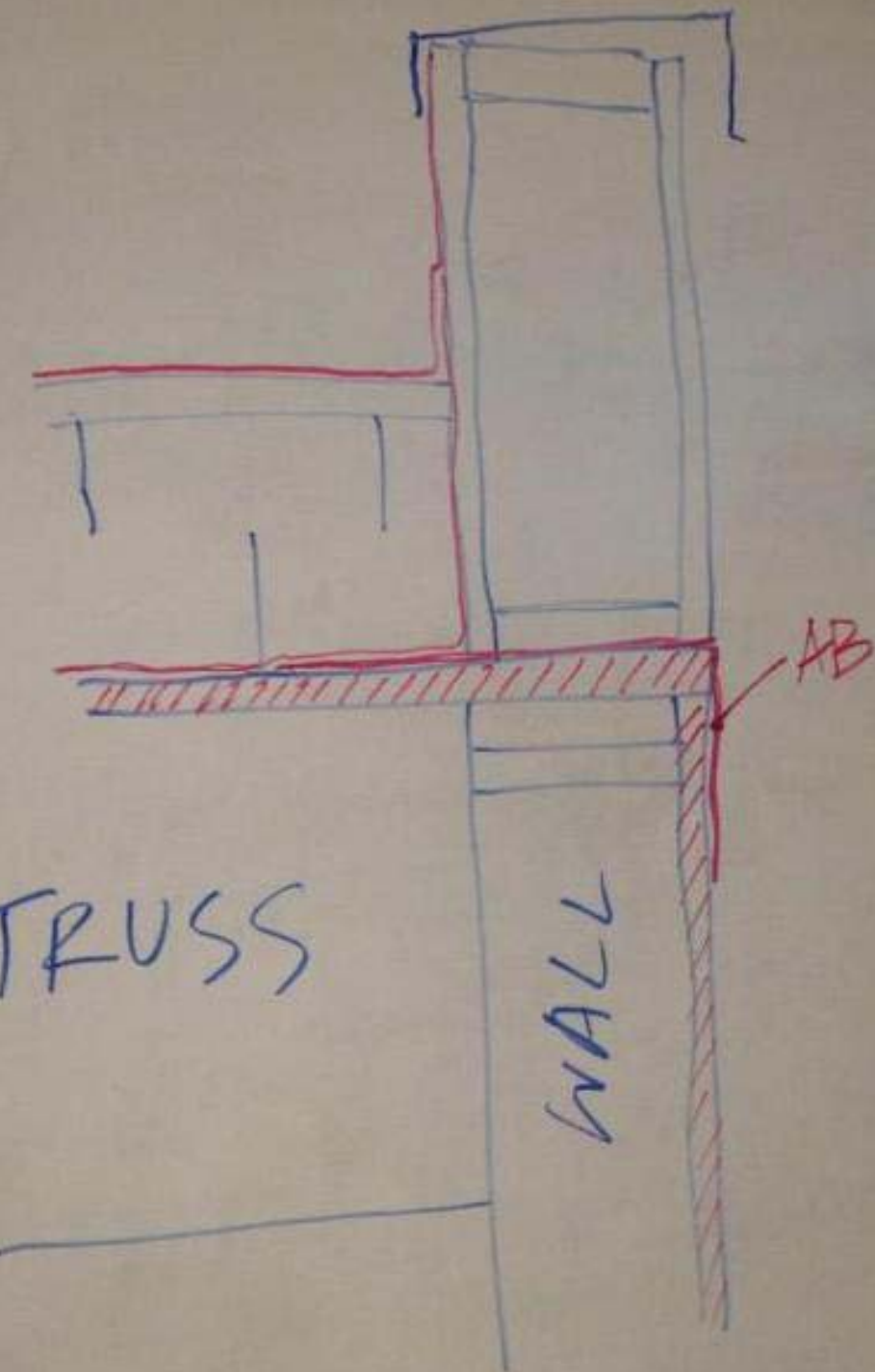


Shading Elements



# Enclosure Design & Construction Process

- Iterative design process
- Early concepts
- Coordinating the work



ORCHARD @ ORENCO

EXT. WALL OPTIONS

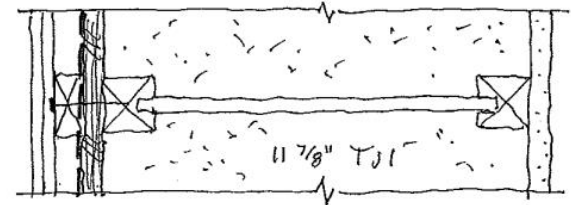
2/29/12

WALL (A)

- 11 7/8" TJI WALL FRAMING
- 11 7/8" BLOWN FG INSUL.

WWR-VALUE = R-39

MOISTURE: FAIR

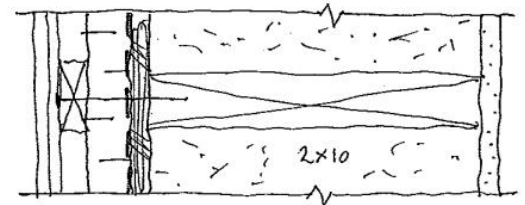


WALL (B)

- 2x10 WALL FRAMING
- 9 1/4" BLOWN FG INSUL.
- 1 1/4" MINERAL WOOL EXT. INSUL.

WWR-VALUE = R-40

MOISTURE: GOOD

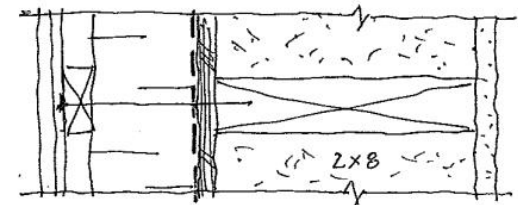


WALL (C)

- 2x8 WALL FRAMING
- 7 1/4" BLOWN FG INSUL.
- 3" MINERAL WOOL EXT. INSUL.

WWR-VALUE = R-40

MOISTURE: BETTER

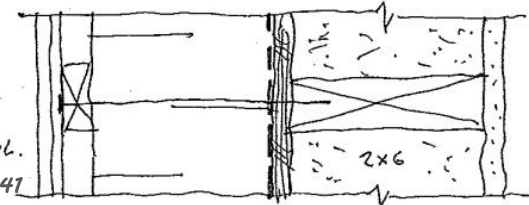


WALL (D)

- 2x6 WALL FRAMING
- 5 1/2" BLOWN FG INSUL.
- 5" MINERAL WOOL EXT. INSUL.

WWR-VALUE = R-41

MOISTURE: BEST!

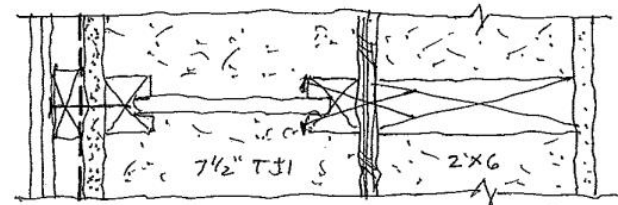


WALL (E)

- 2x6 WALL FRAMING
- 5 1/2" BLOWN FG INSUL.
- 7 1/2" BLOWN FG INSUL. w/ 7 1/2" TJI TRUSS.

WWR-VALUE = R-48

MOISTURE: ?













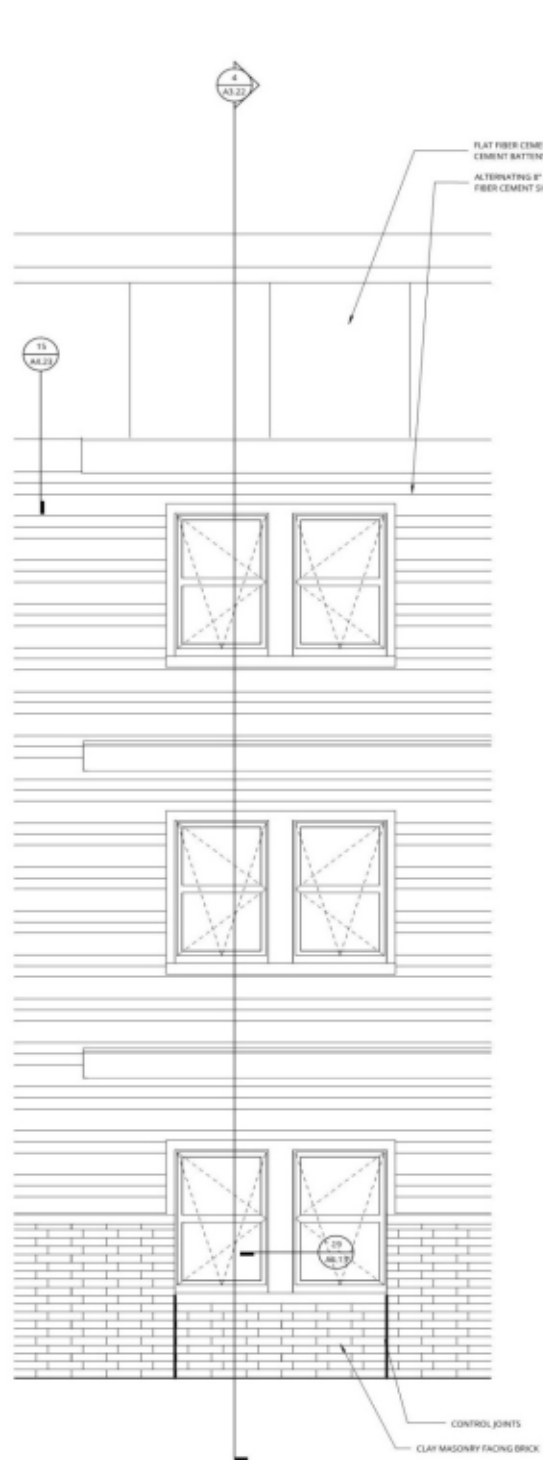
# The Importance of Details

- Success is achieved - or not - at the details!
- To ensure performance at the detail level, establish continuity of the critical barriers and then clearly indicate that continuity in the design drawings
  - Water-shedding surface
  - Water-resistive barrier
  - Air barrier
  - Thermal barrier
  - Vapor barrier

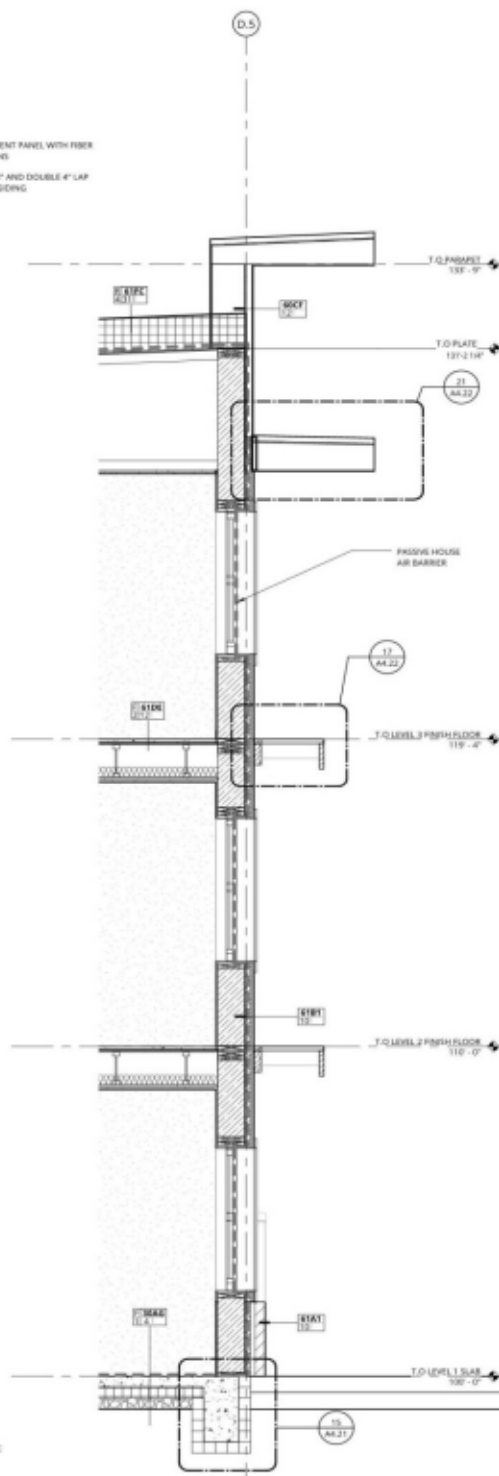
# Tracing The Critical Barriers

- Design and construction team members can use a review exercise where one traces the barriers through the various building enclosure drawings
- Verify continuity OR identify discontinuities in critical barriers
- Air barrier continuity is “proven” at the detail level; however, it is very helpful to construction team to indicate ABS in larger scale drawings

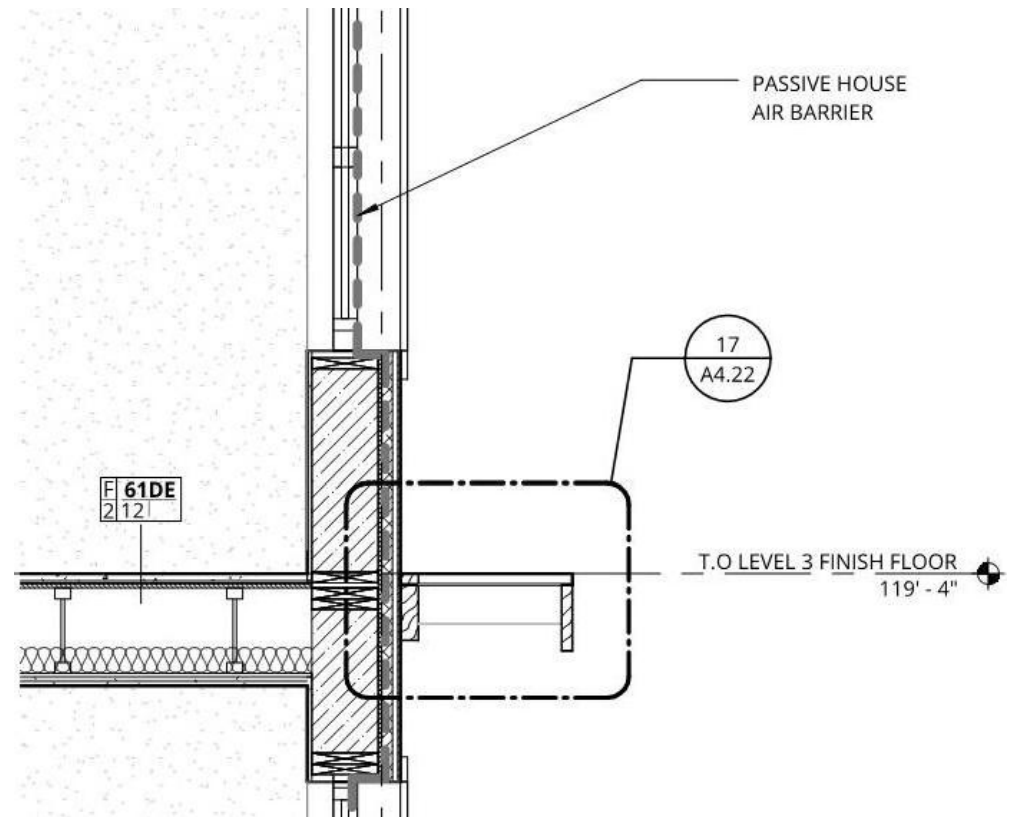




**3** ENLARGED ELEVATION AT UNIT TYP  
A3.22 | 1/2" = 1'-0"



**4** WALL SECTION AT UNIT TYP.  
A3.22 | 1/2" = 1'-0"



Images courtesy of Ankrom Moisan Architects

## Wall Section

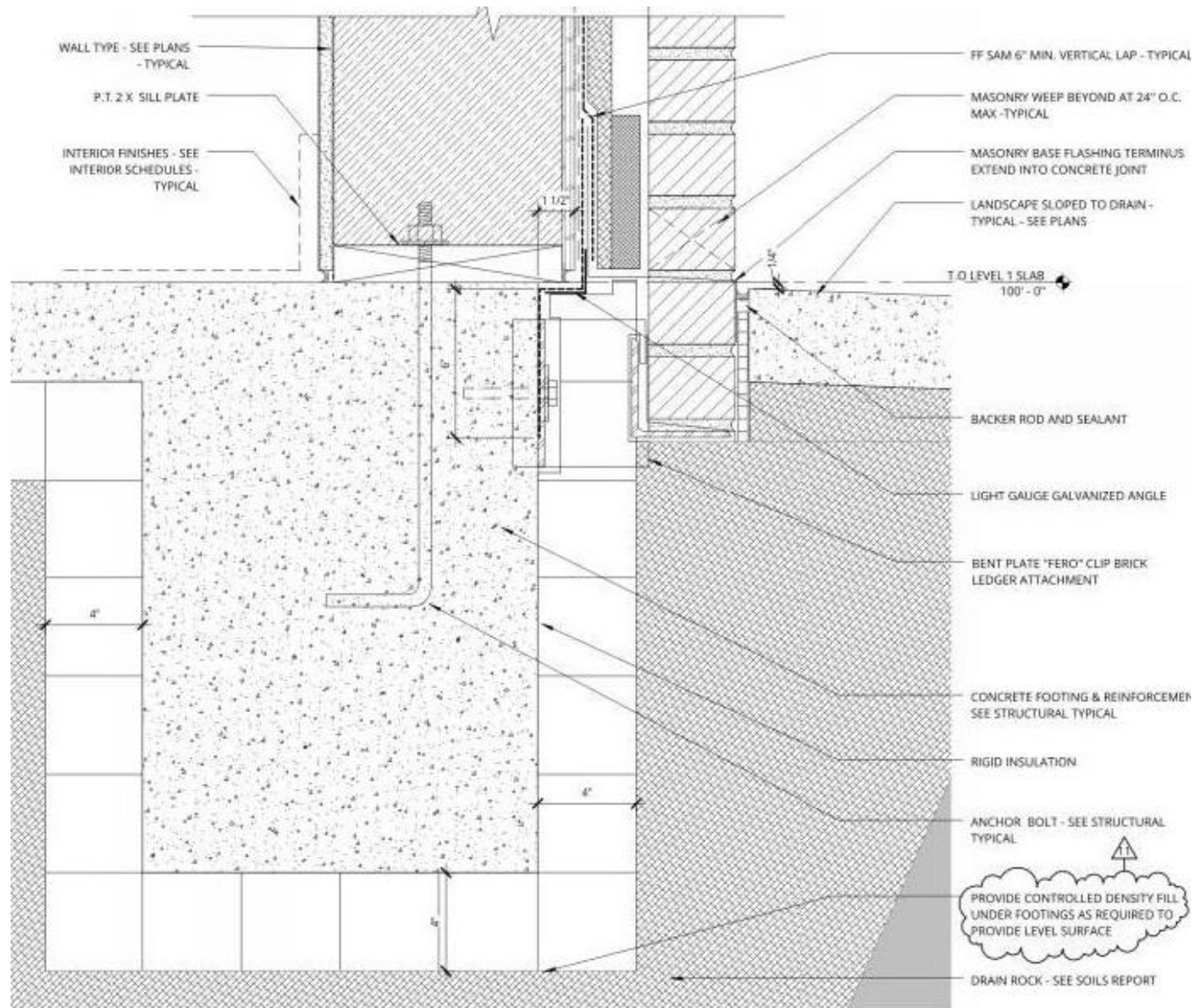


Image courtesy of Ankrom Moisan Architects

## Design Drawing at Typical Exterior Wall to Foundation

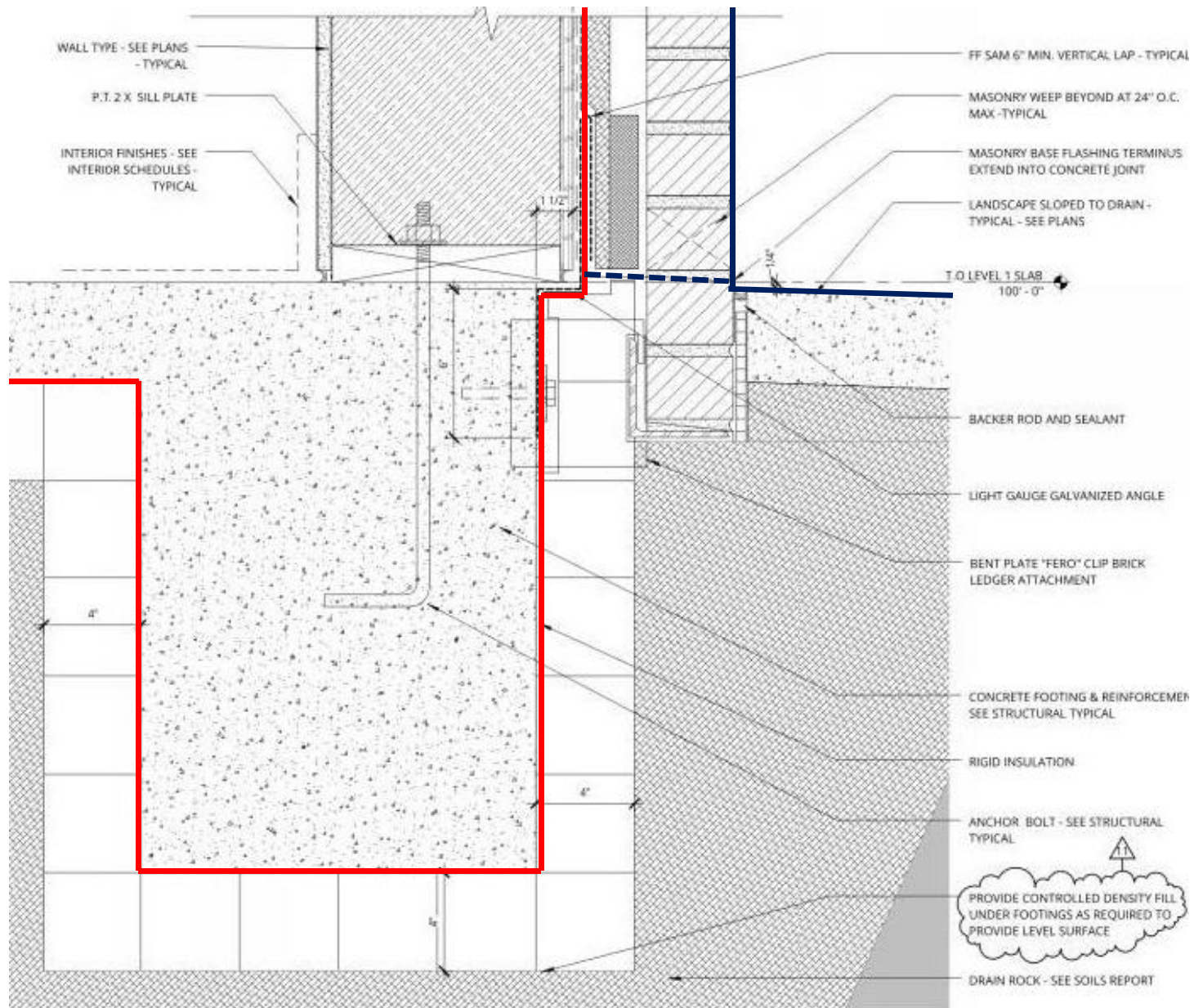






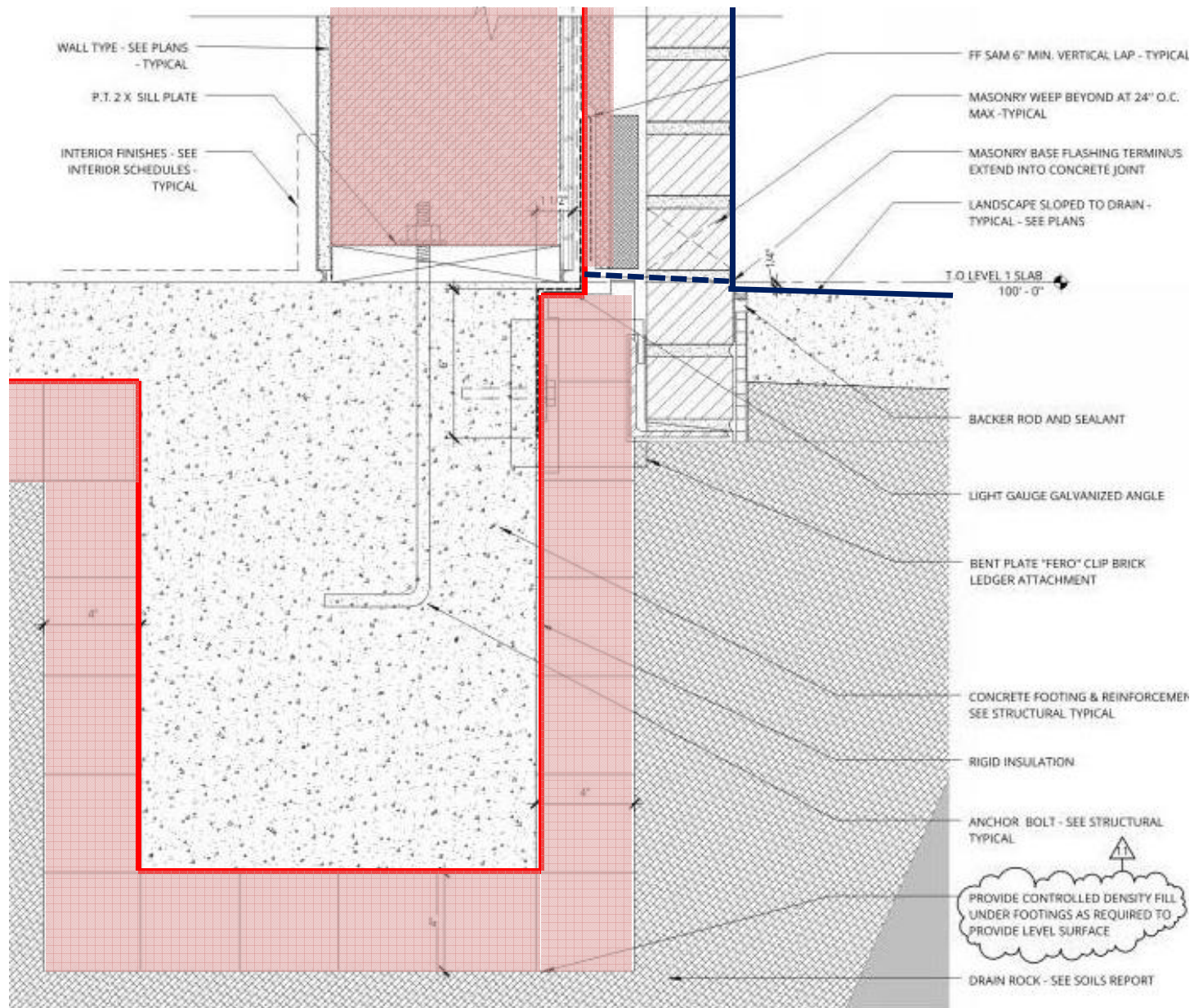




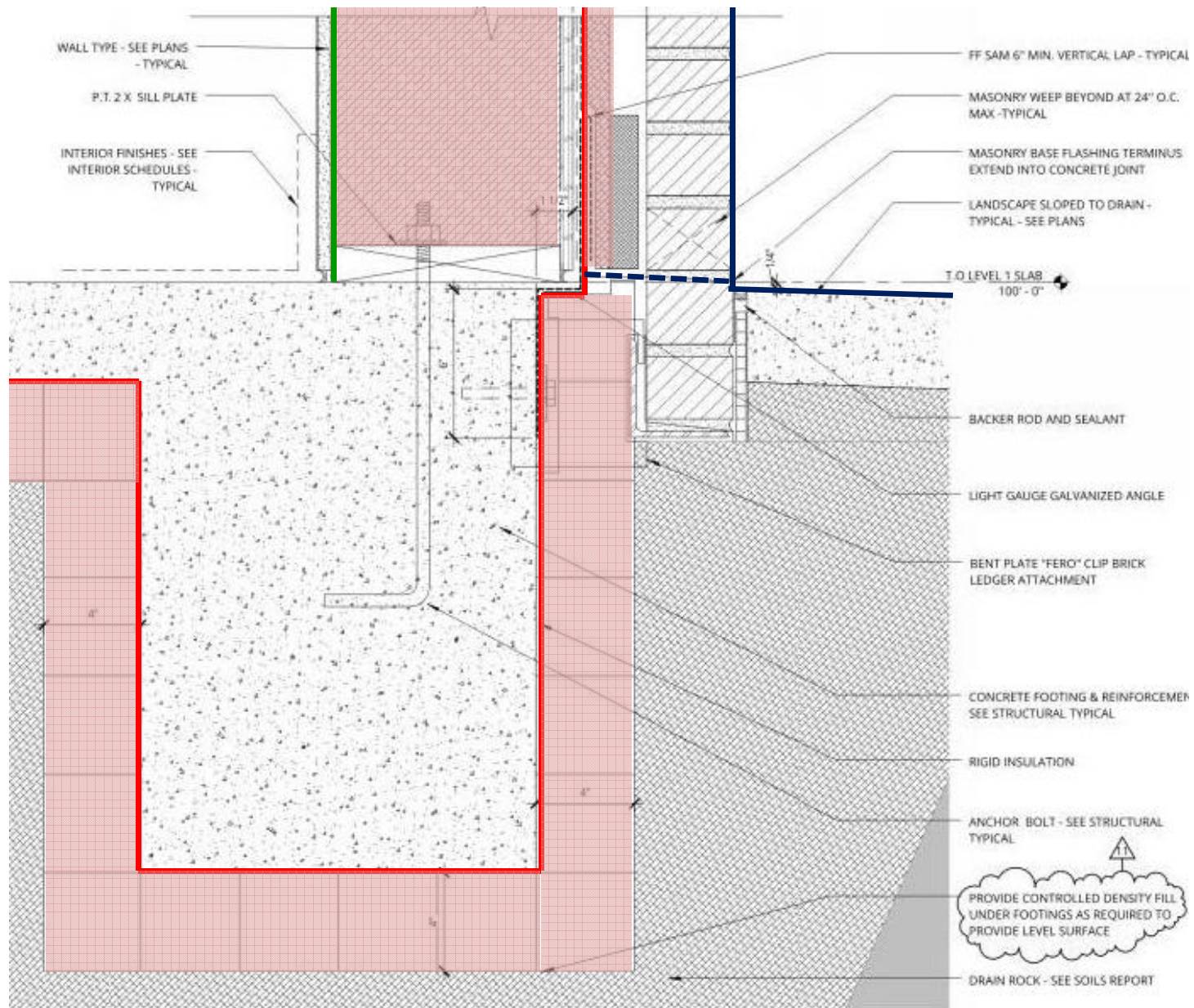


## Critical Barrier Continuity: Air Barrier



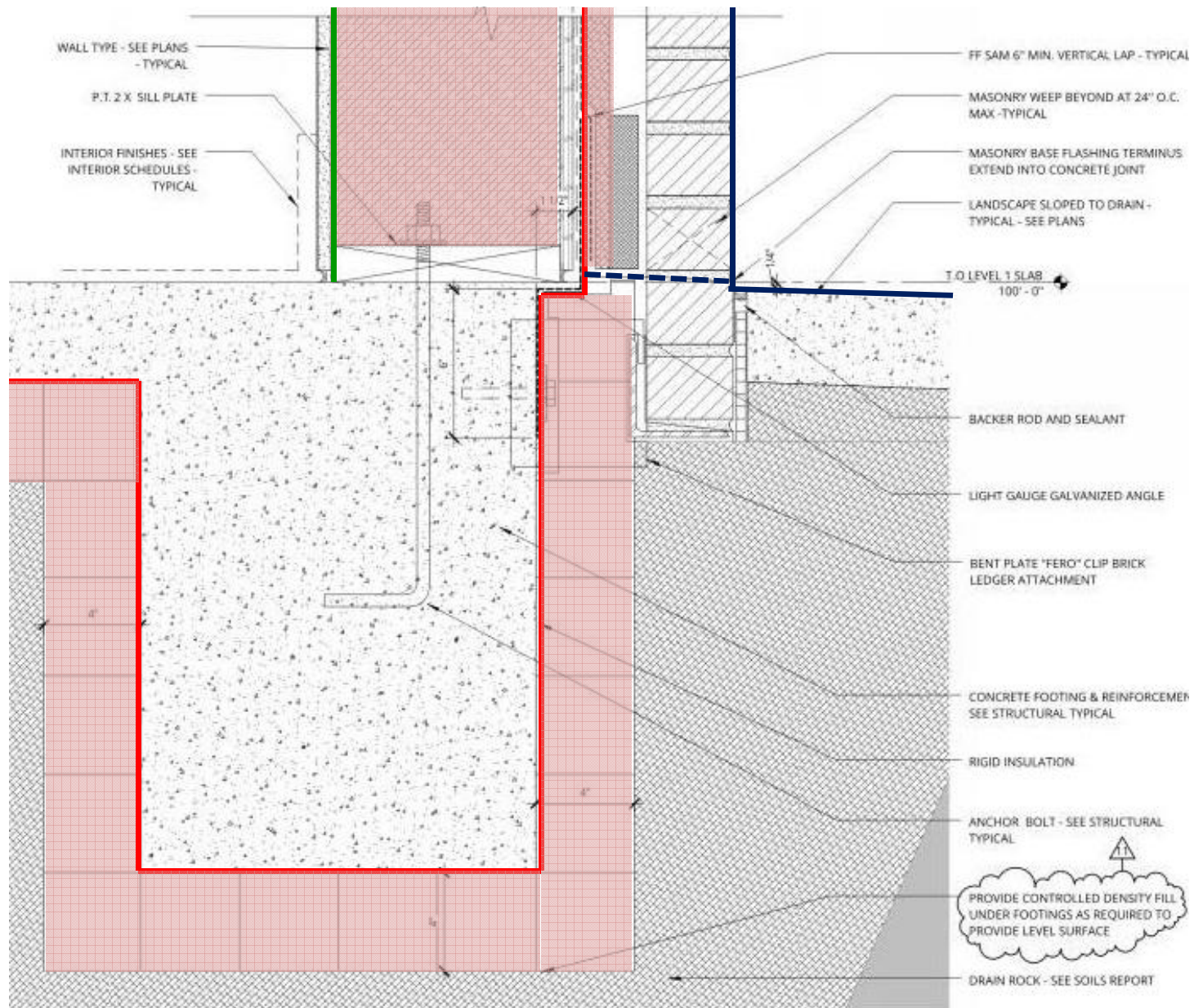


## Critical Barrier Continuity: Thermal Barrier



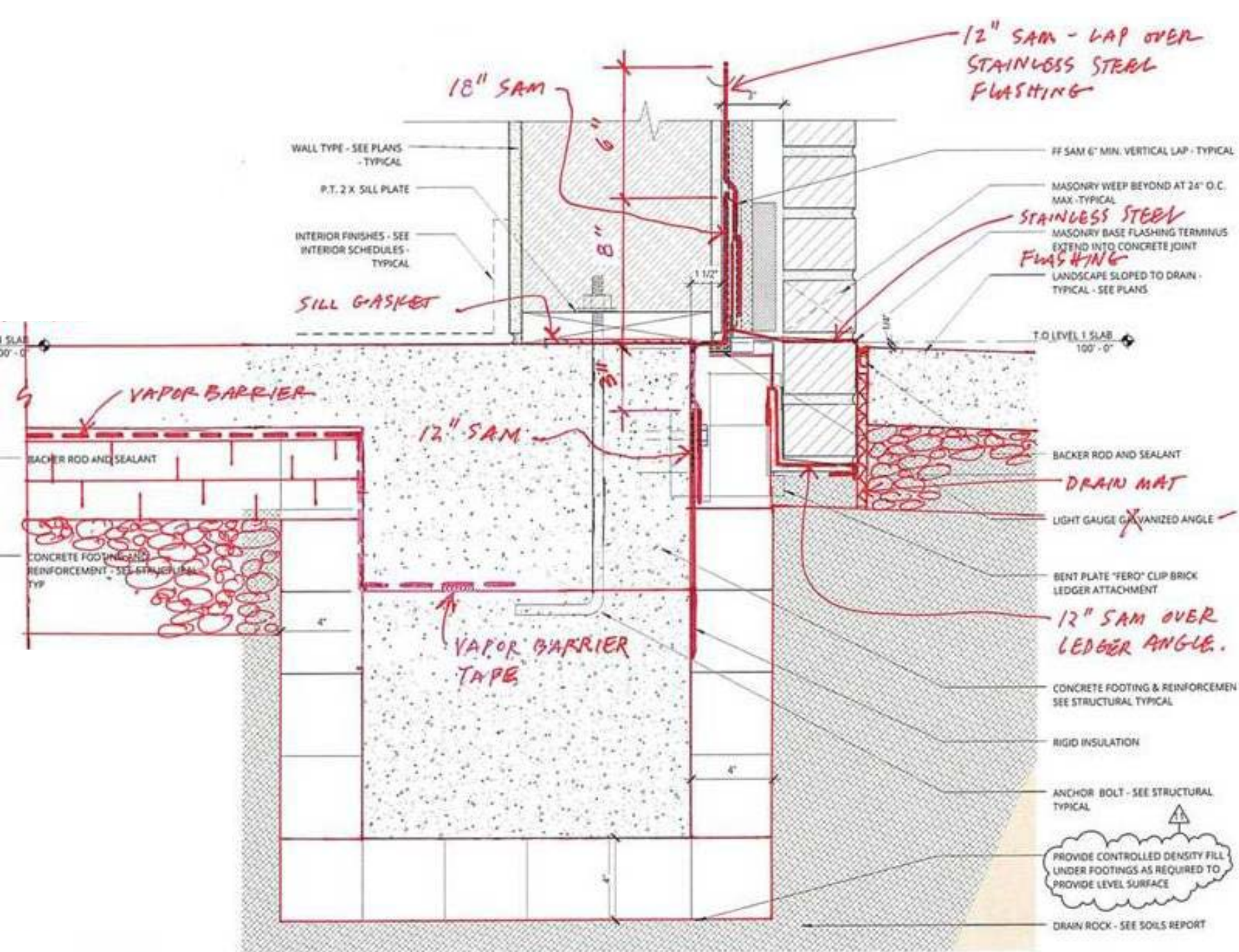
## Critical Barrier Continuity: Vapor Barrier





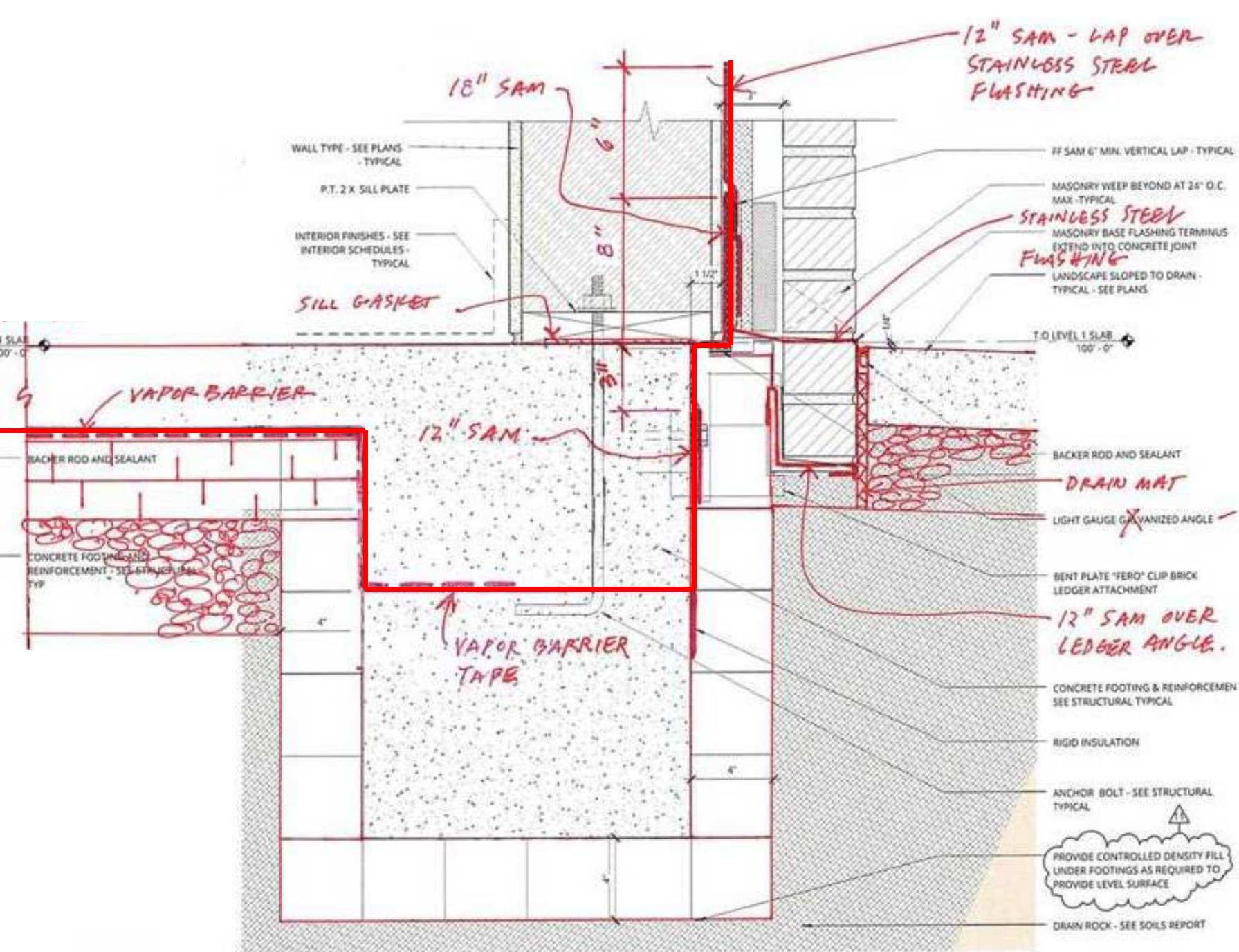
**Critical Barrier Continuity: Vapor Barrier ???**





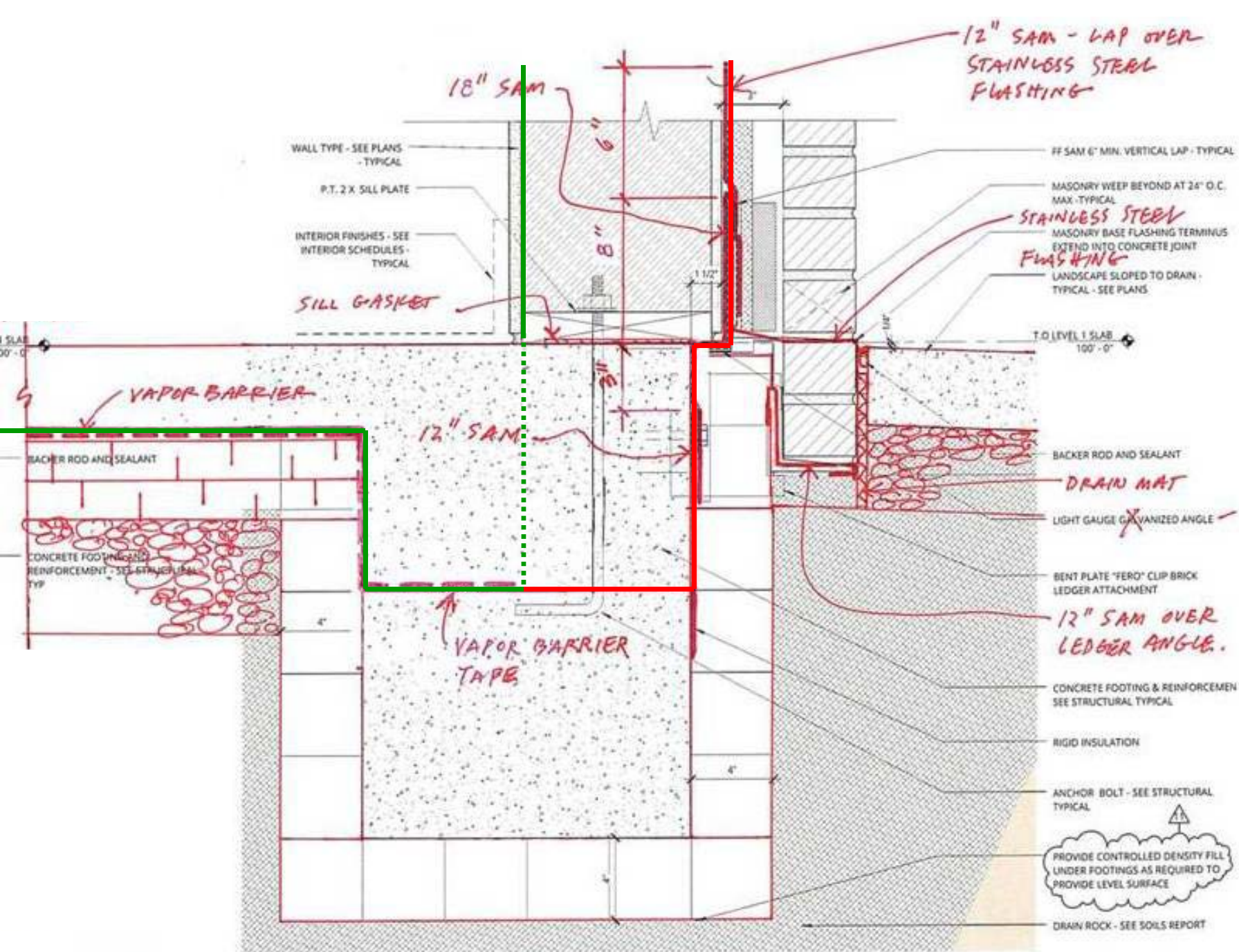
**Coordination Drawing at Typical Exterior Wall to Foundation**





**Critical Barrier Continuity: Air Barrier (Revised)**



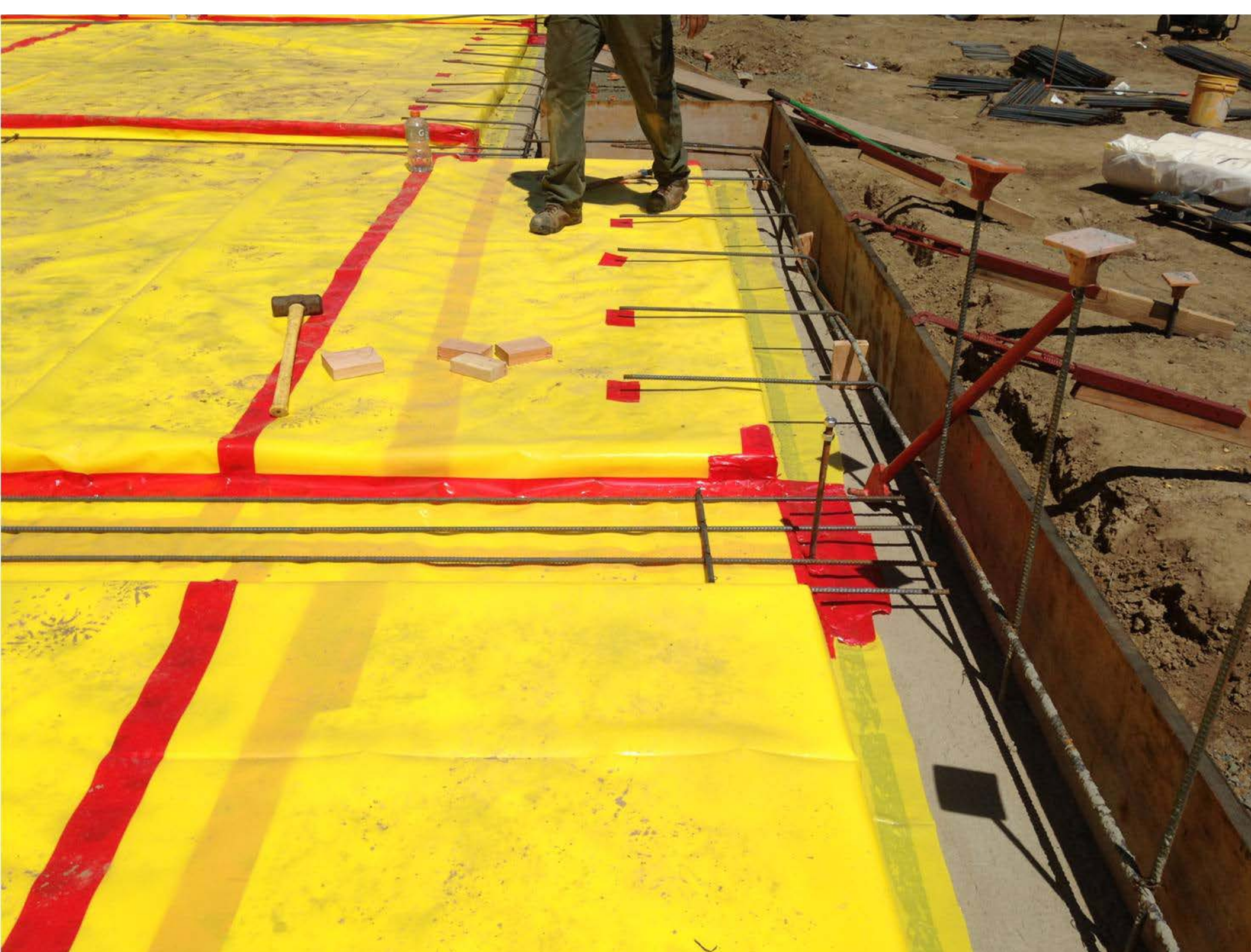


## Critical Barrier Continuity: Vapor Barrier





























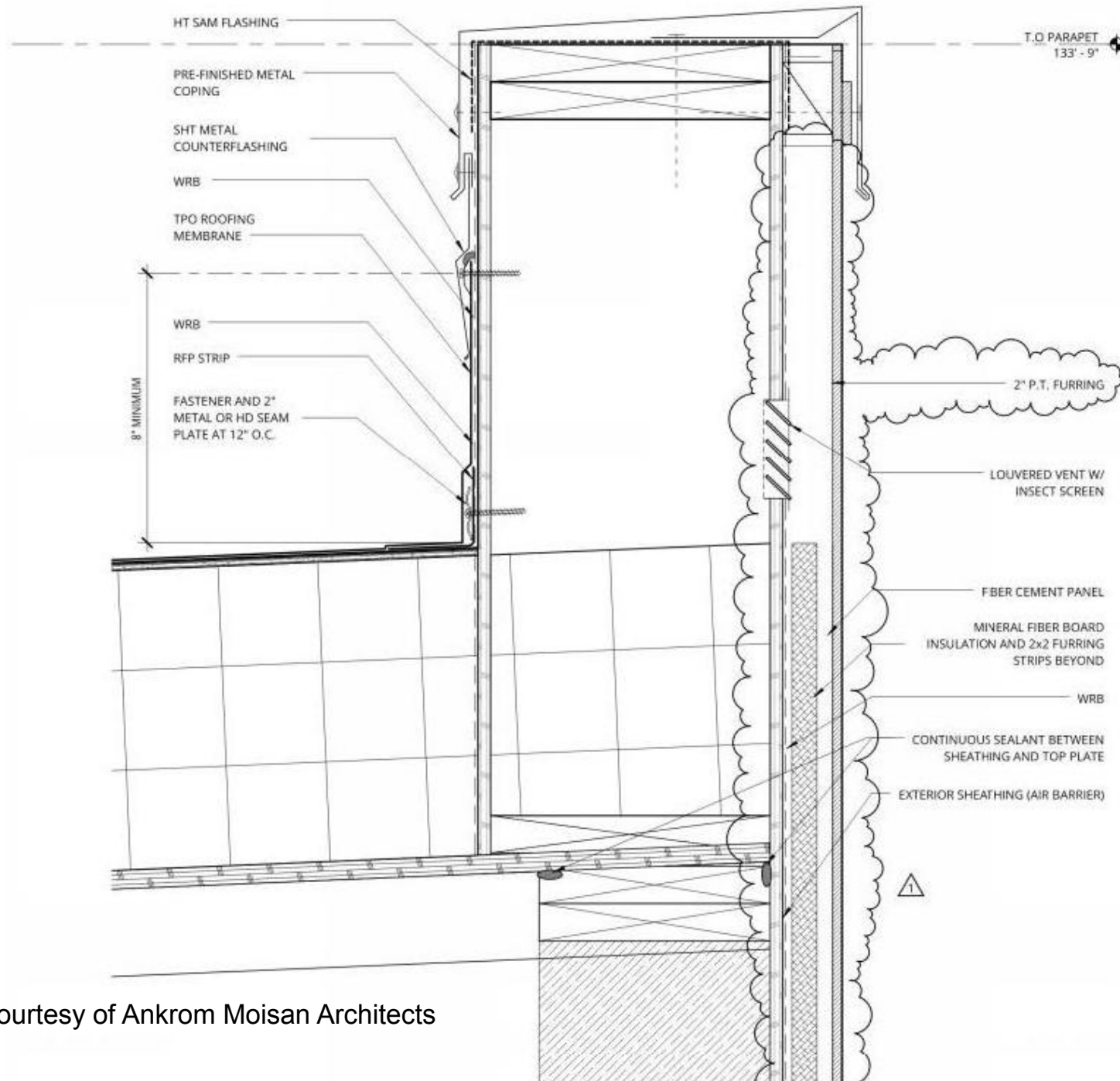
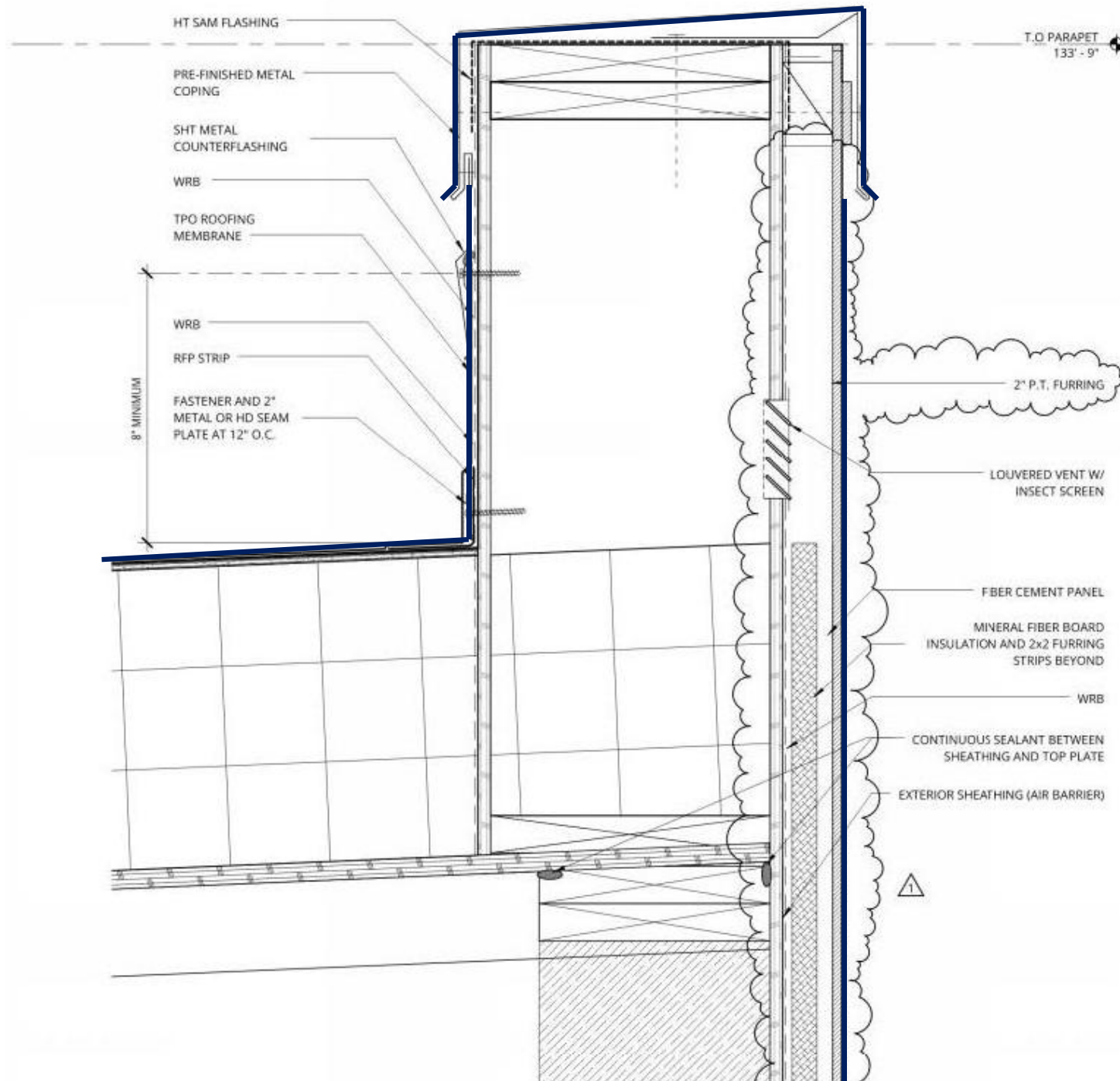


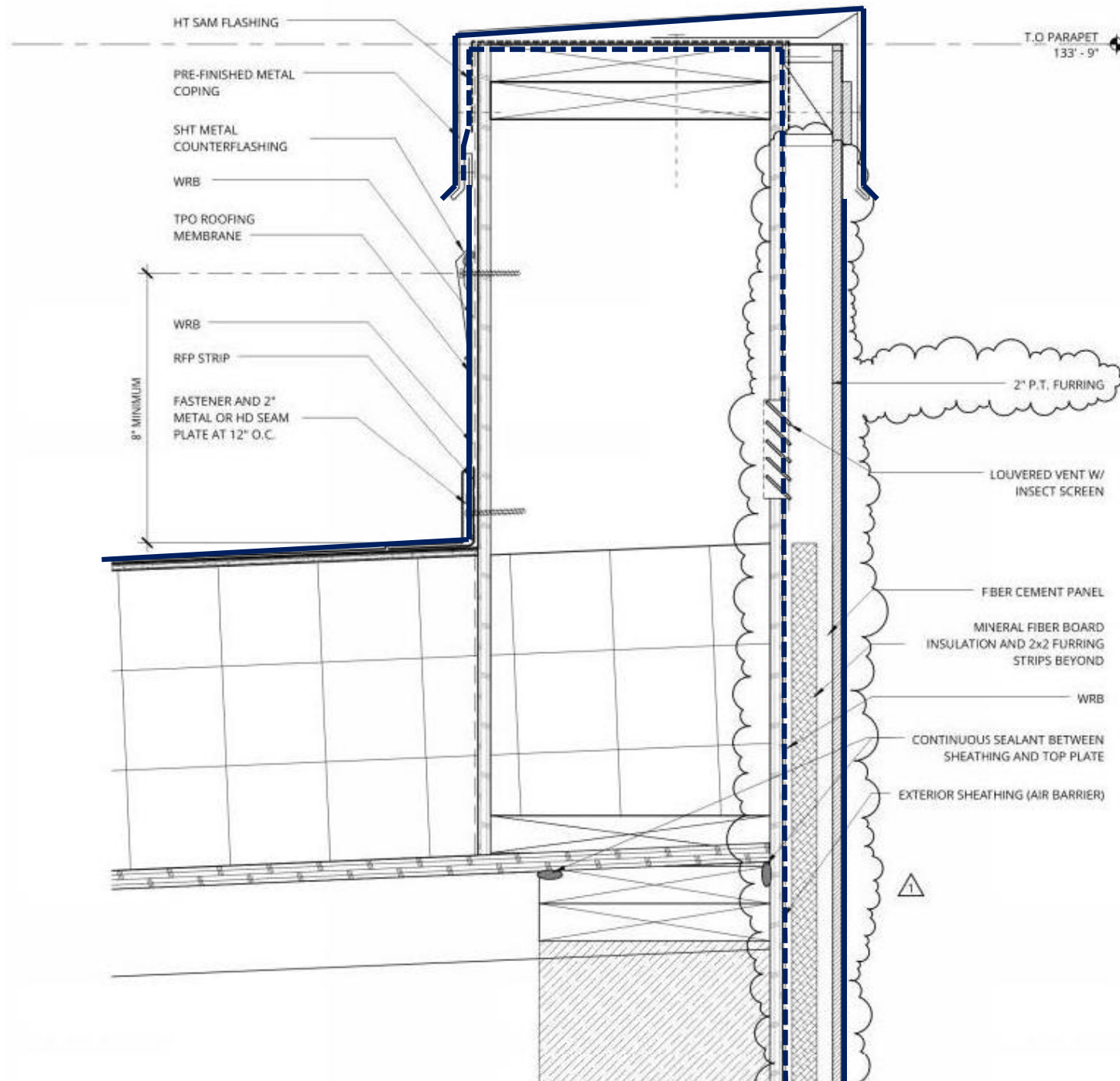
Image courtesy of Ankrom Moisan Architects

## Design Drawing at Typical Exterior Wall to Roof

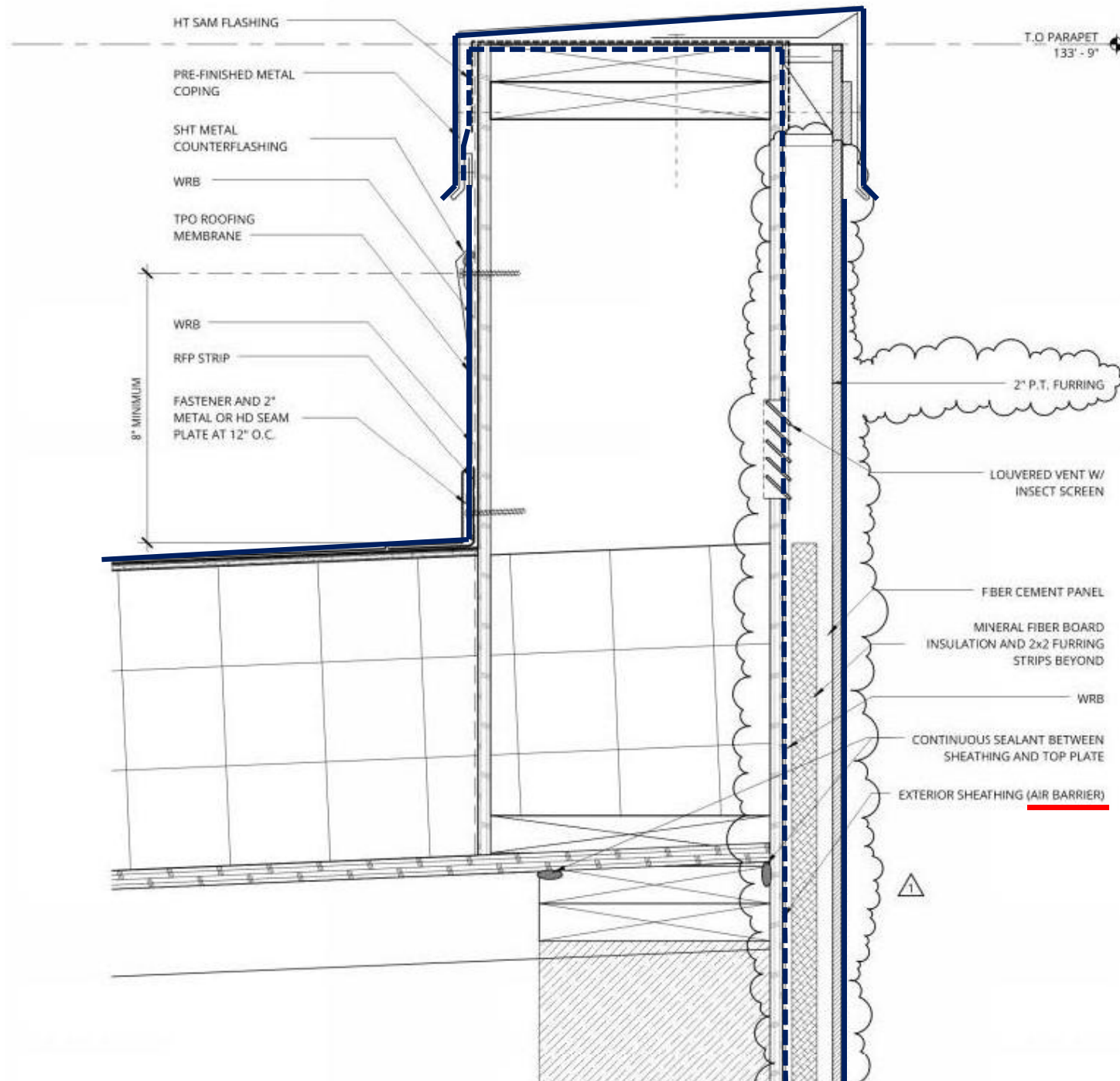


## Critical Barrier Continuity: Water-Shedding Surface



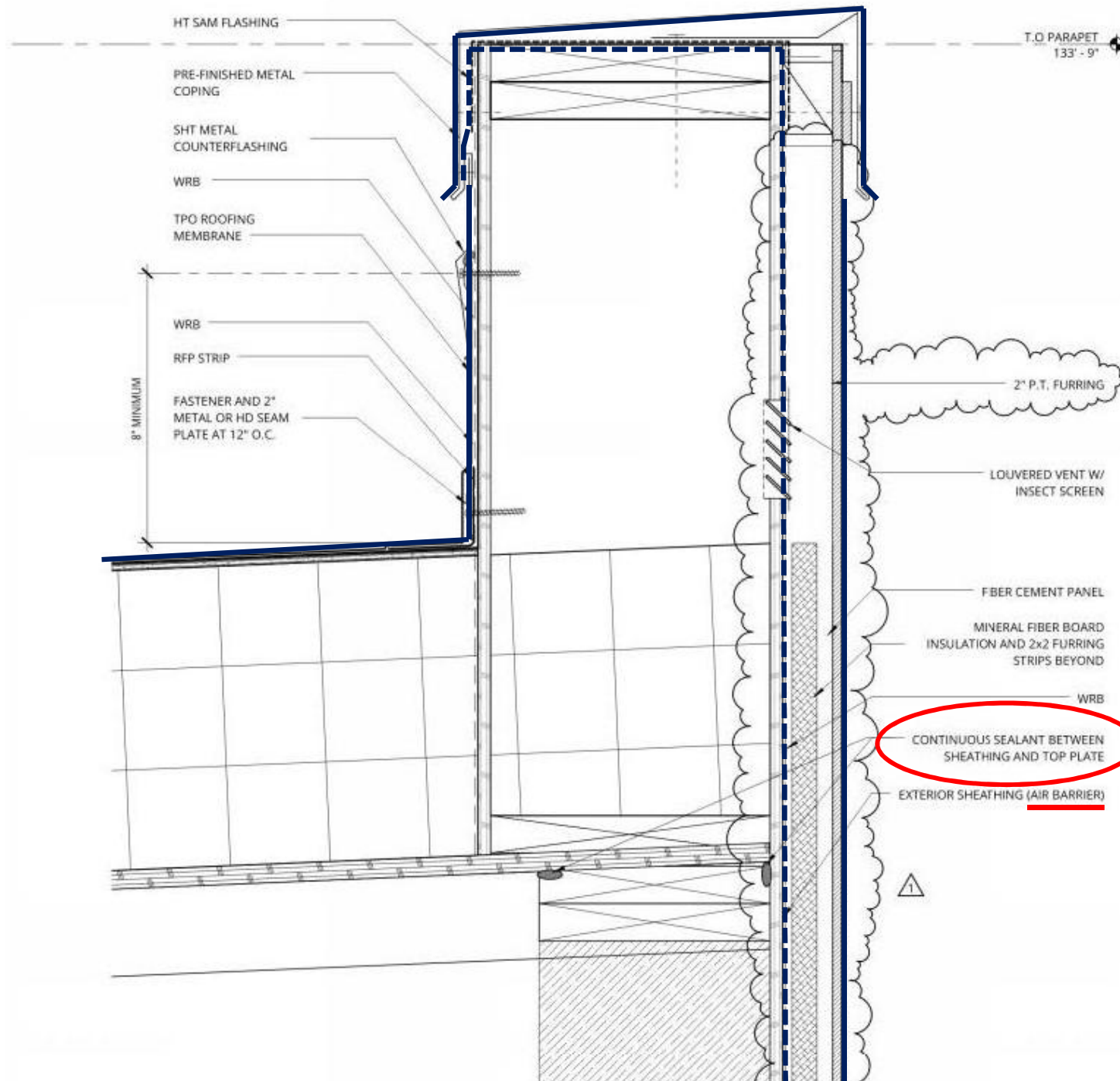


## Critical Barrier Continuity: Water-Resistive Barrier

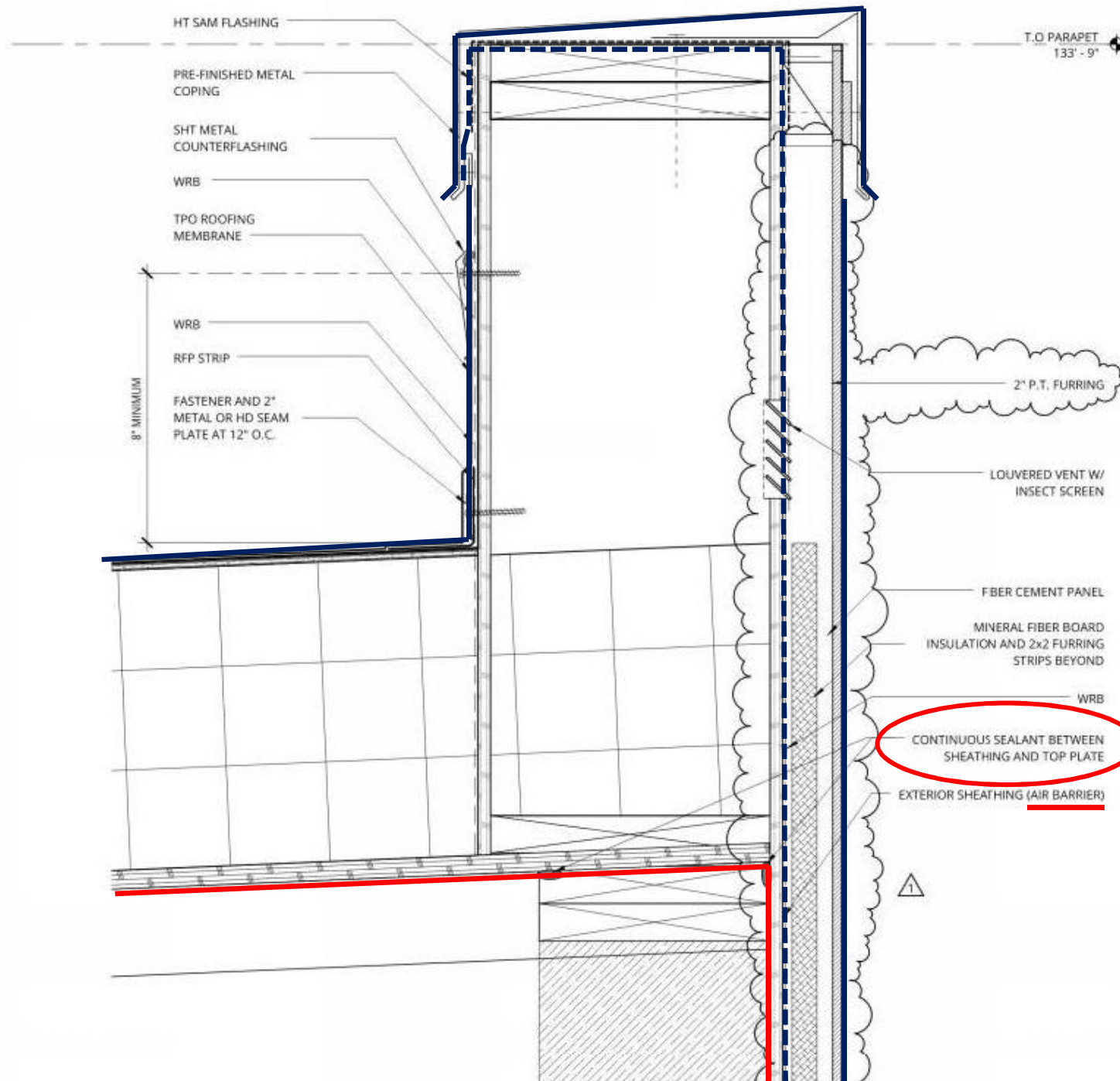


## Critical Barrier Continuity: Air Barrier



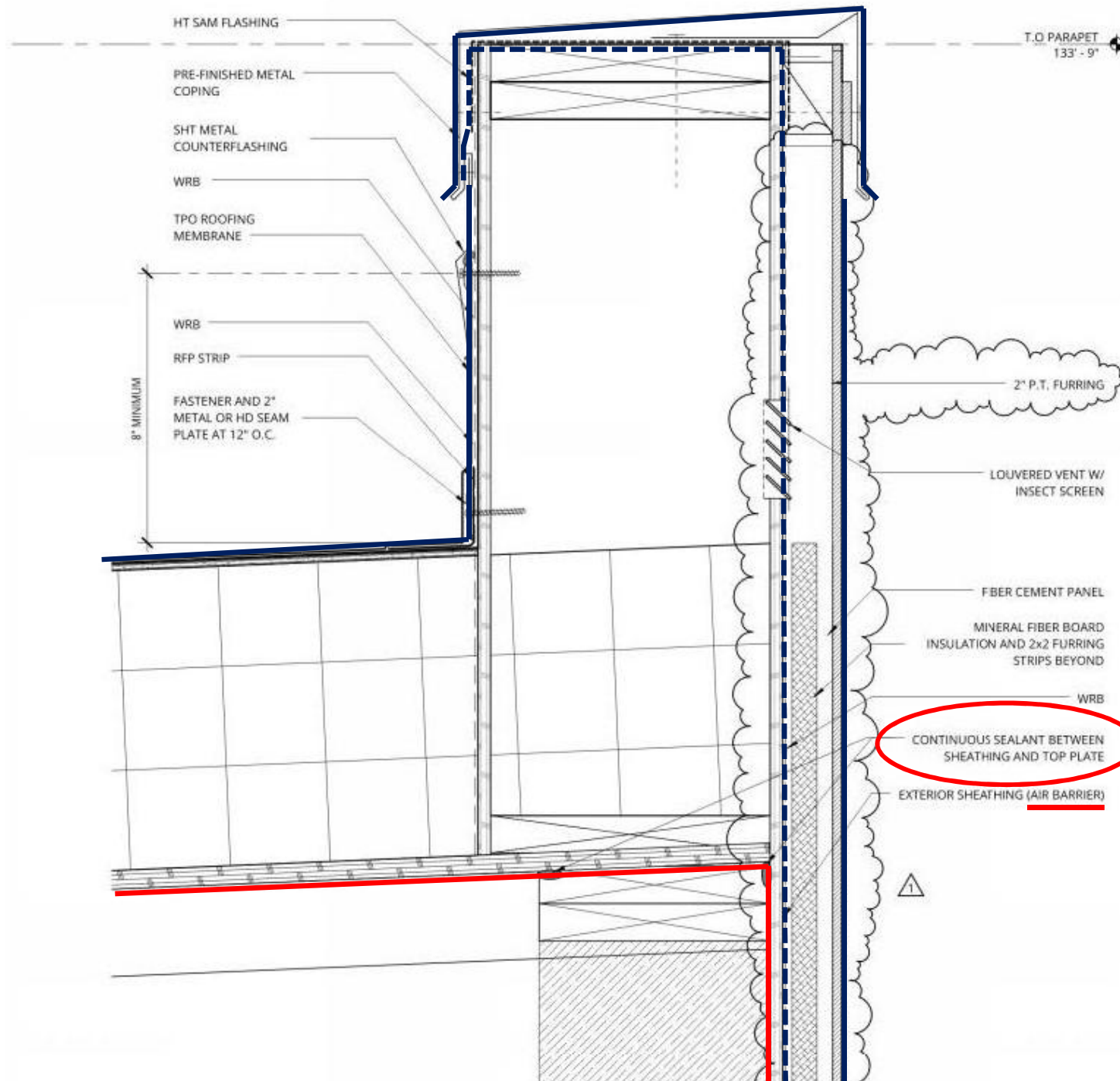


## Critical Barrier Continuity: Air Barrier

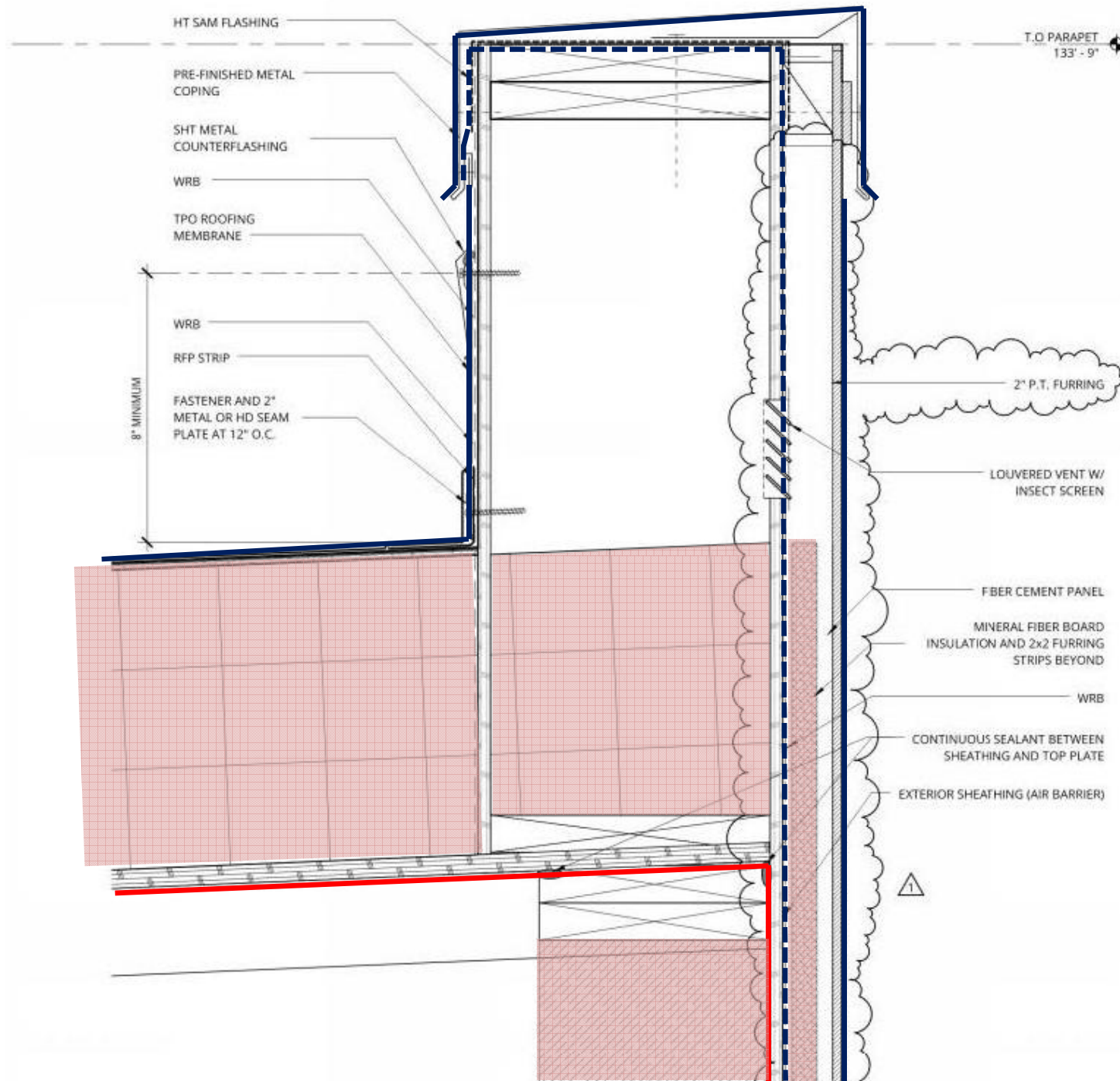


## Critical Barrier Continuity: Air Barrier



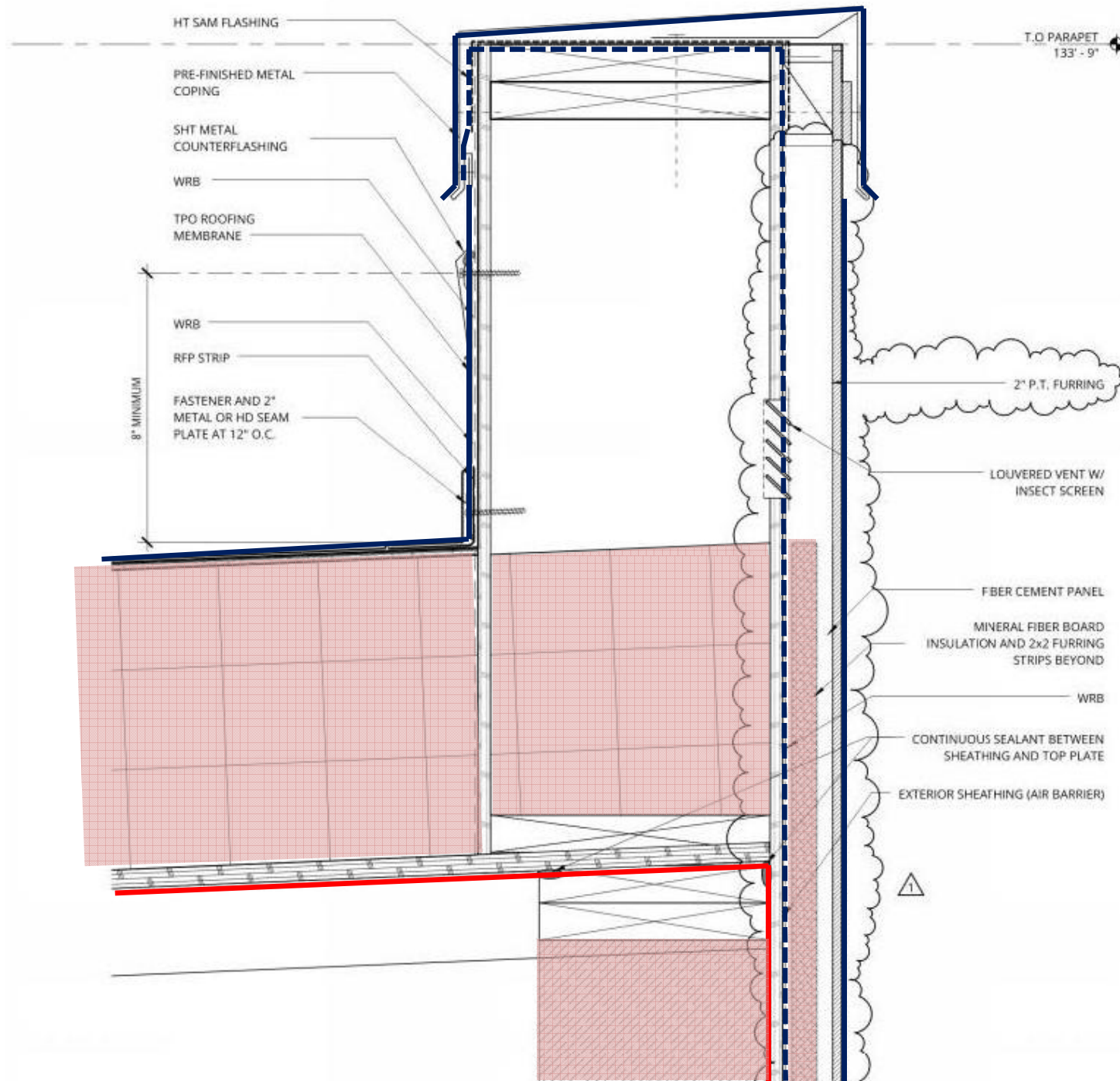


**Critical Barrier Continuity: Air Barrier ???**

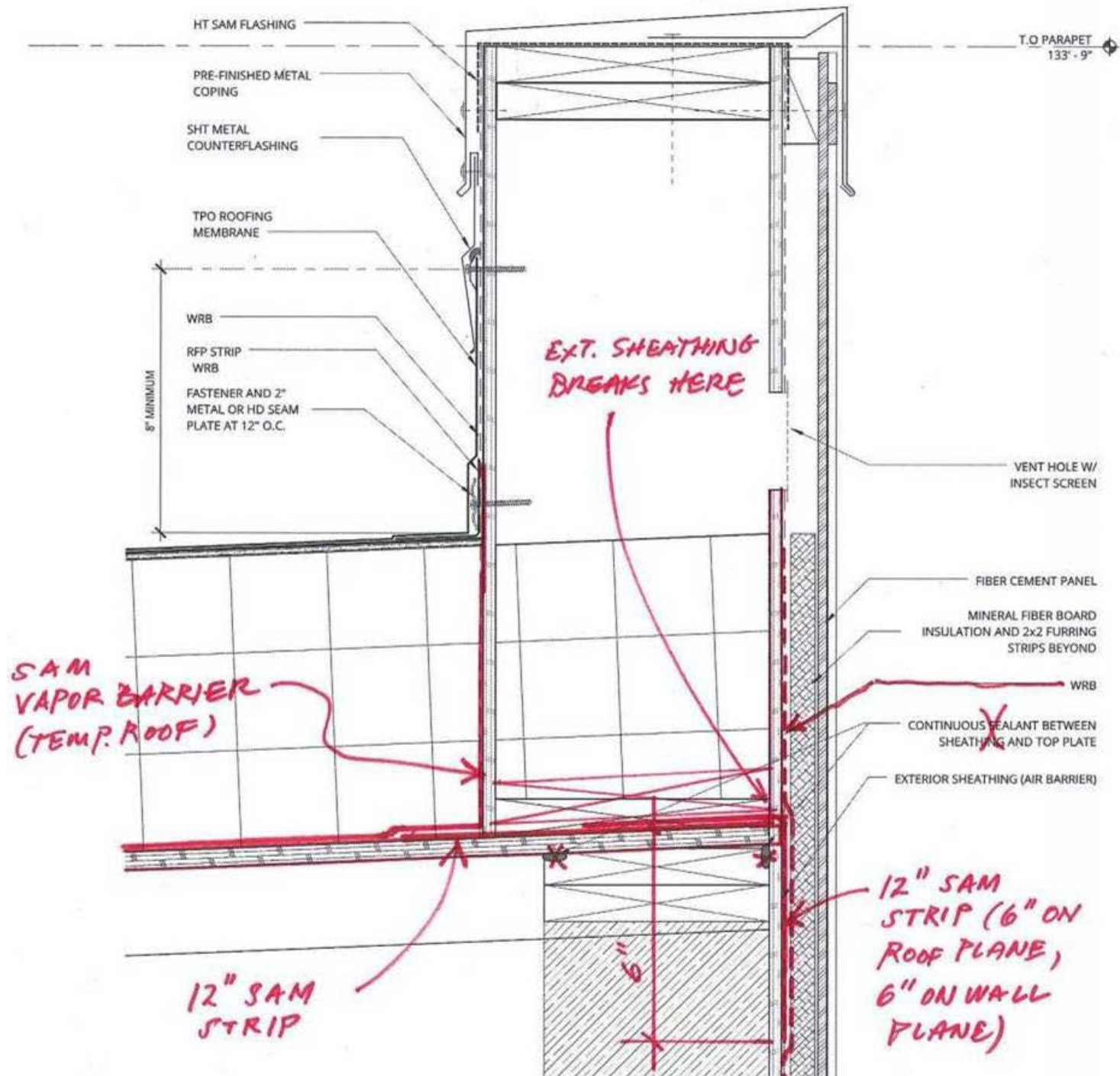


## Critical Barrier Continuity: Thermal Barrier



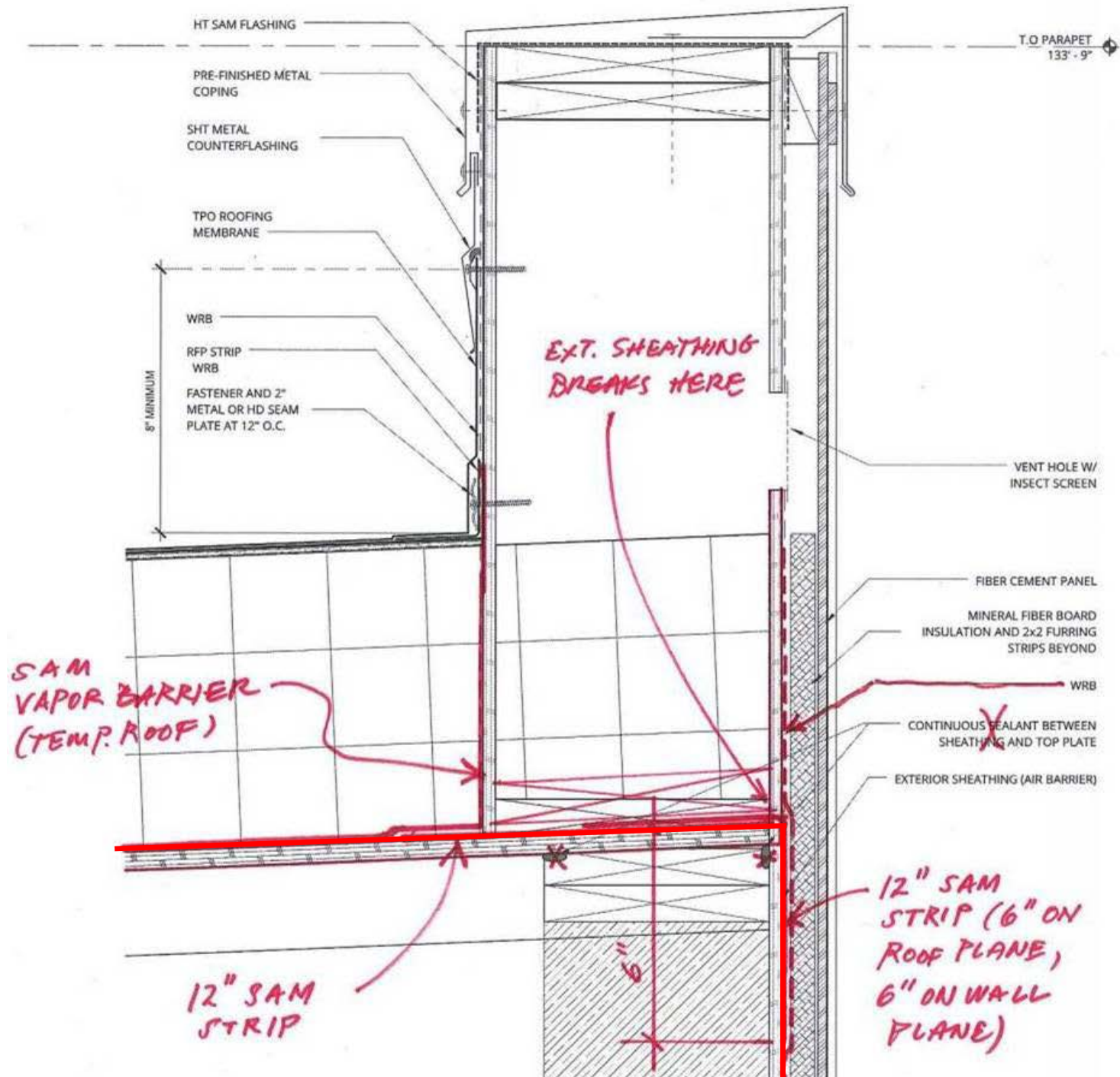


**Critical Barrier Continuity: Vapor Barrier ???**

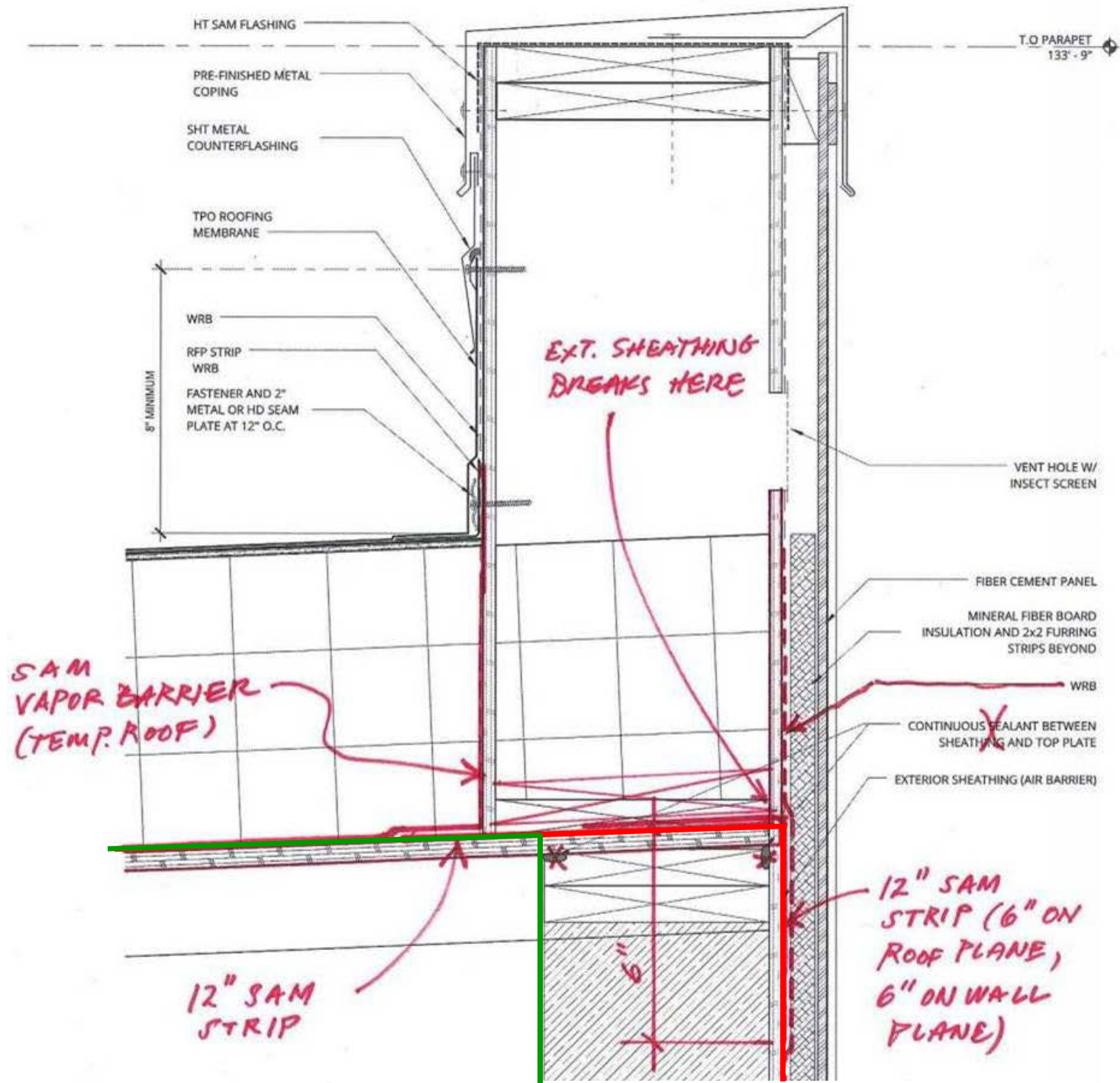


**Coordination Drawing at Typical Exterior Wall to Roof**





## Critical Barrier Continuity: Air Barrier (Revised)



## Critical Barrier Continuity: Vapor Barrier











































# Concluding Remarks

- Prelim. airtightness results: 0.075 ACH50
- It takes a team...working collaboratively and pushing in the same direction
- Early team integration pays off
- Proactive coordination and QC is essential
- Keep it simple



# Q & A