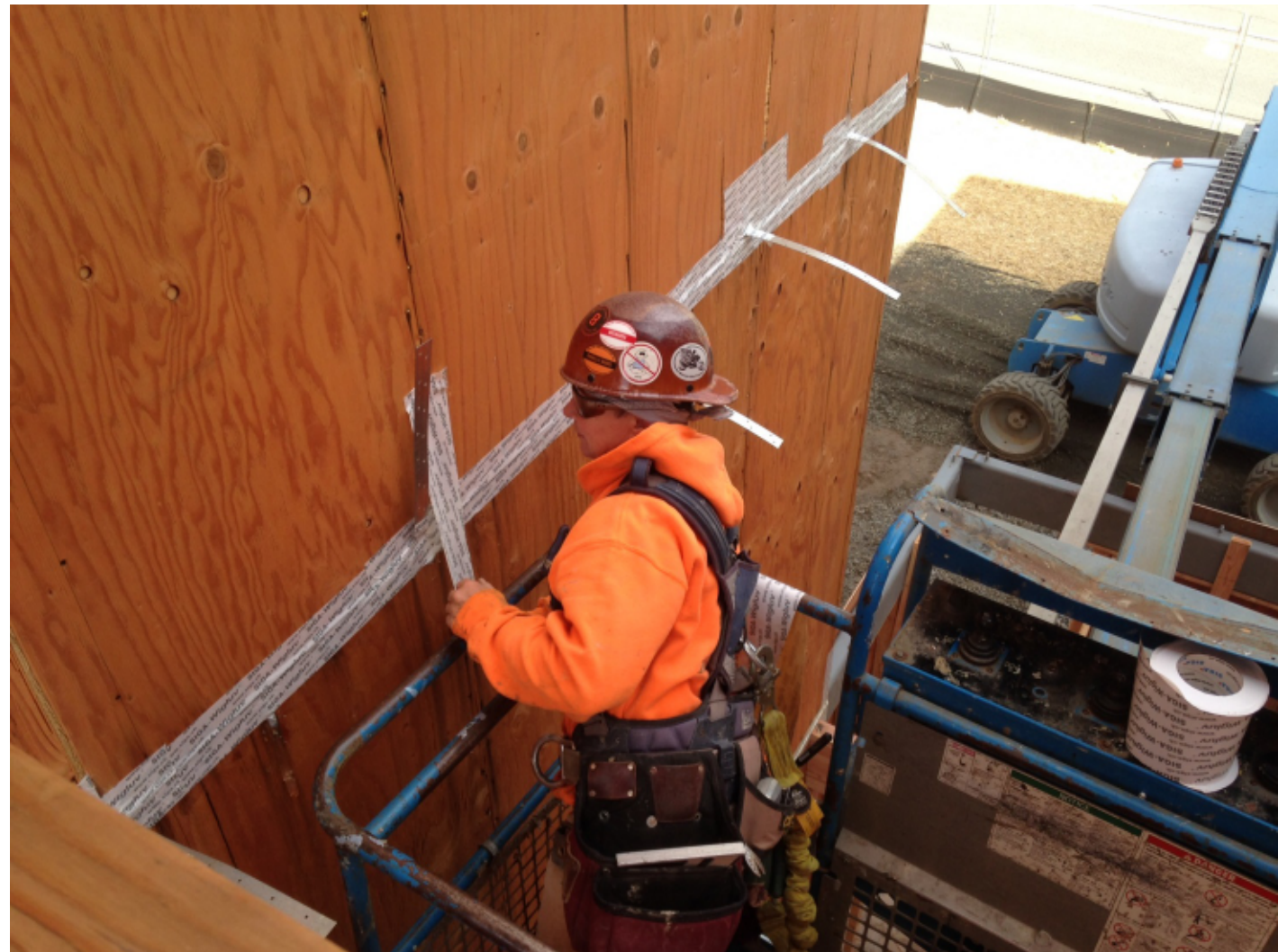


Five Not So Easy Pieces

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

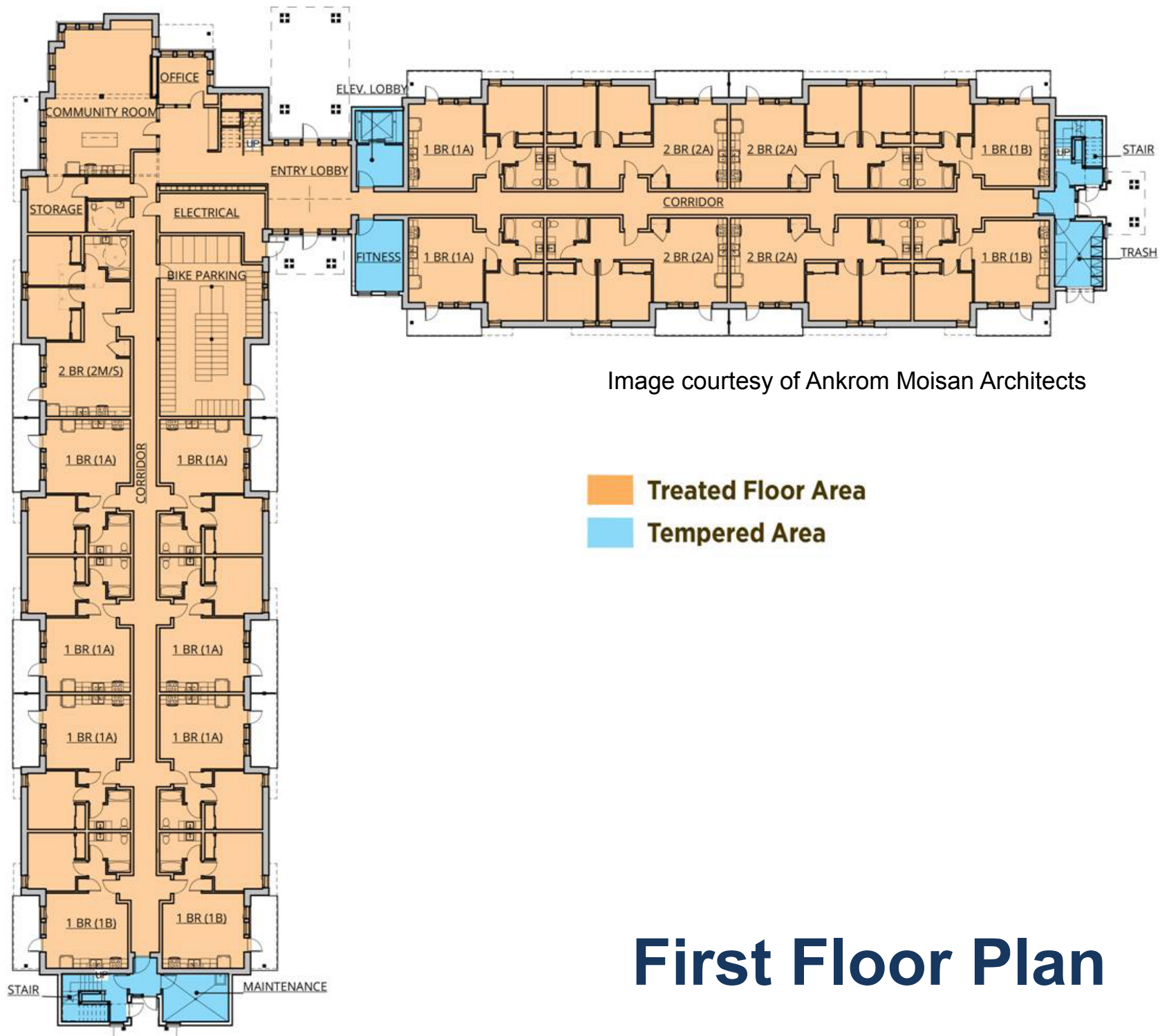
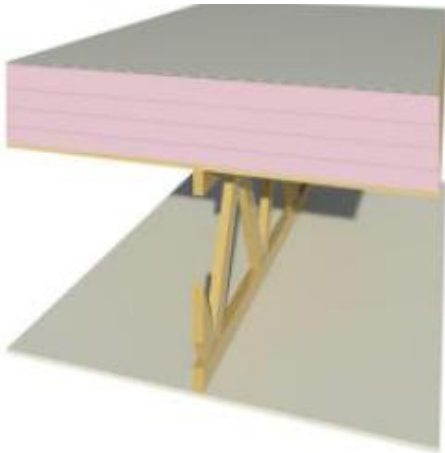


Image courtesy of Ankrom Moisan Architects

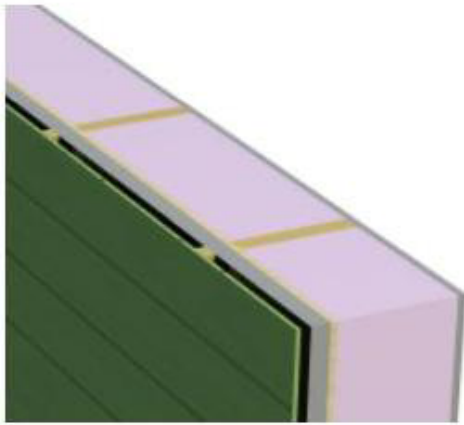
- Treated Floor Area
- Tempered Area

First Floor Plan



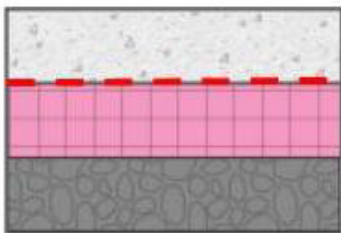
Typical Roof Assembly: R-81

- 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

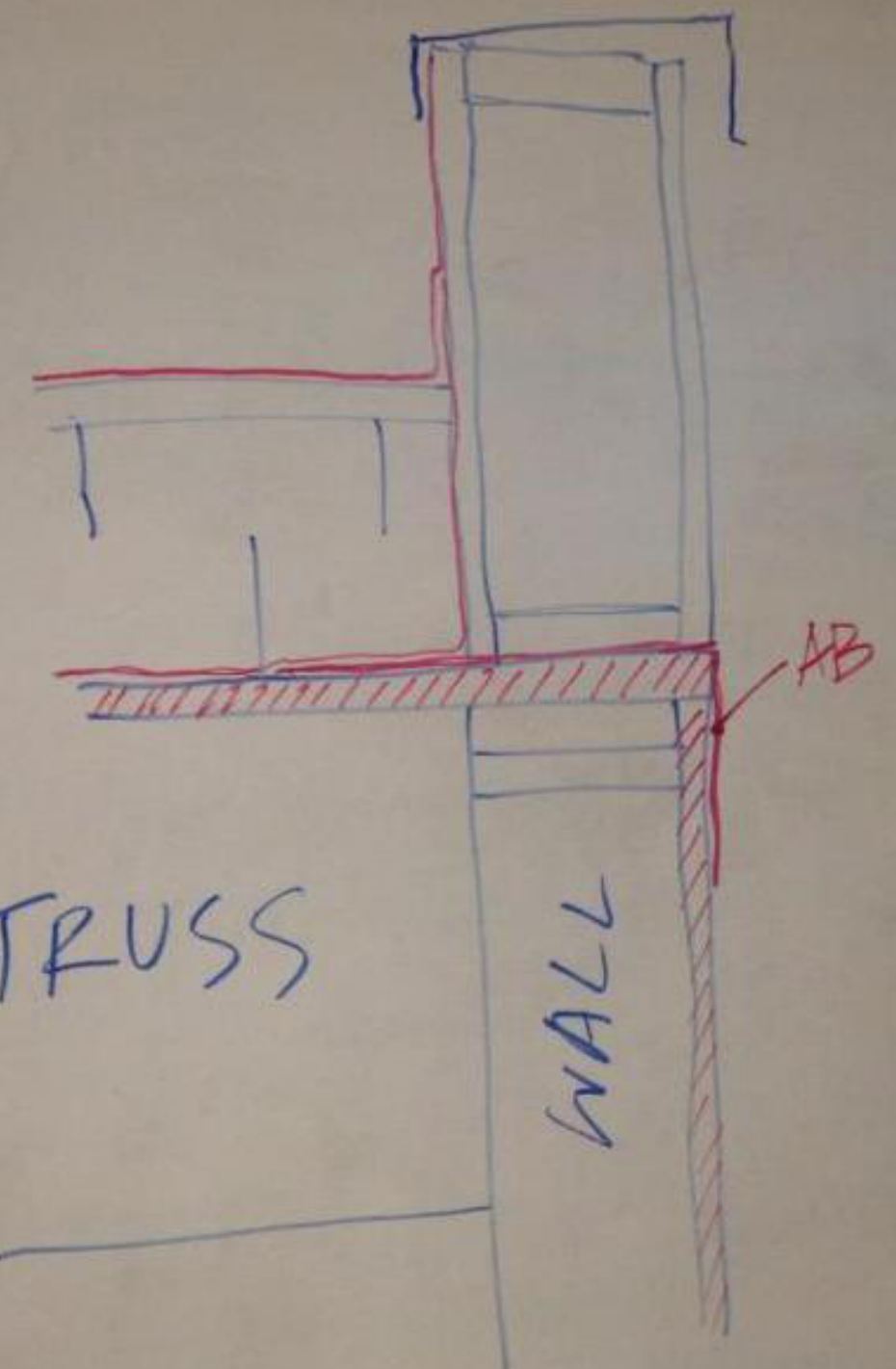
Eyebrows



Shading Elements

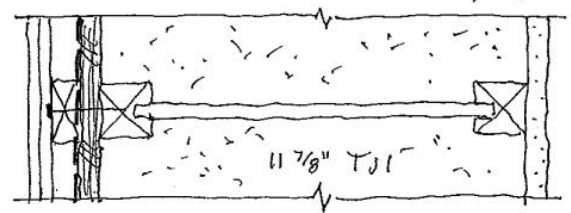
Enclosure Design & Construction Process

- Iterative design process
- Early concepts
- Coordinating the work

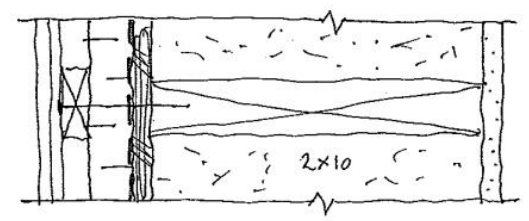


ORCHARDS @ ORENCO — EXT. WALL OPTIONS 2/29/12

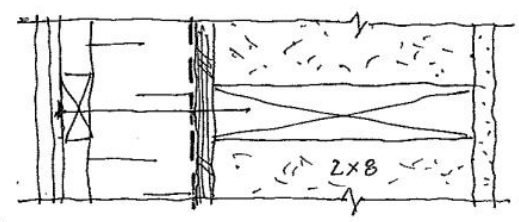
- WALL (A)
- 1 7/8" TJI WALL FRAMING
 - 1 7/8" BLOWN FG INSUL.
- WWR-VALUE = R-39
MOISTURE: FAIR



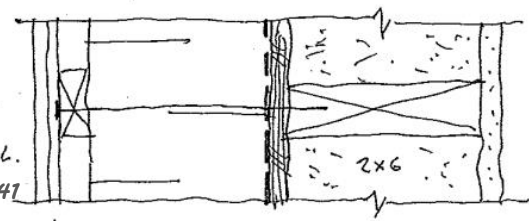
- WALL (B)
- 2x10 WALL FRAMING
 - 9 1/4" BLOWN FG INSUL.
 - 1 1/4" MINERAL WOOL EXT. INSUL.
- WWR-VALUE = R-40
MOISTURE: GOOD



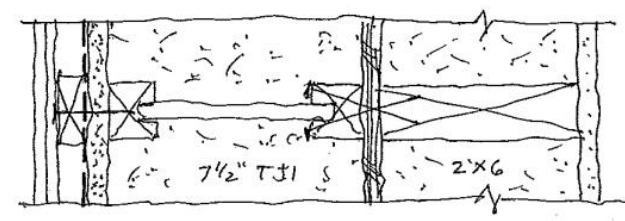
- WALL (C)
- 2x8 WALL FRAMING
 - 7 1/4" BLOWN FG INSUL.
 - 3" MINERAL WOOL EXT. INSUL.
- WWR-VALUE = R-40
MOISTURE: BETTER



- 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: ?





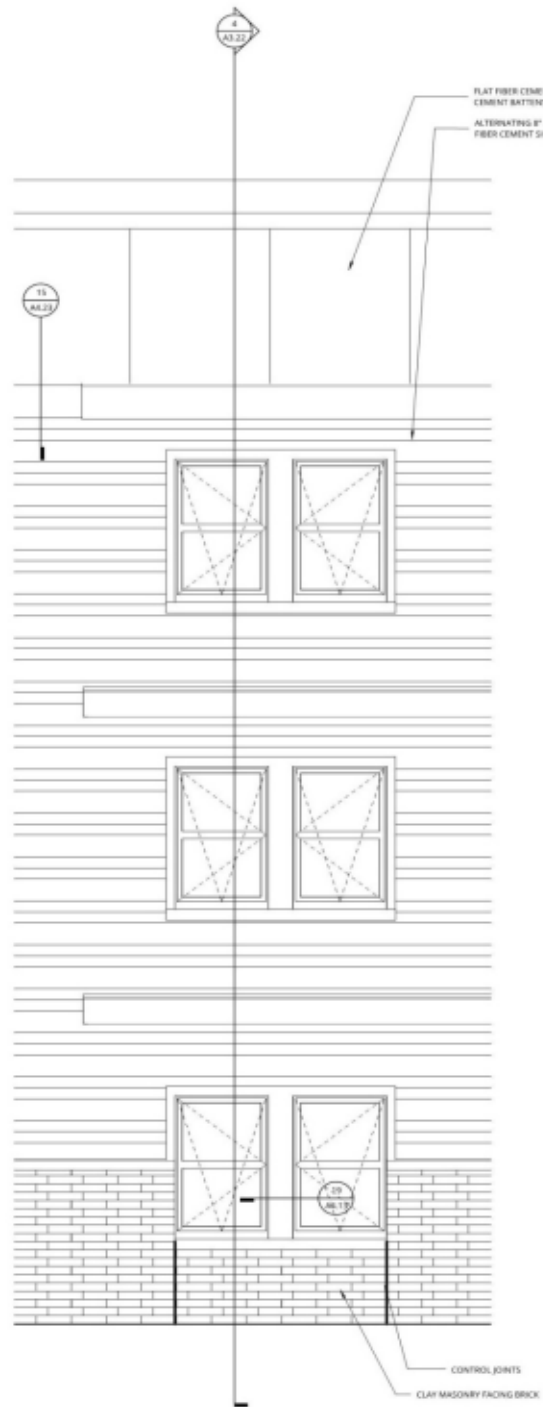


The Importance of Details

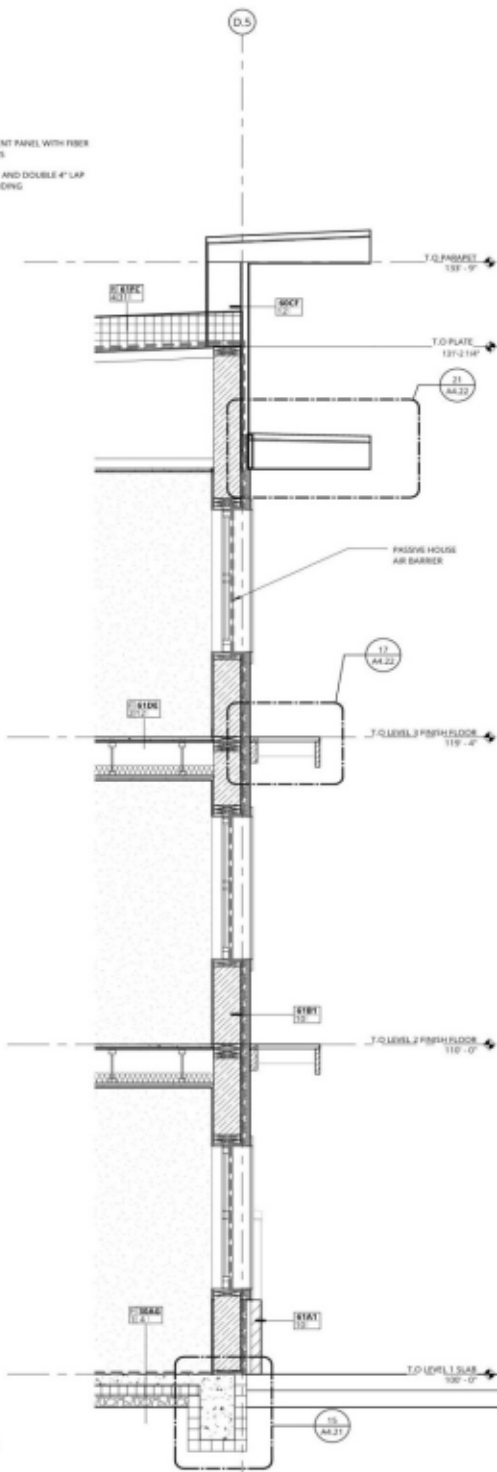
- Success is achieved - or not - at the details!
- To ensure performance at the detail level, establish continuity of the critical barriers and then clearly indicate that continuity in the design drawings
 - Water-shedding surface
 - Water-resistive barrier
 - Air barrier
 - Thermal barrier
 - Vapor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

Tracing The Critical Barriers

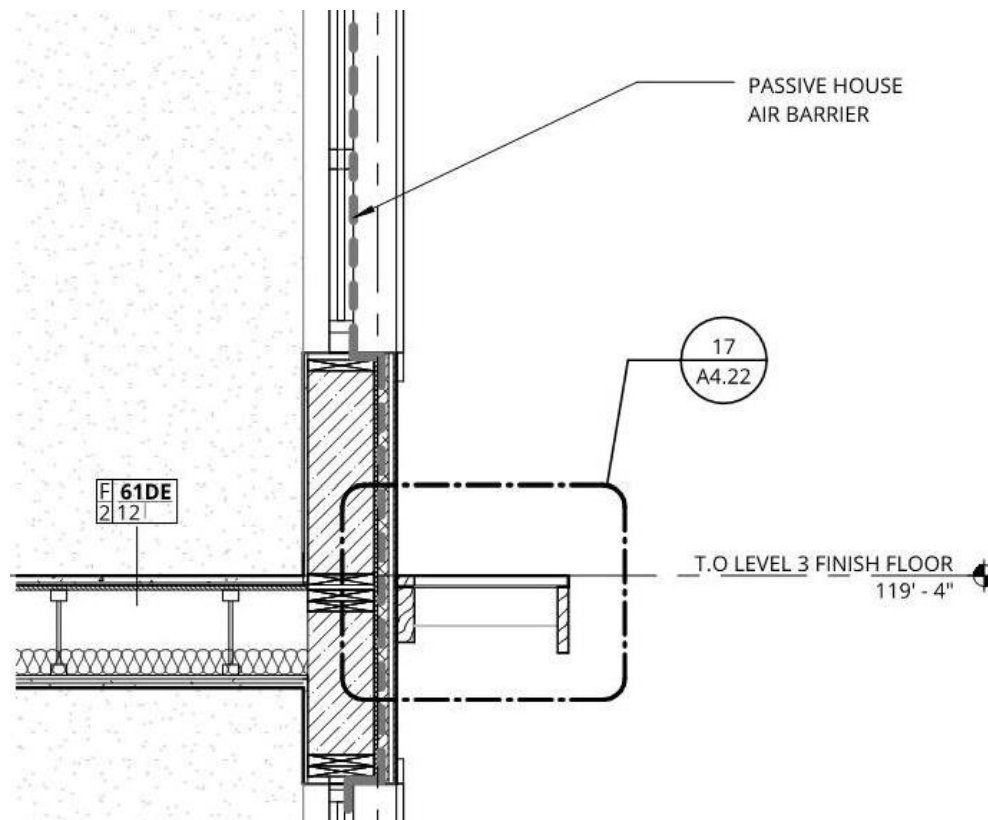
- Design and construction team members can use a review exercise where one traces the barriers through the various building enclosure drawings
- Verify continuity OR identify discontinuities in critical barriers
- Air barrier continuity is “proven” at the detail level; however, it is very helpful to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

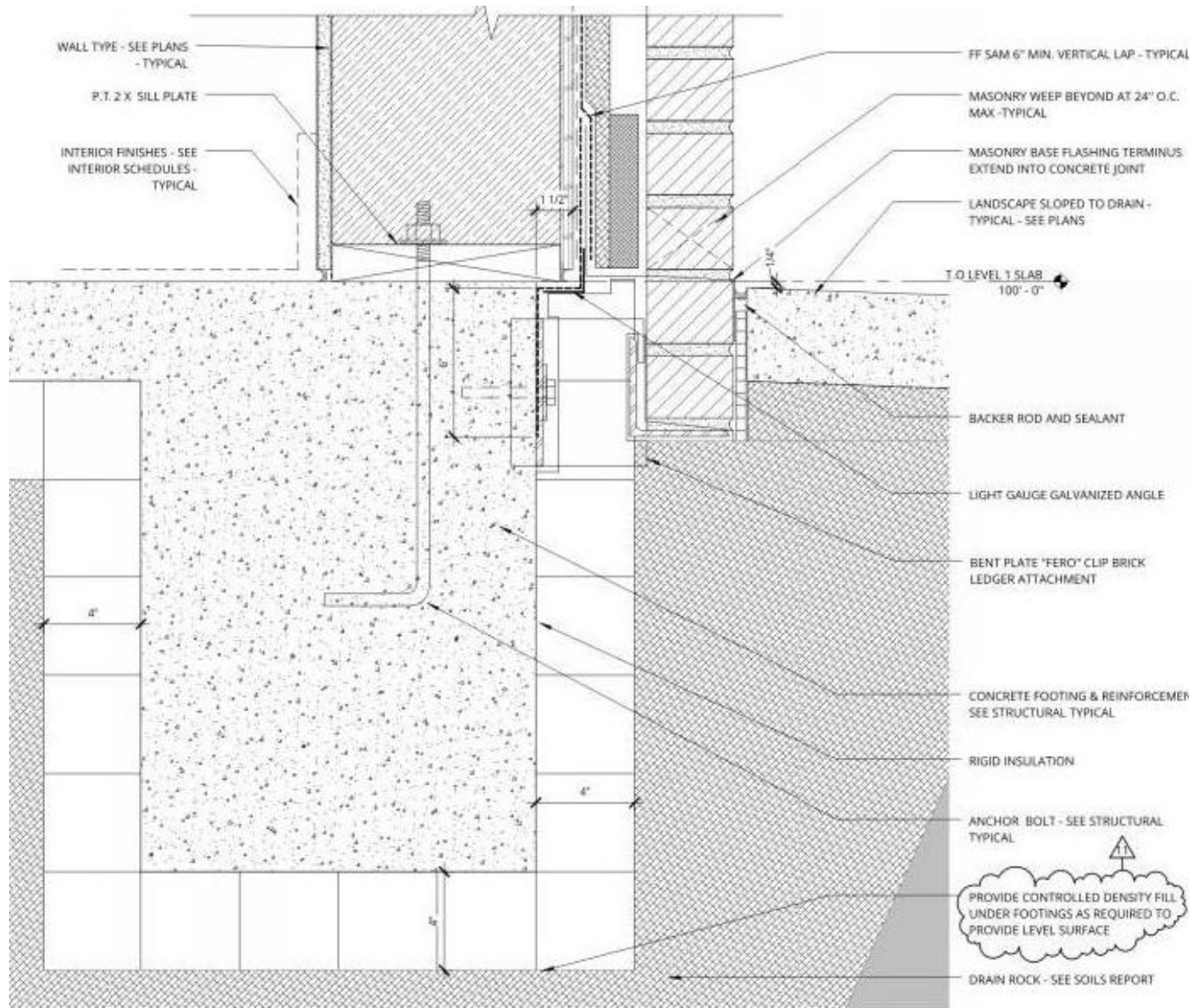
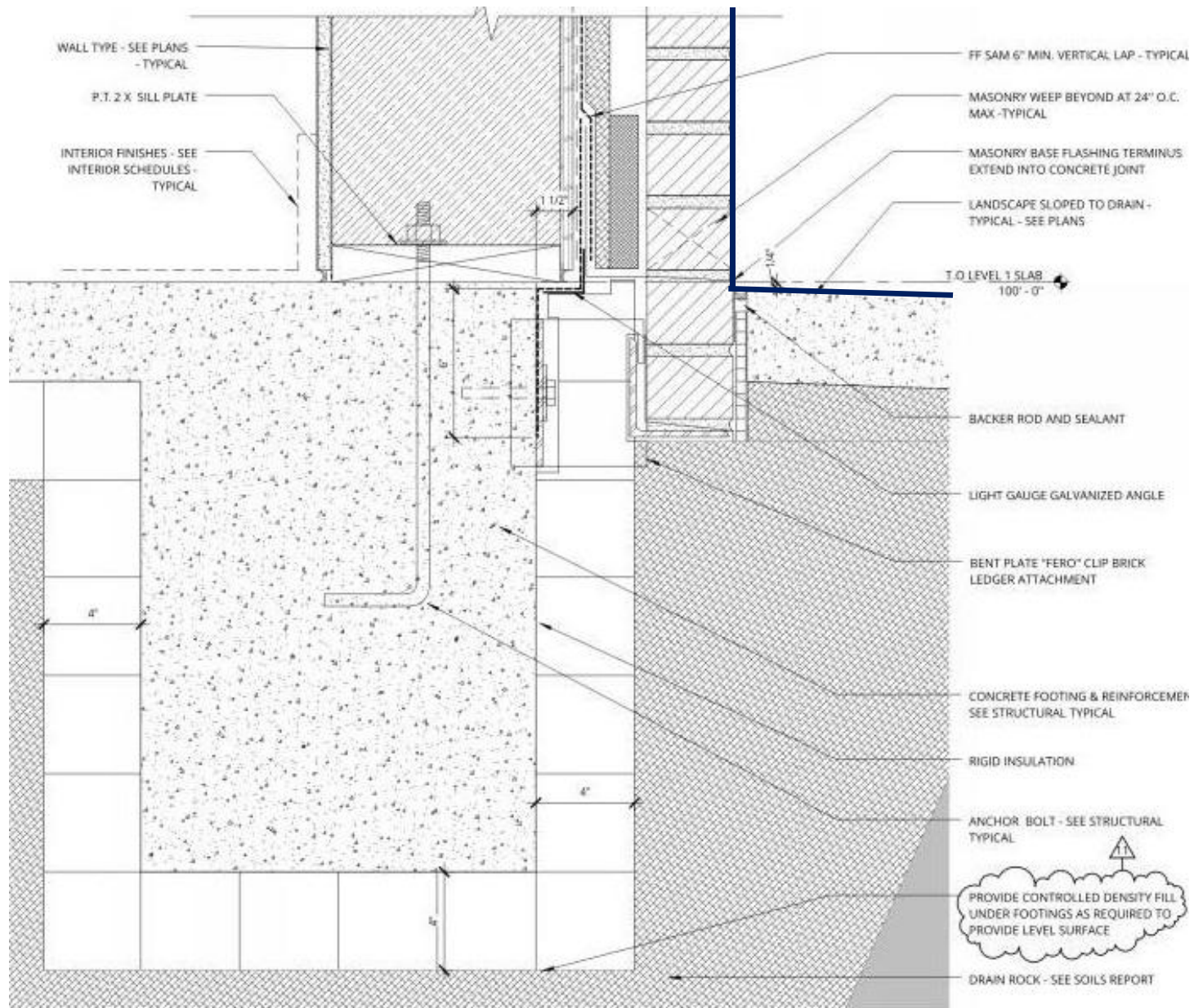
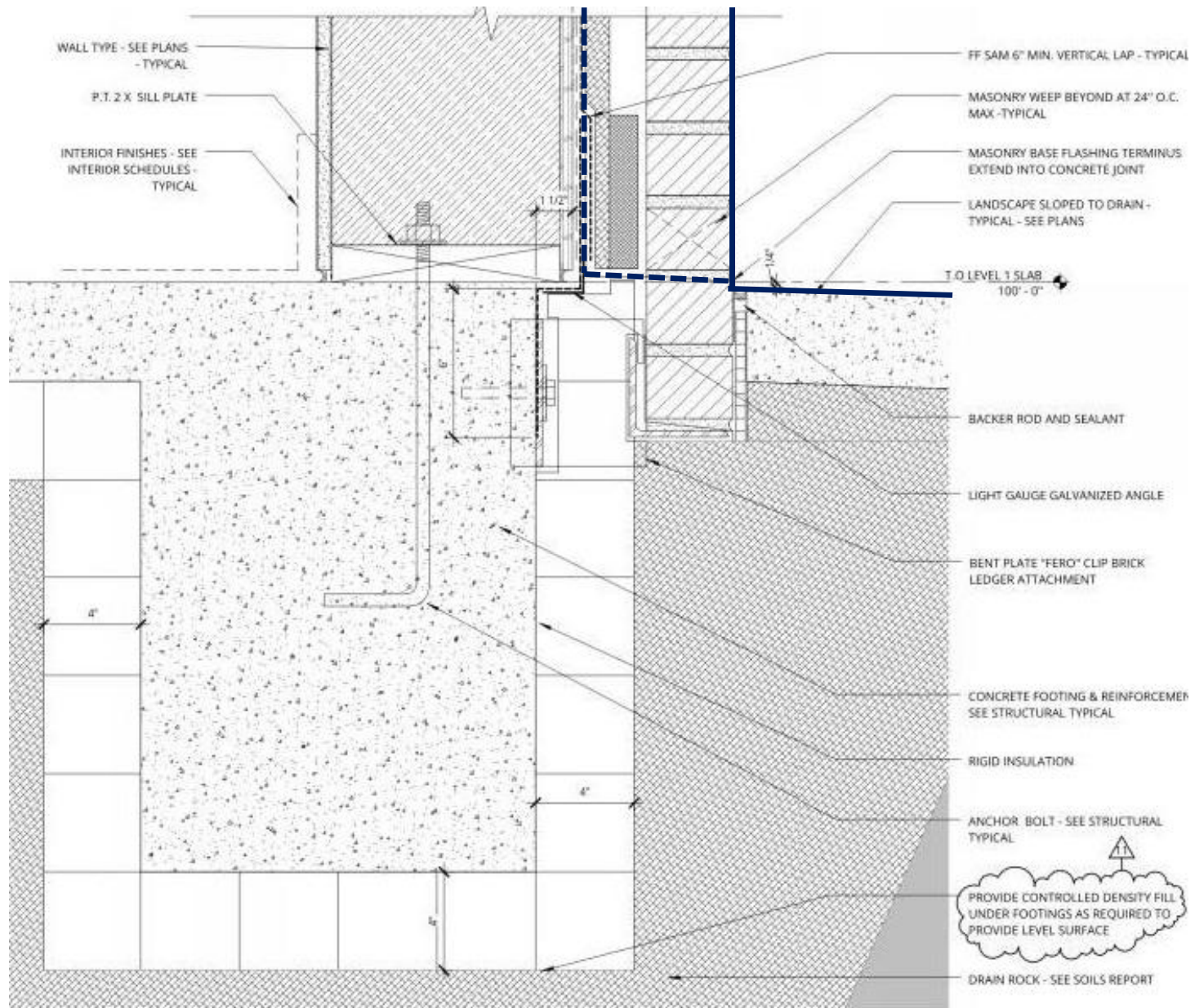


Image courtesy of Ankrom Moisan Architects

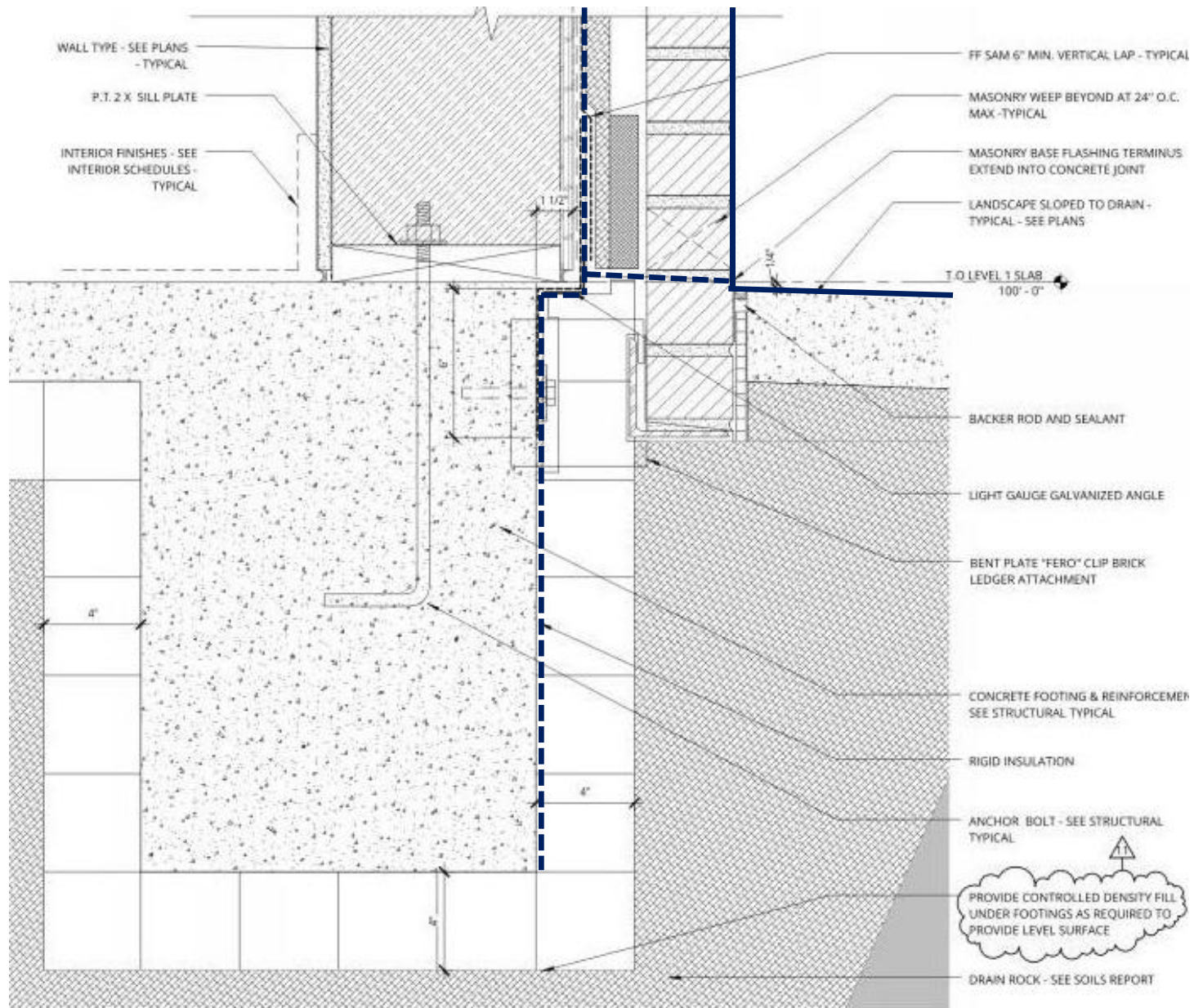
Design Drawing at Typical Exterior Wall to Foundation



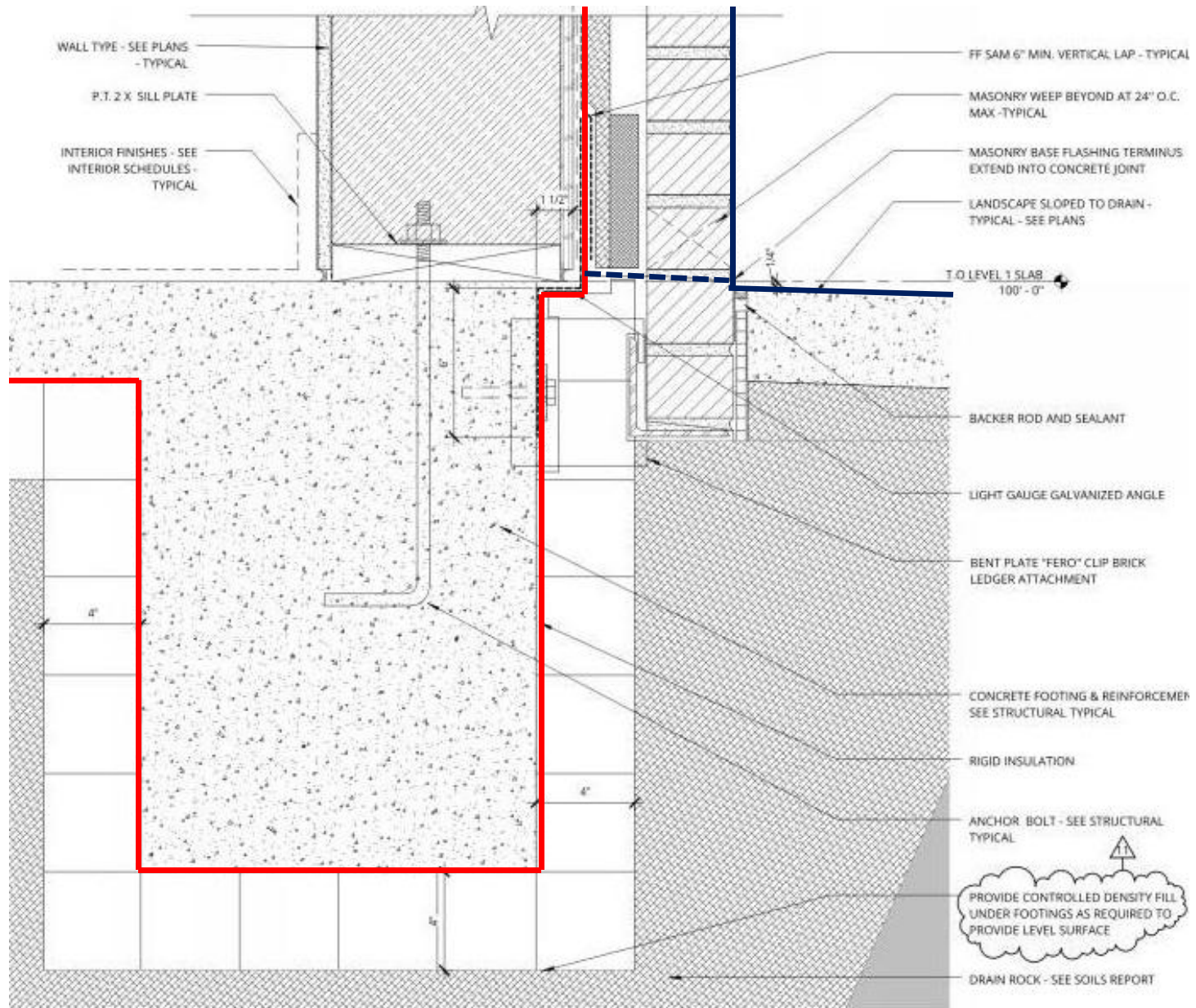
Critical Barrier Continuity: Water-Shedding Surface



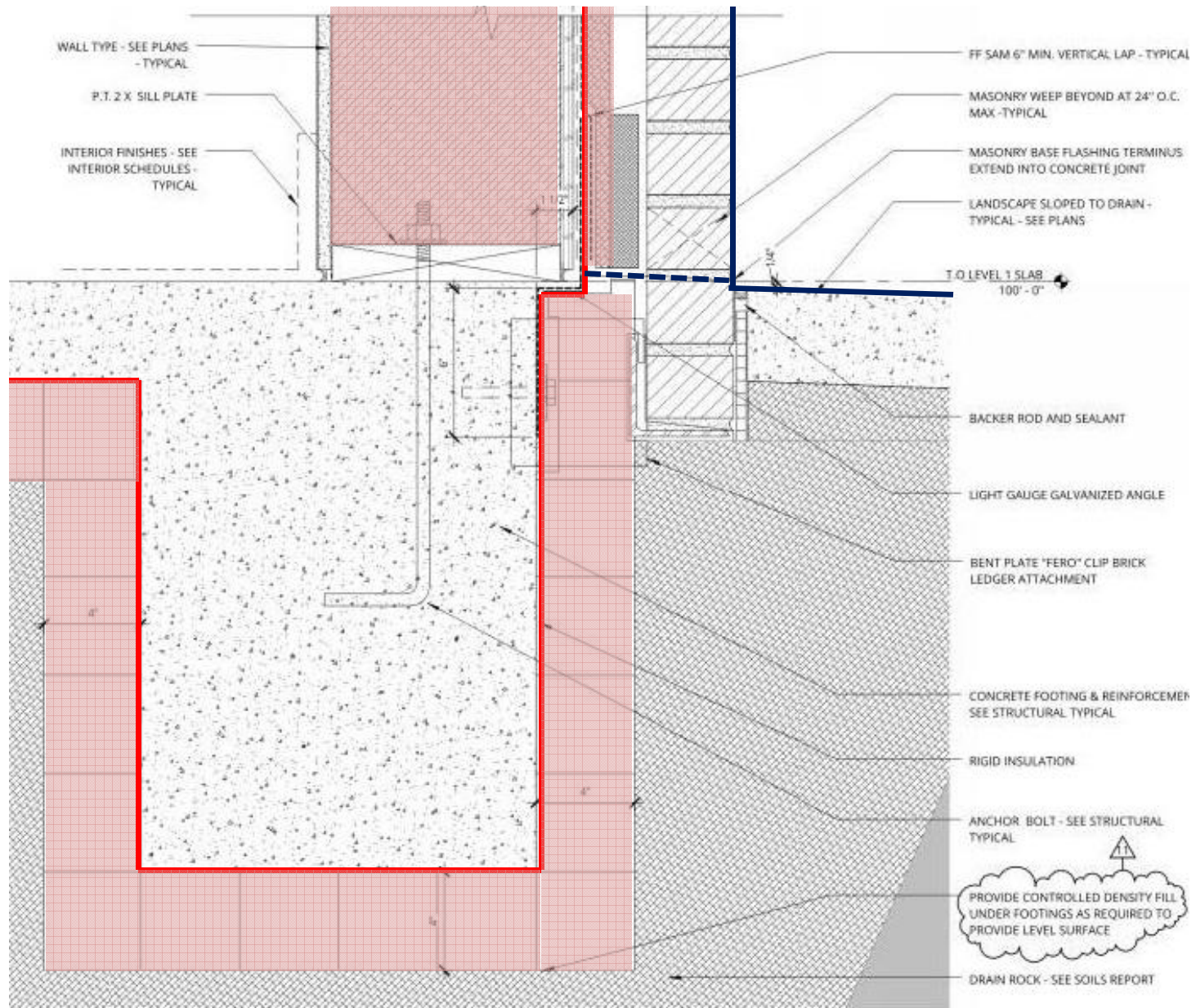
Critical Barrier Continuity: Water-Resistive Barrier



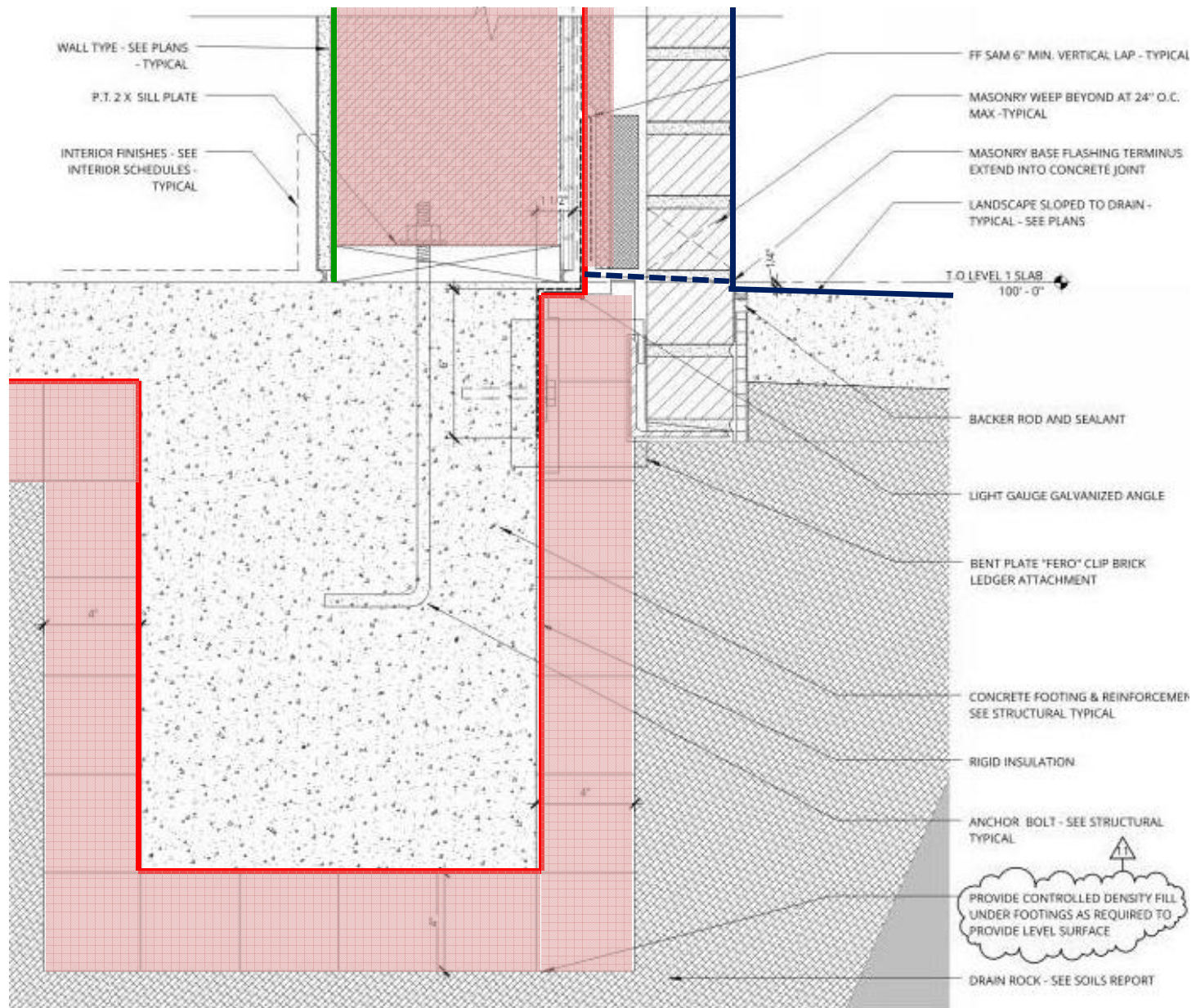
Critical Barrier Continuity: Water-Resistive Barrier



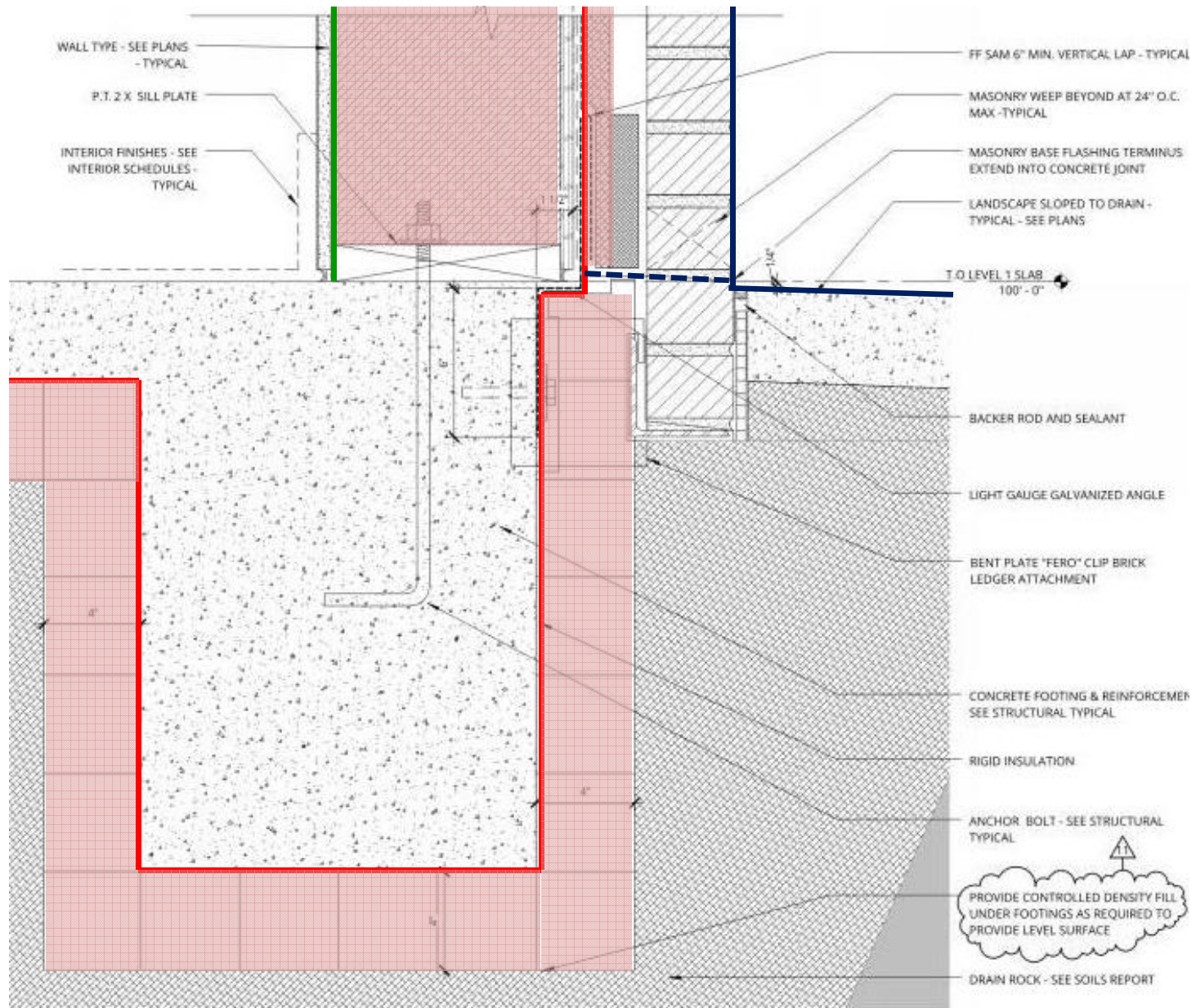
Critical Barrier Continuity: Air Barrier



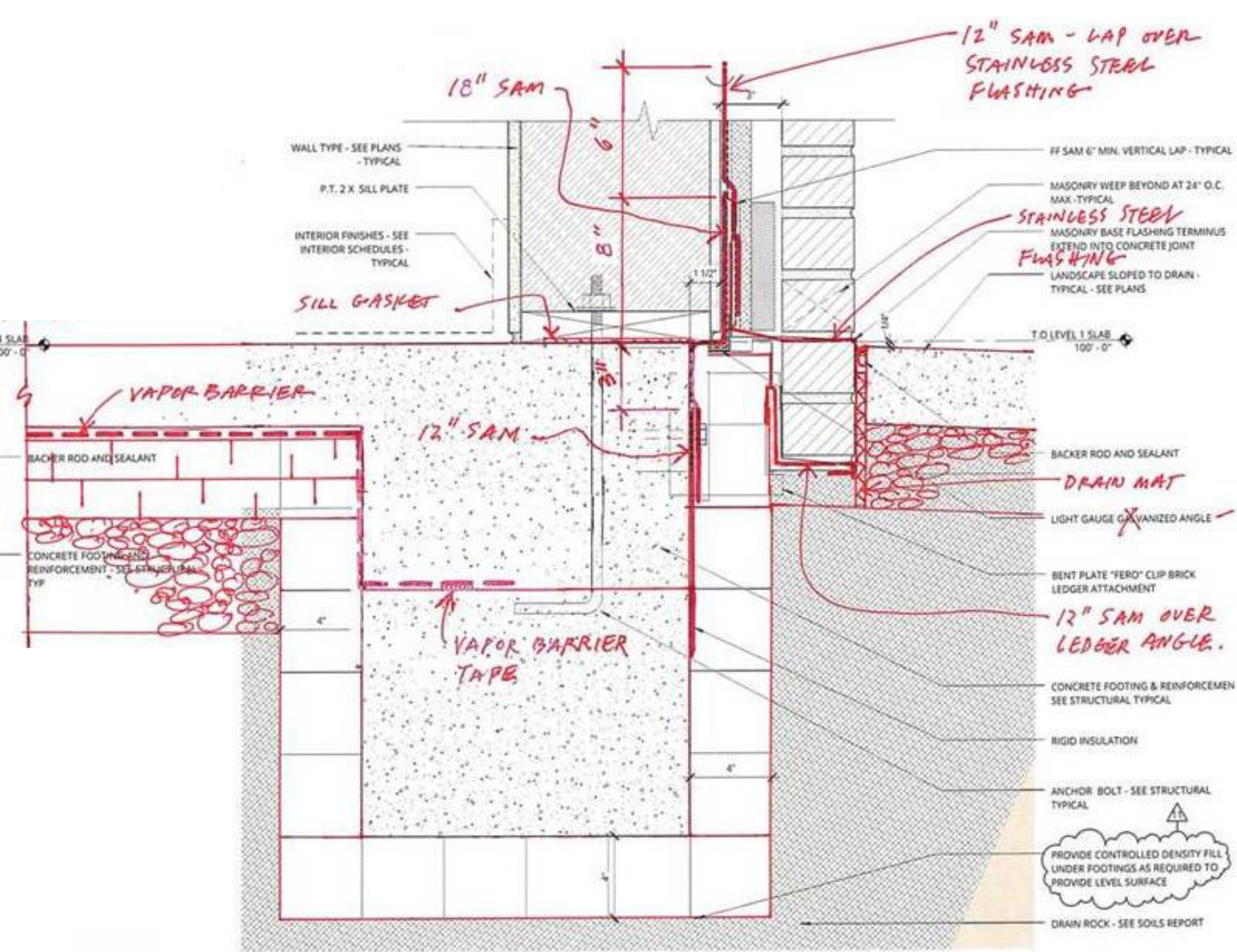
Critical Barrier Continuity: Thermal Barrier



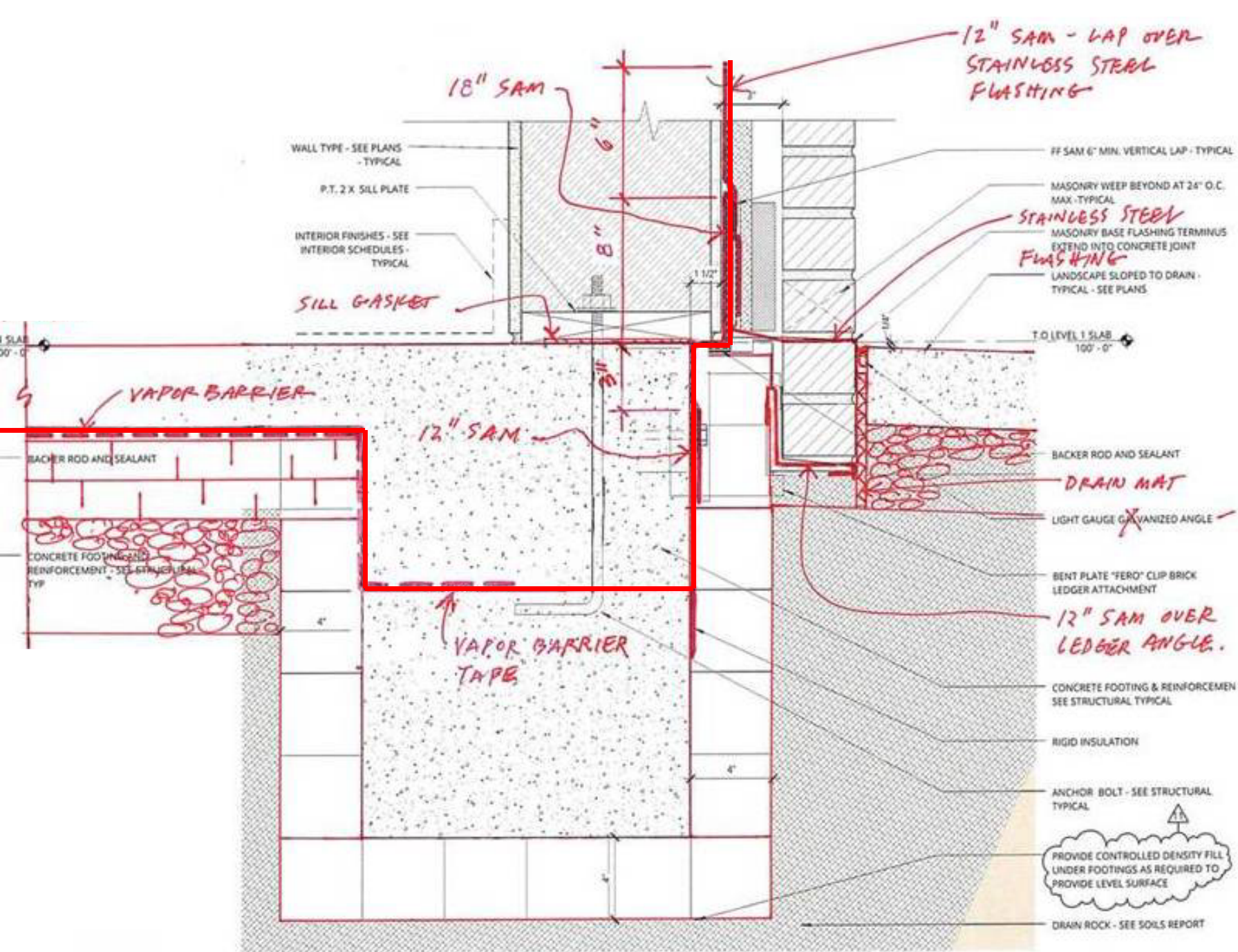
Critical Barrier Continuity: Vapor Barrier



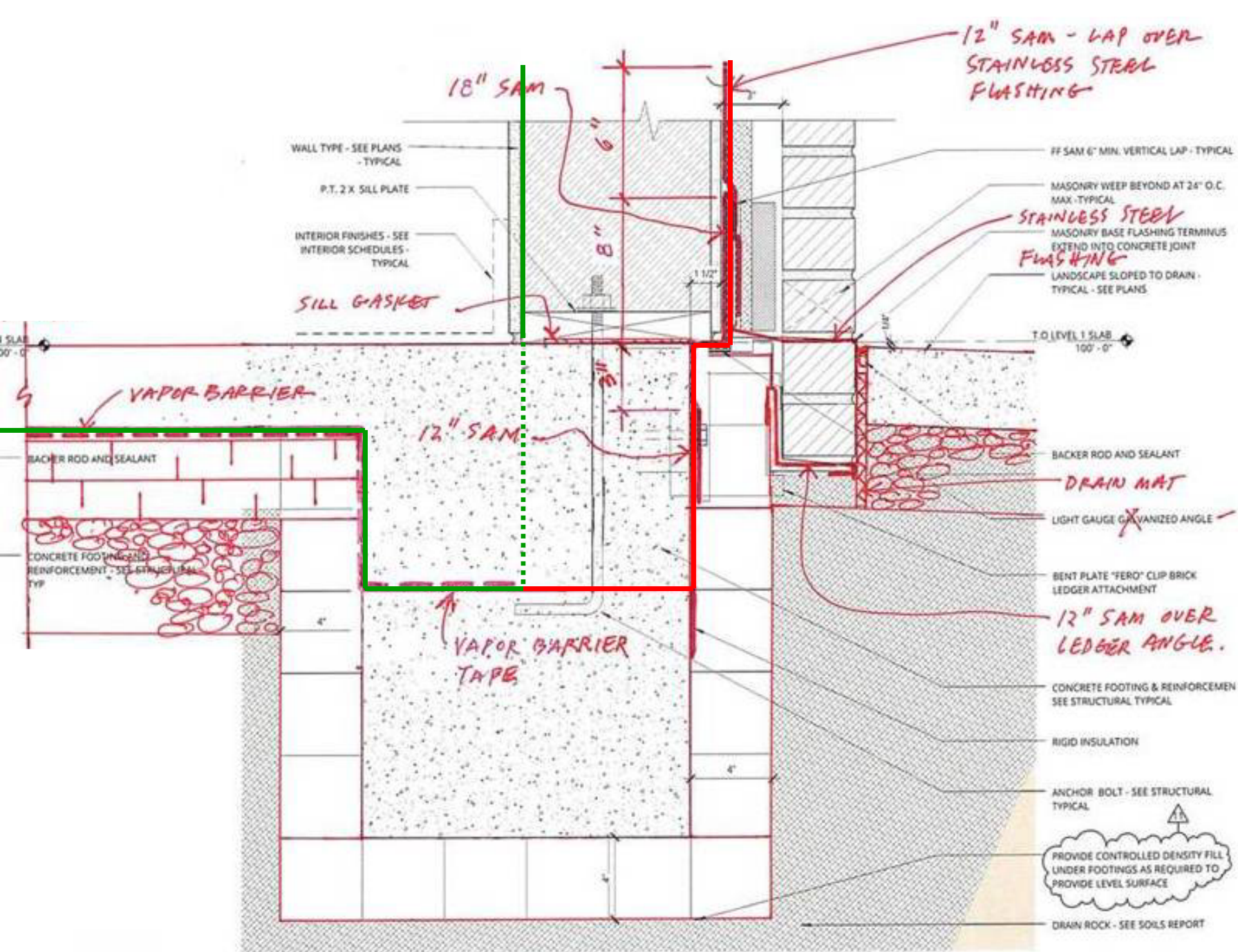
Critical Barrier Continuity: Vapor Barrier ???



Coordination Drawing at Typical Exterior Wall to Foundation

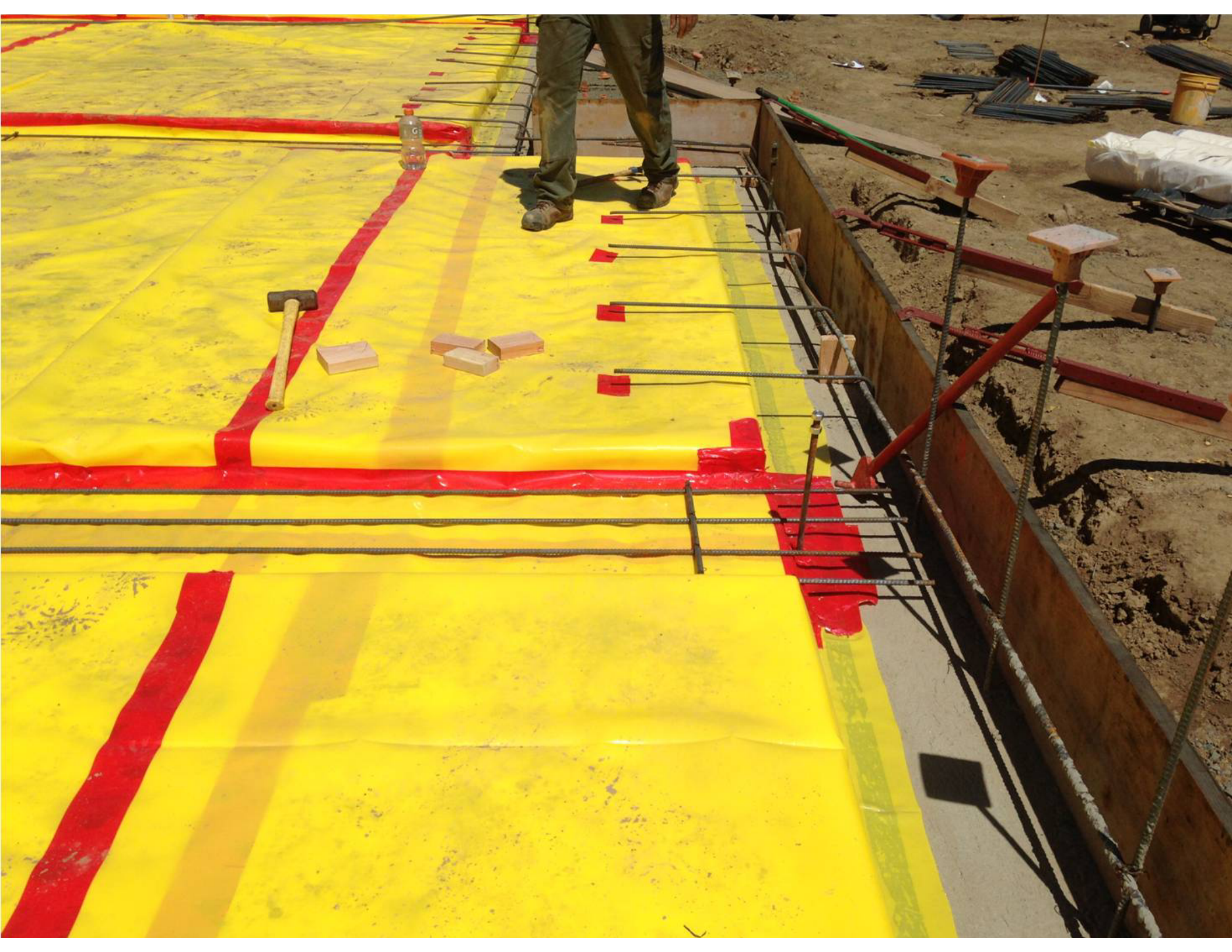


Critical Barrier Continuity: Air Barrier (Revised)



Critical Barrier Continuity: Vapor Barrier













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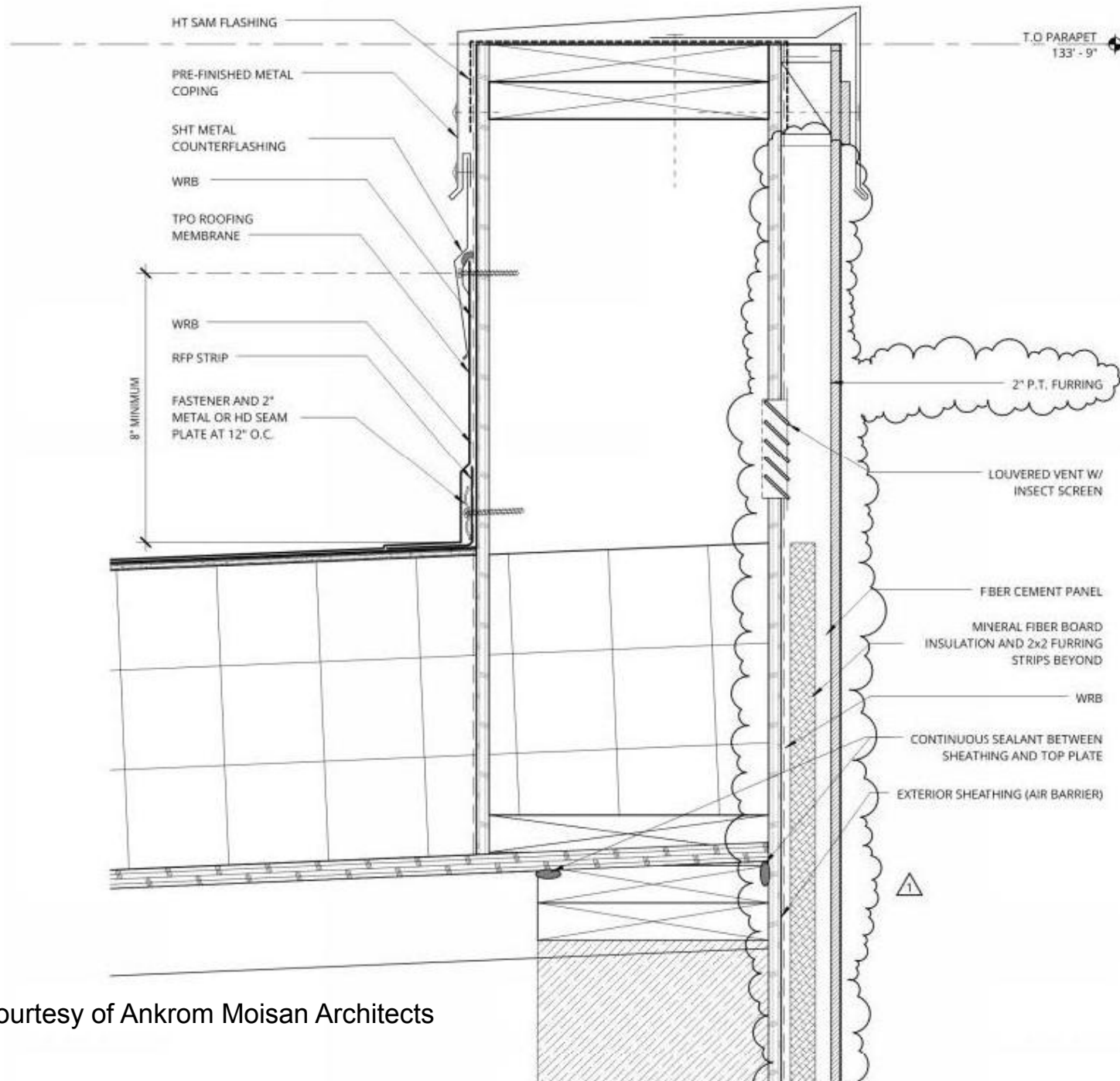
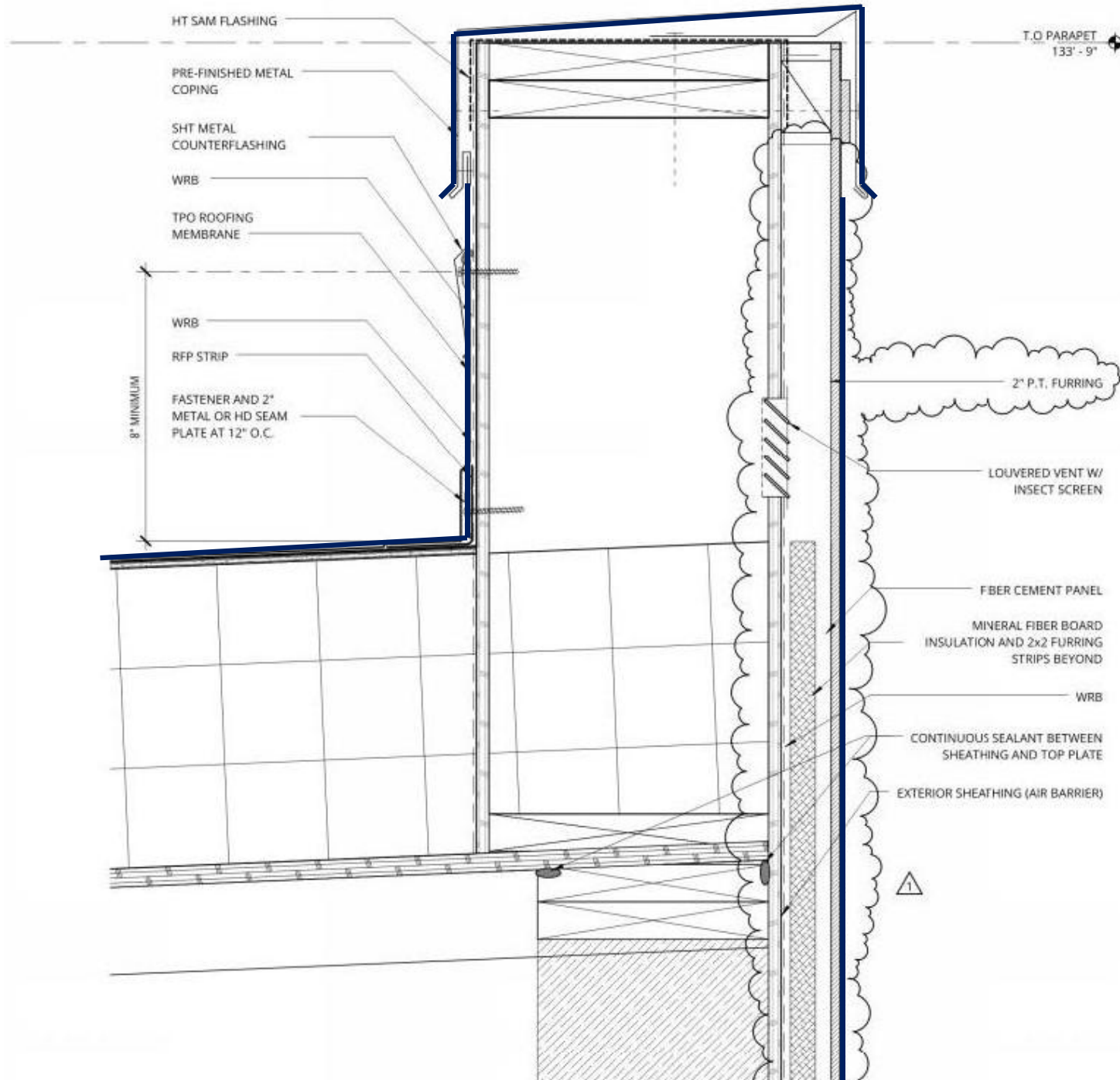
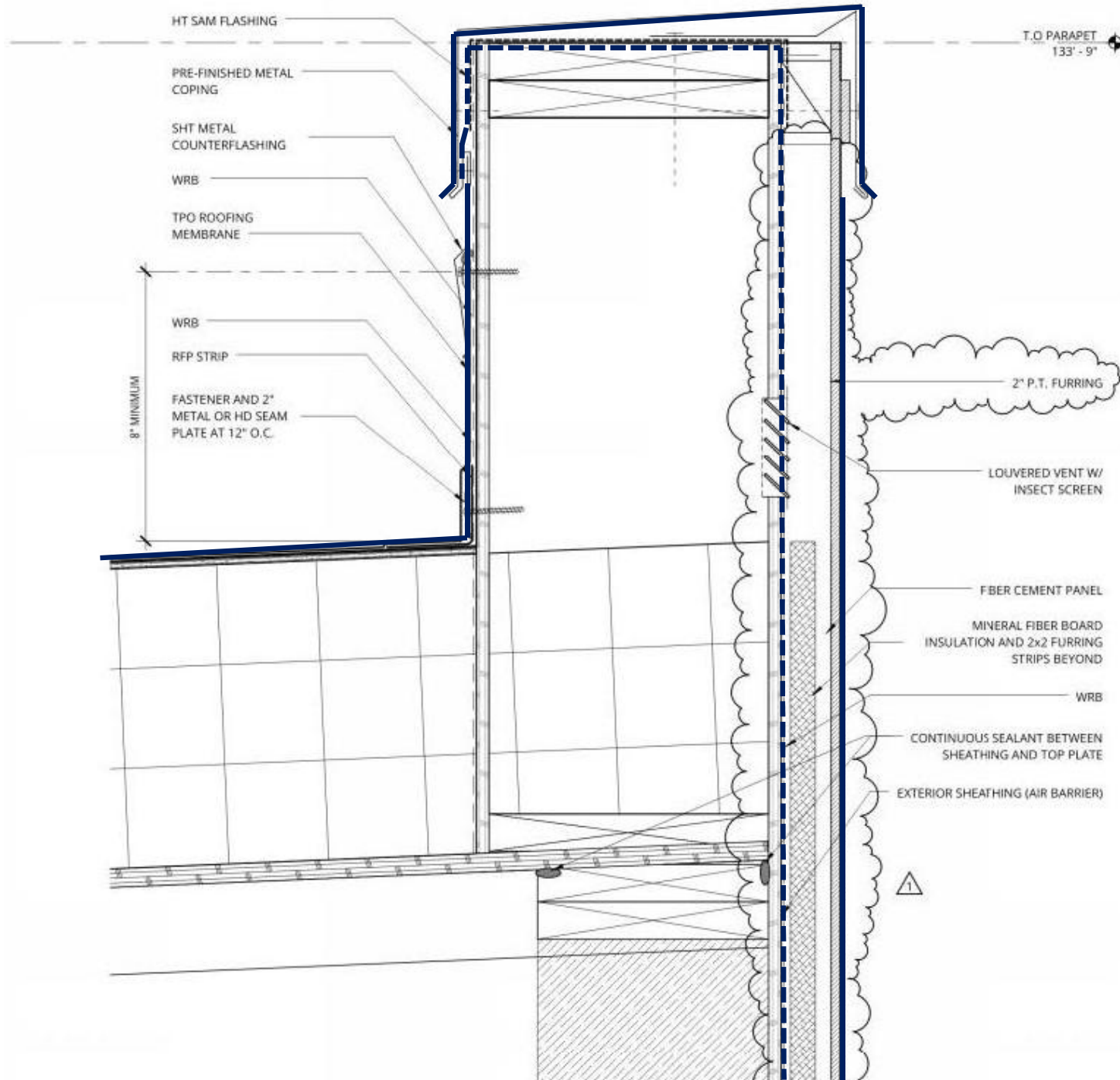


Image courtesy of Ankrom Moisan Architects

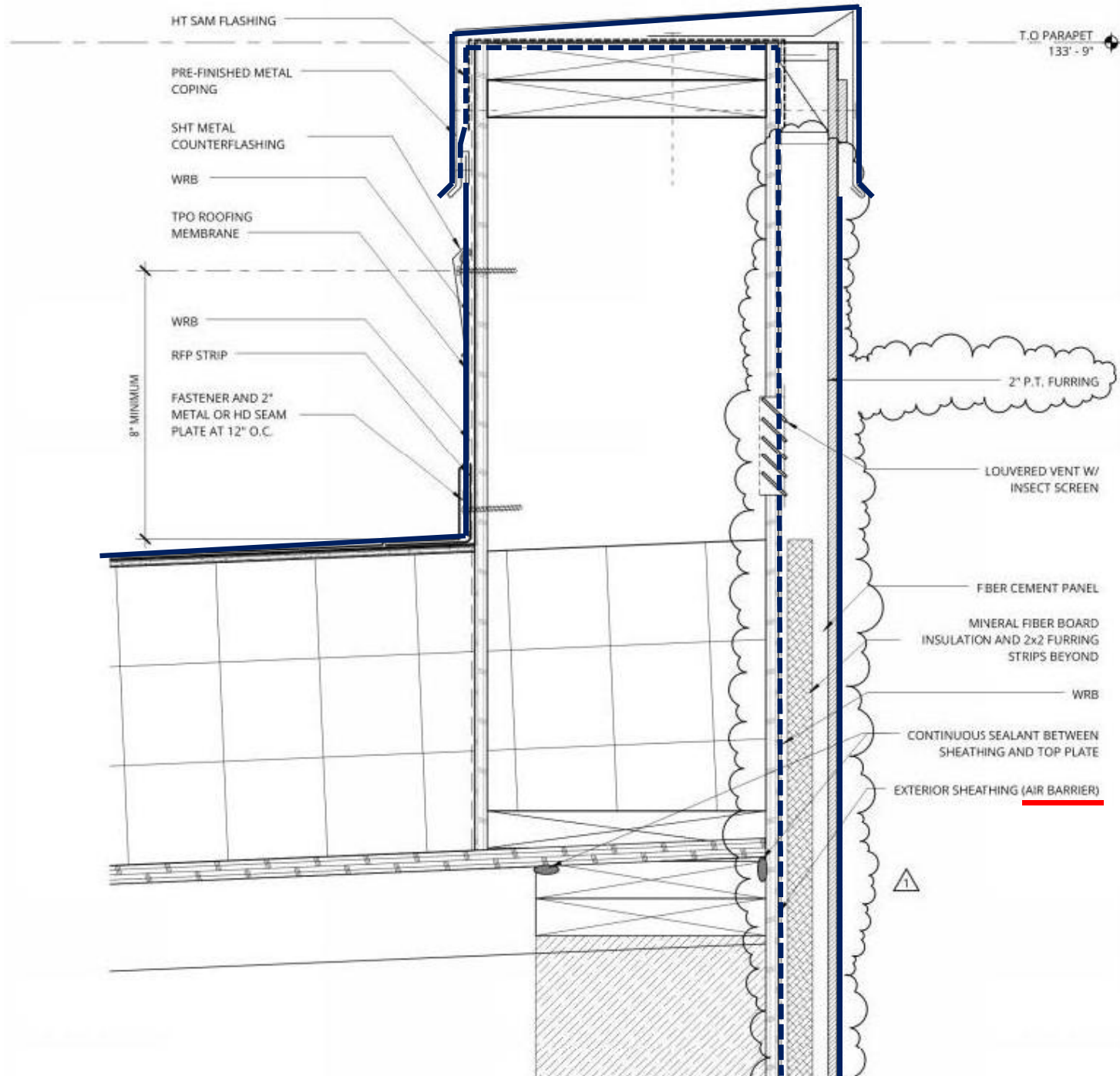
Design Drawing at Typical Exterior Wall to Roof



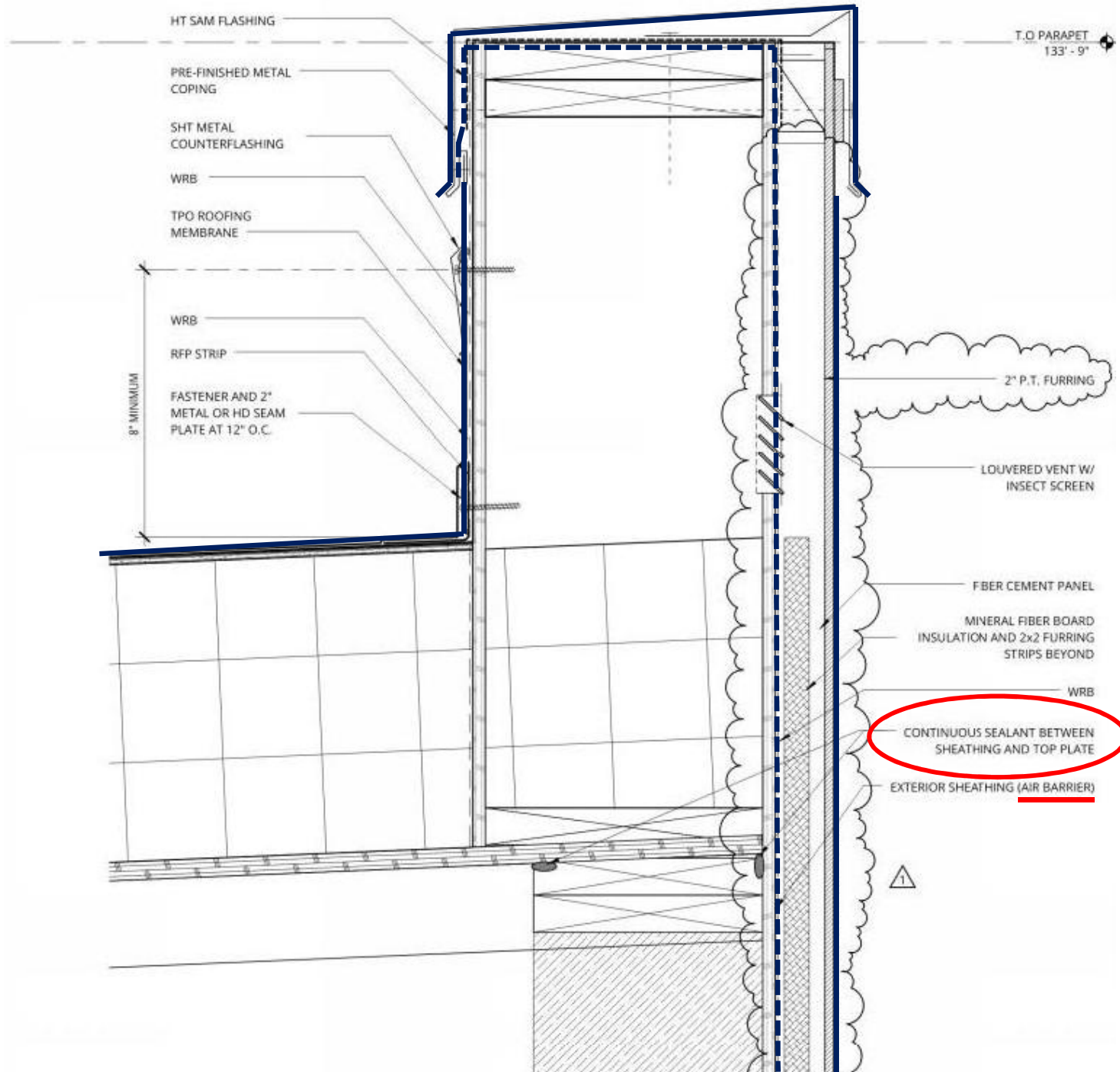
Critical Barrier Continuity: Water-Shedding Surface



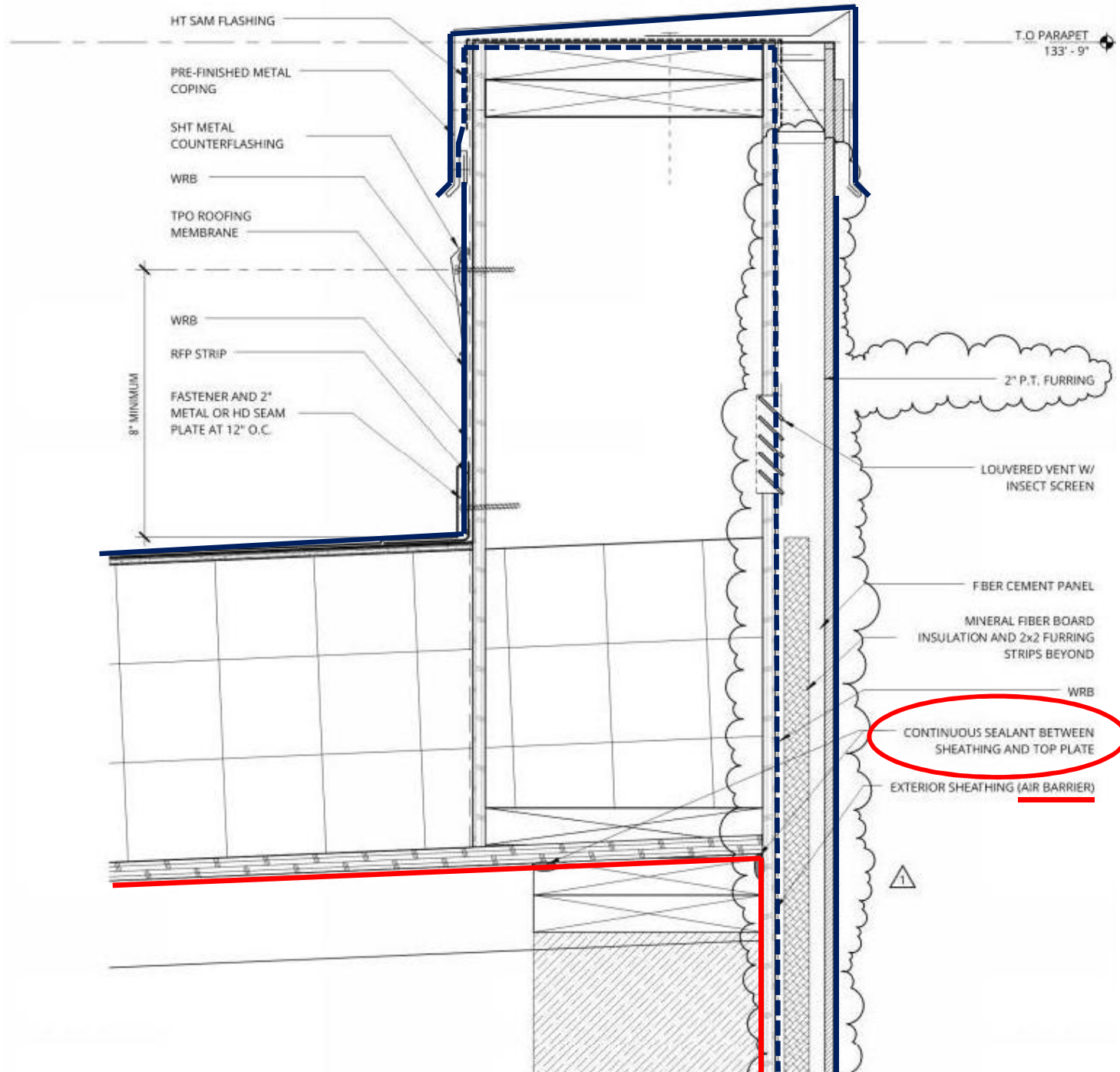
Critical Barrier Continuity: Water-Resistive Barrier



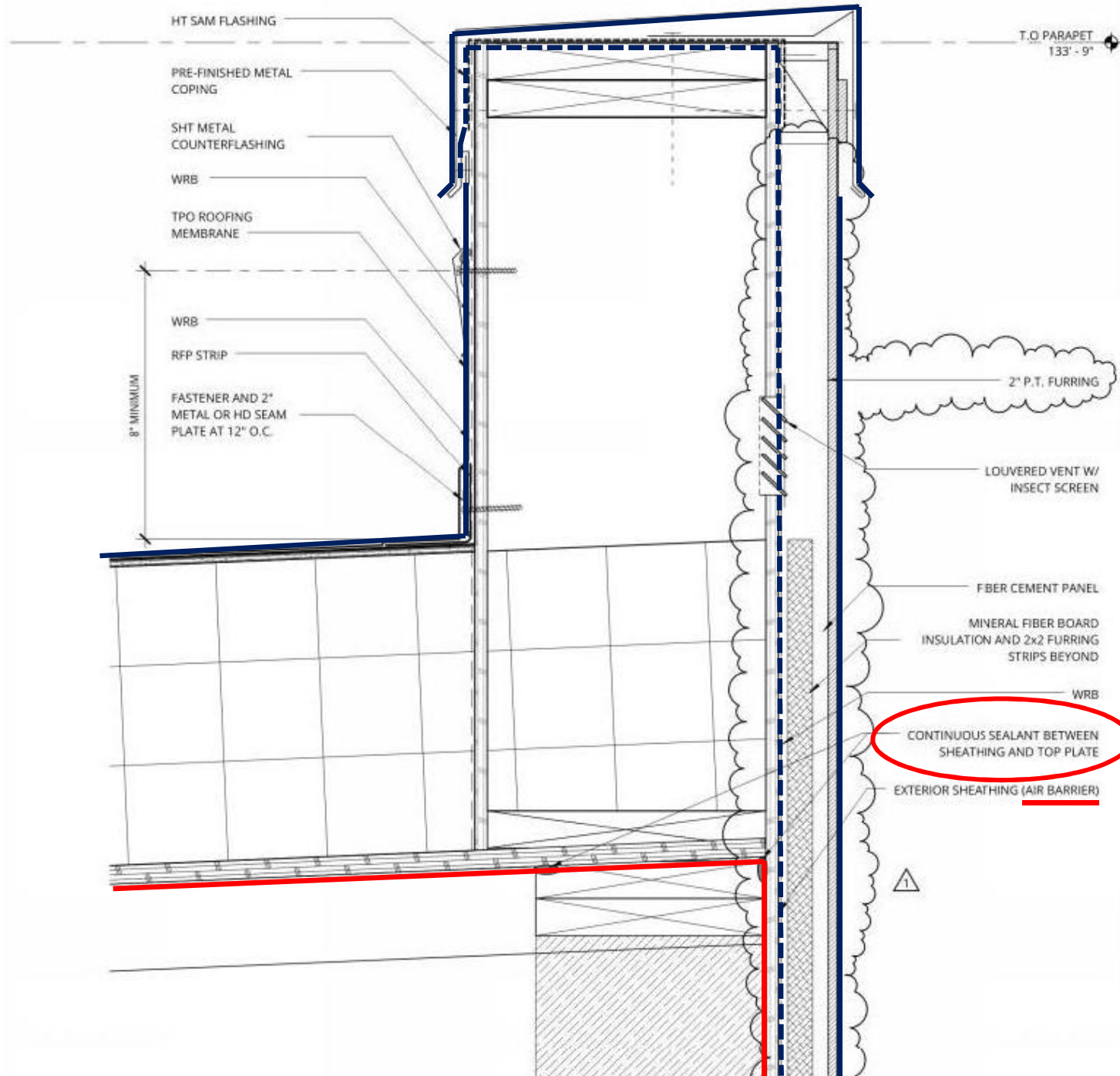
Critical Barrier Continuity: Air Barrier



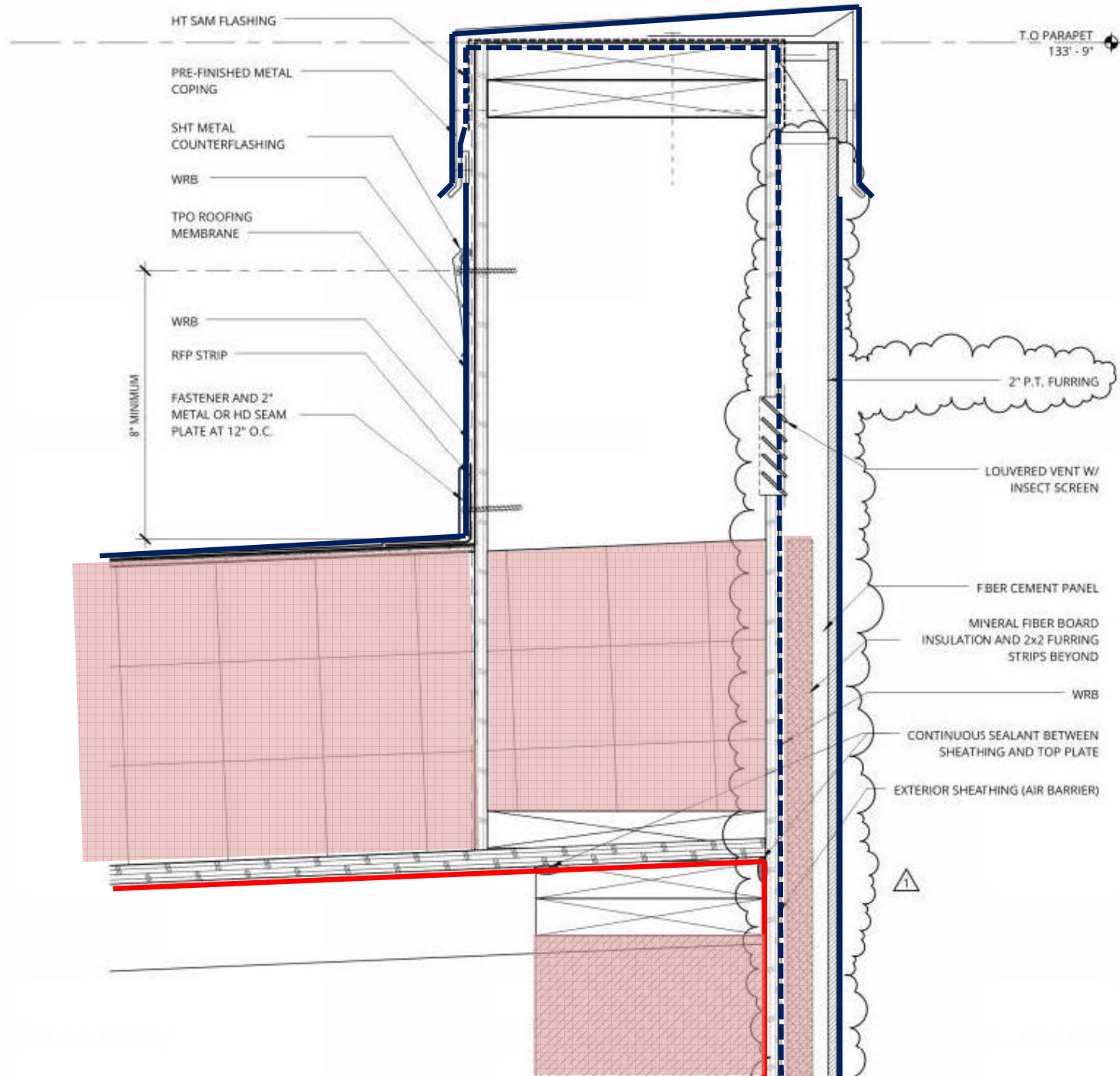
Critical Barrier Continuity: Air Barrier



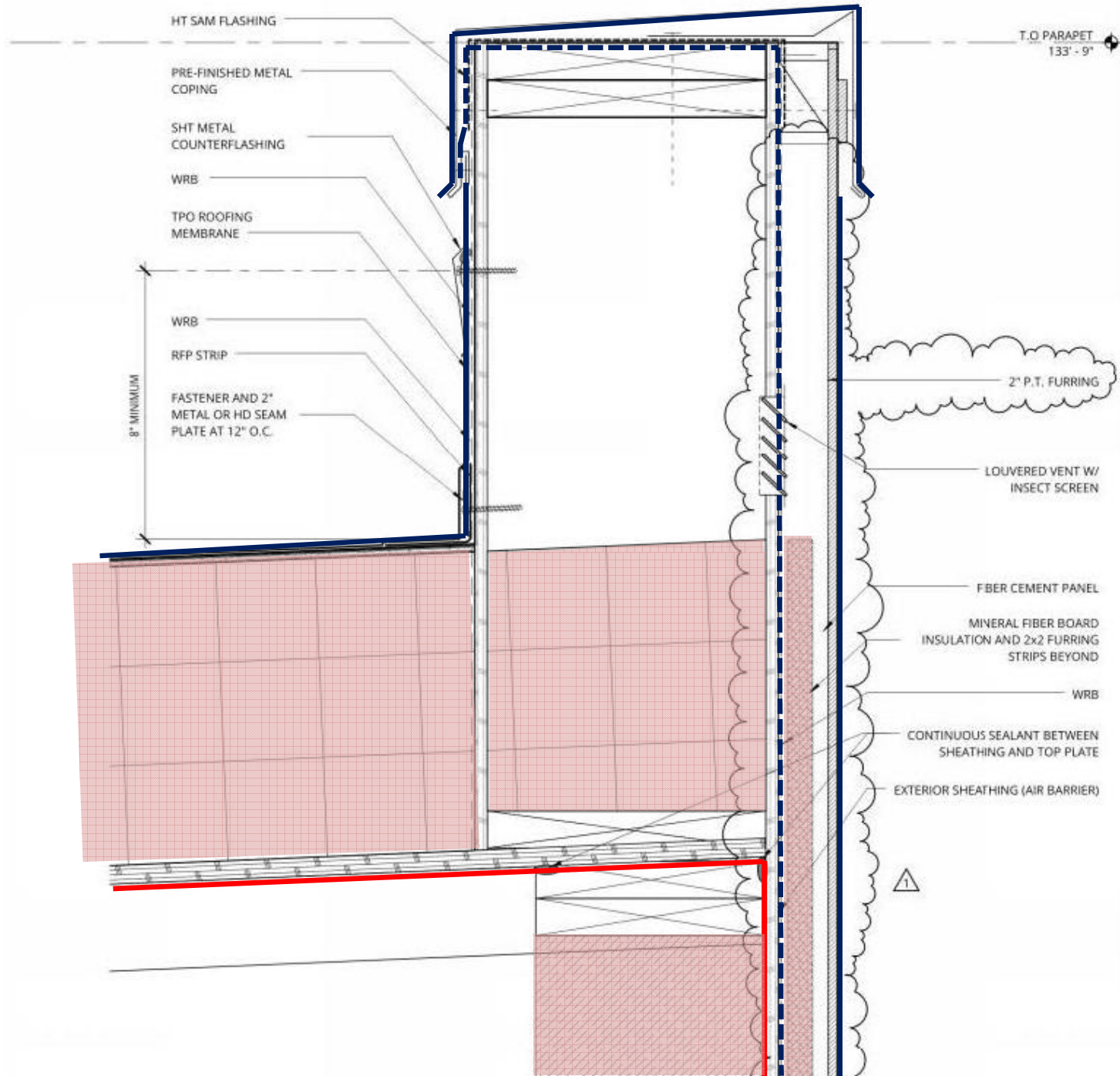
Critical Barrier Continuity: Air Barrier



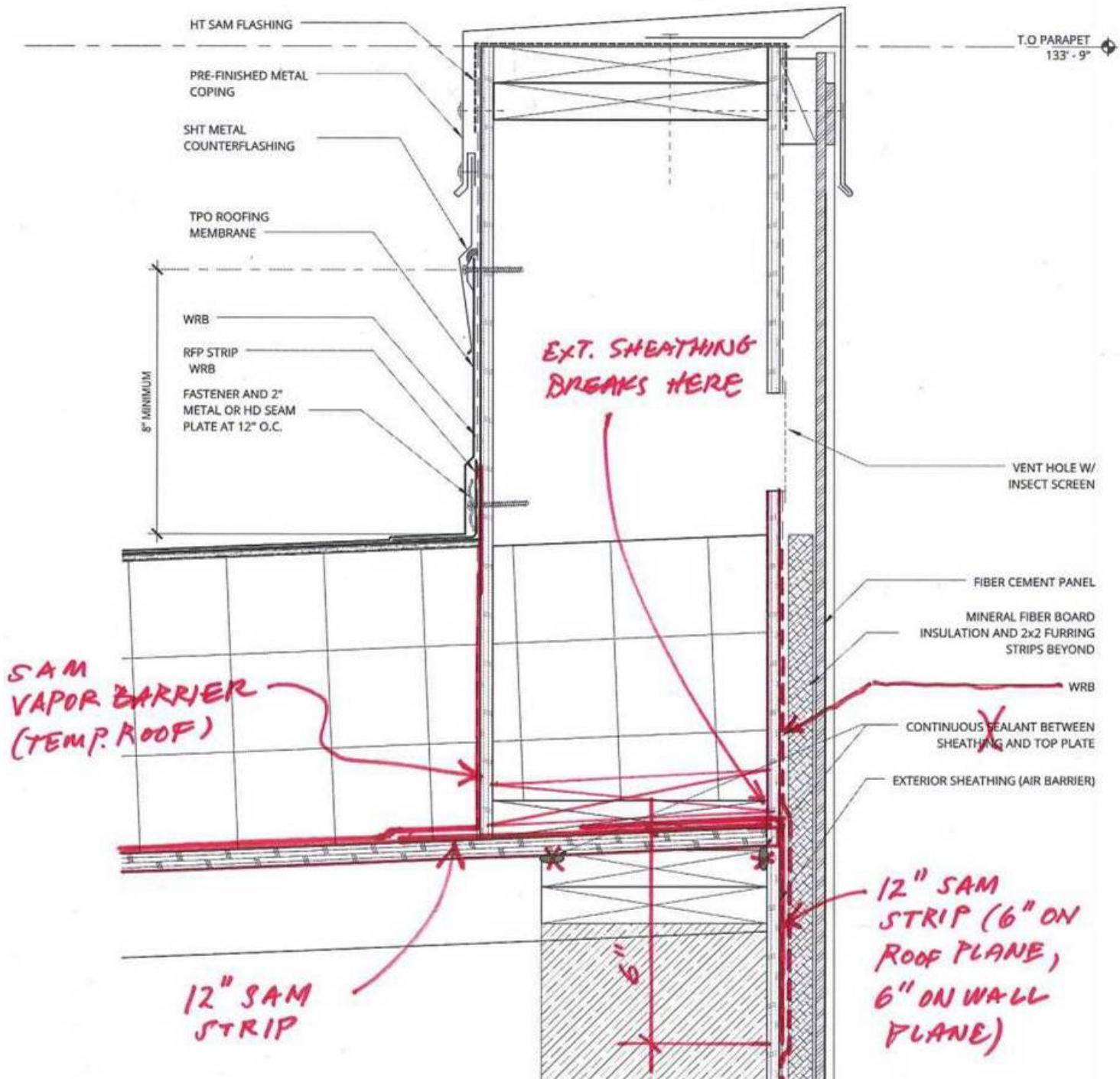
Critical Barrier Continuity: Air Barrier ???



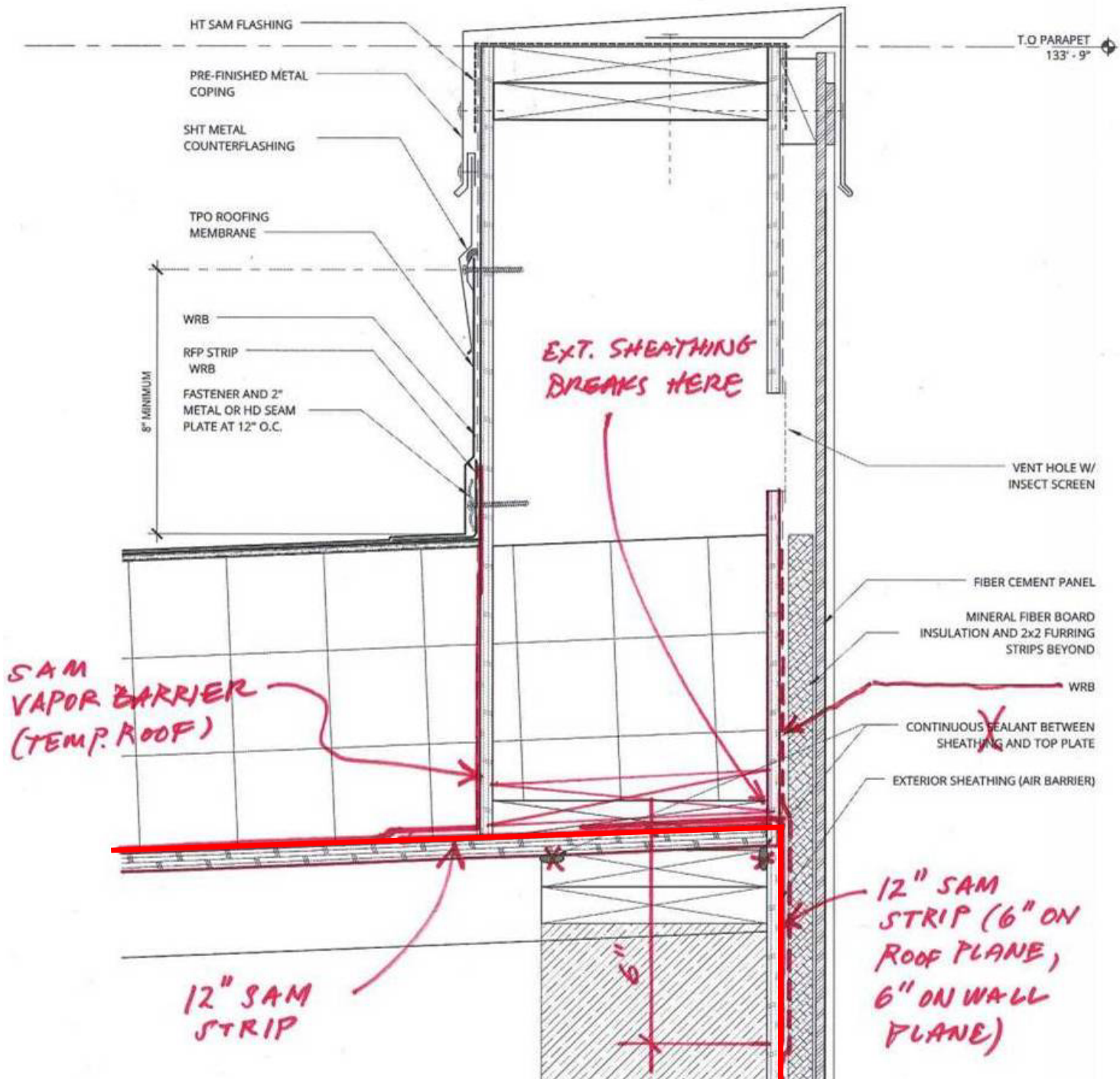
Critical Barrier Continuity: Thermal Barrier



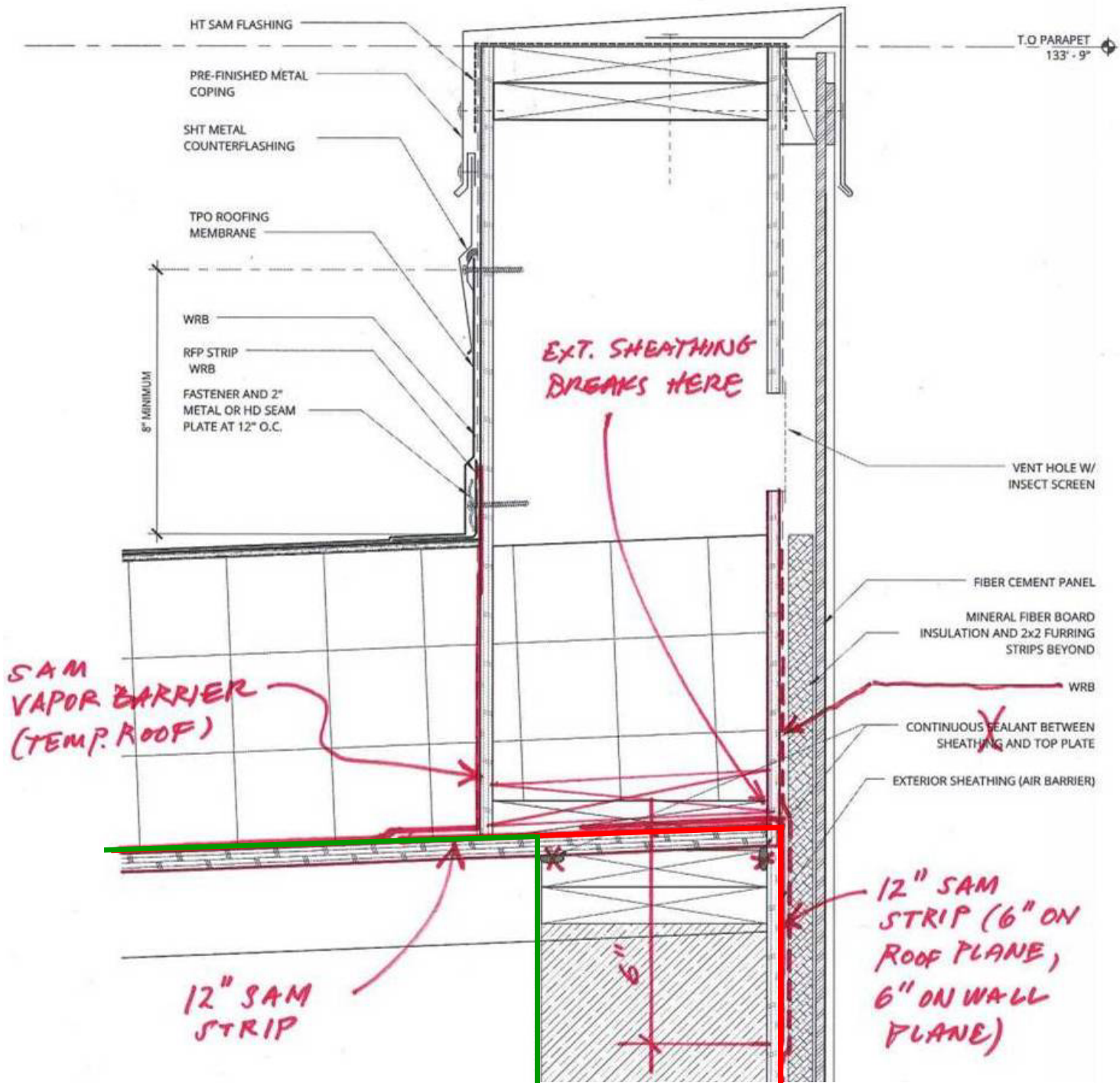
Critical Barrier Continuity: Vapor Barrier ???



Coordination Drawing at Typical Exterior Wall to Roof



Critical Barrier Continuity: Air Barrier (Revised)



Critical Barrier Continuity: Vapor Barrier













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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