Is Wood-Frame Modular the Future of Multi-Family Construction?

Building Enclosure Design for Modular Construction

Presented by Joe Piñon, M.S., P.E. (CA)

RDH BUILDING SCIENCE

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

Learning Objectives

1. Highlight potential benefits associated with the use of modular construction in multi-family buildings.

2. Discuss unique design considerations for modular projects, including room layouts, spans, fire resistance, and acoustic performance.

3. Determine how building enclosure control functions, including heat, air and moisture control, differ for modular vs. traditional wood-frame projects.

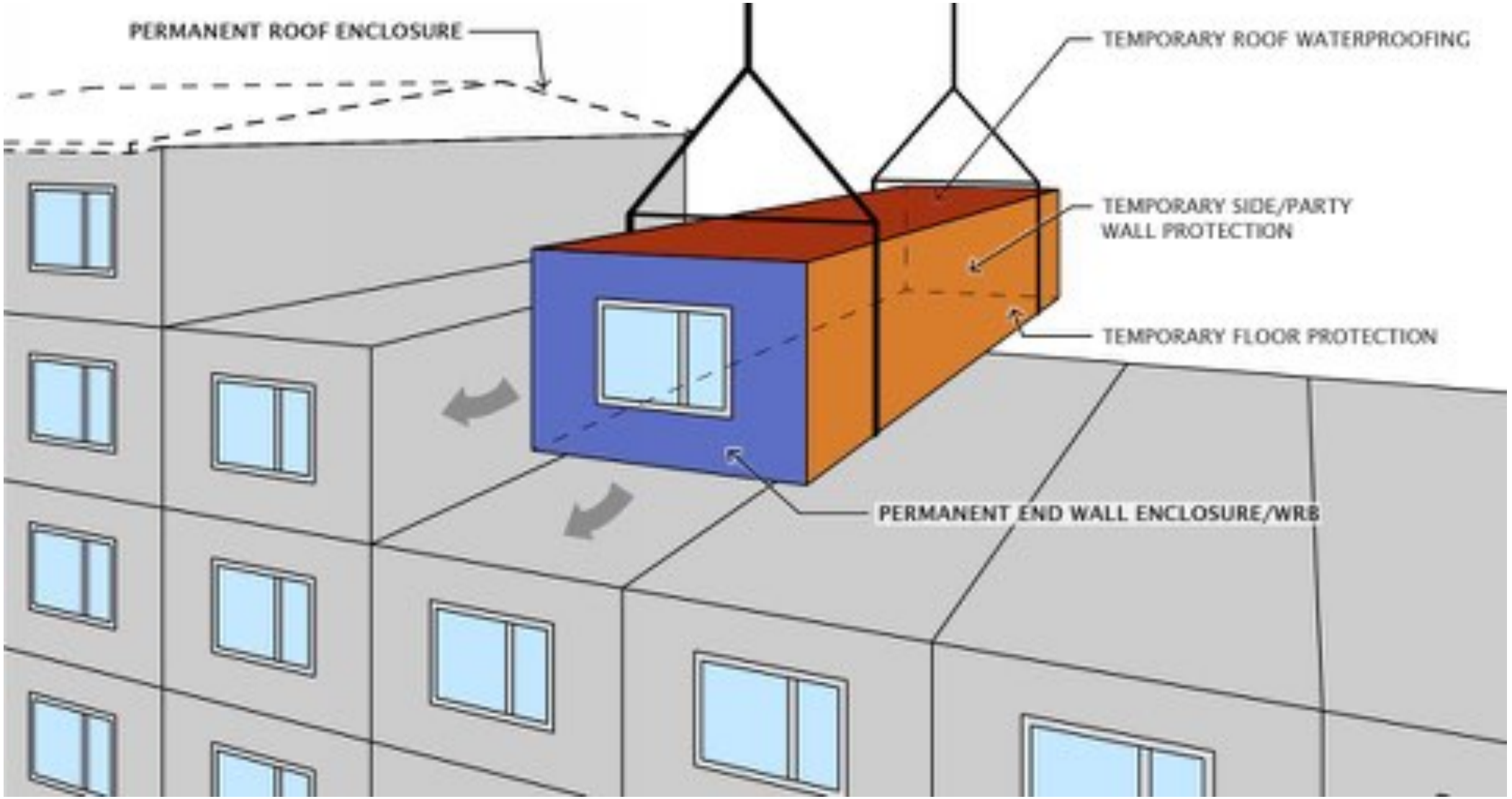
4. Explore the potential for the increased use of modular approaches in wood-frame construction.

PART 1 – Modular Building Enclosures: What's Different & What's the Same?

Modular – What's Different and What's the Same?

1. Lower cost (compared to field labor) and safer working conditions
2. Faster schedule (modules can be built while site is being prepared)
3. **Better quality in a controlled factory environment**
4. Reduced material waste
5. More trade availability than rural sites
6. **Reduced down-time due to weather**

Modular – Joints, Joints, Joints!



Modular Designs

Habitat 67, Expo 67 Montreal, Architect Moshe Safdie

Best of both

Façade Pre-Fabrication Example - Unitized Curtain Wall

Pros:

***Better quality control**

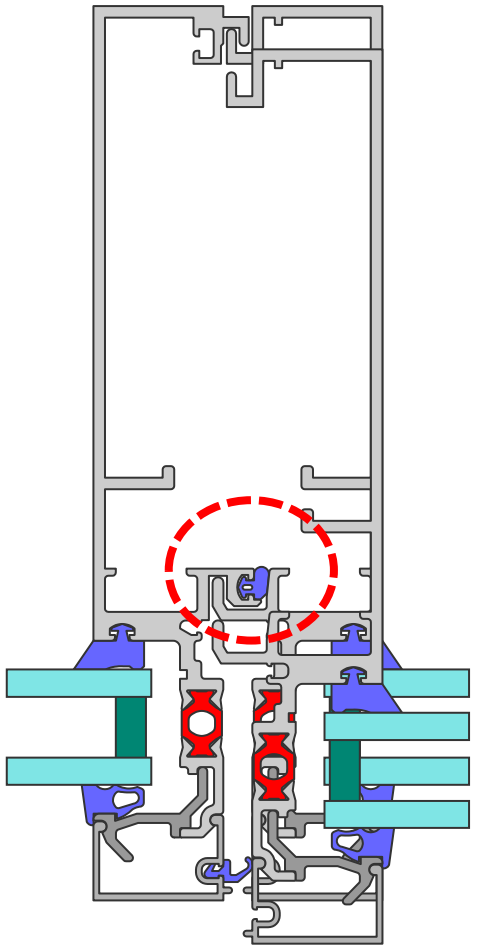
***Faster**

Cons:

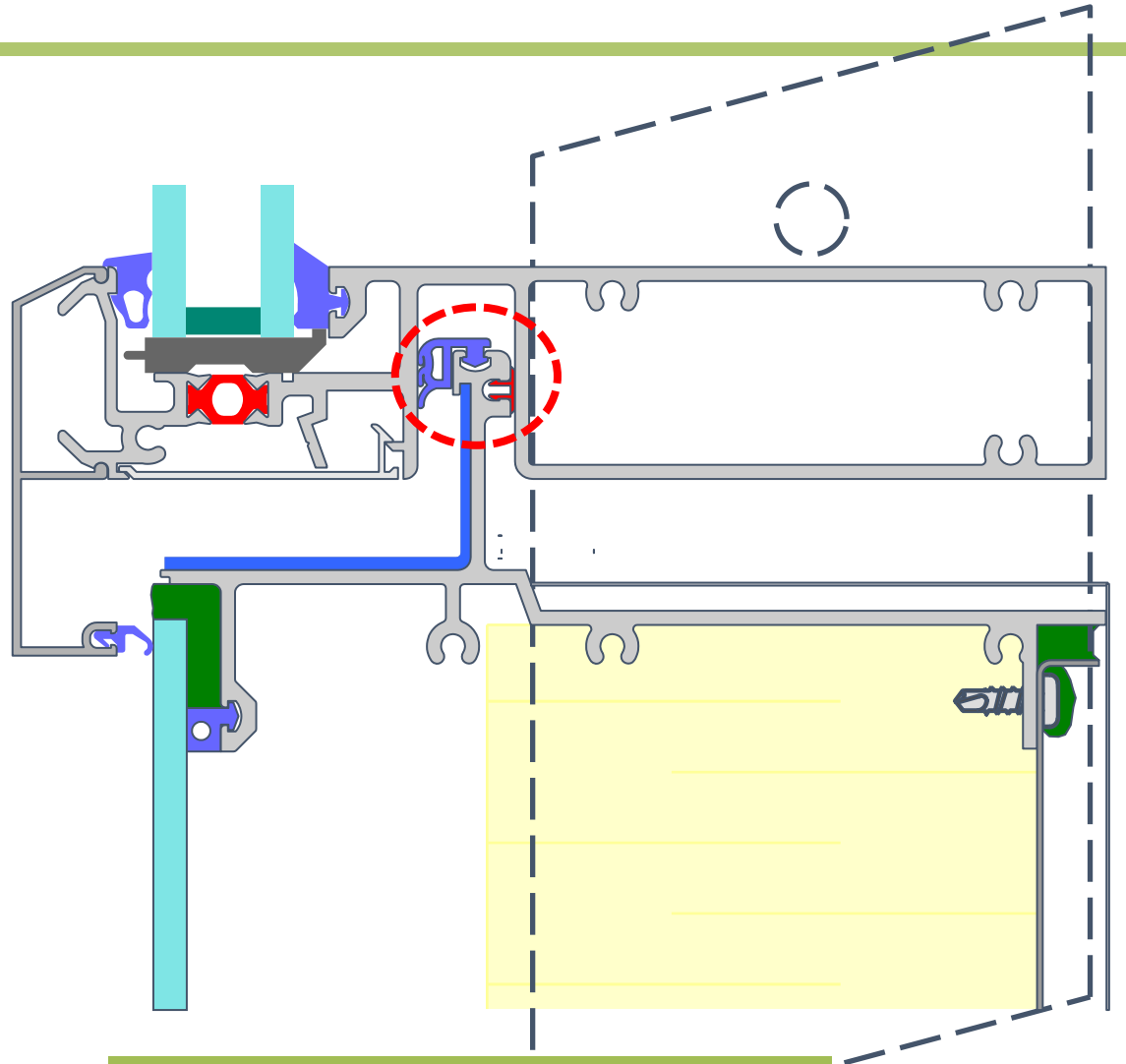
***More joints!**

***not always cheaper**

Unitized Curtain Wall Joints

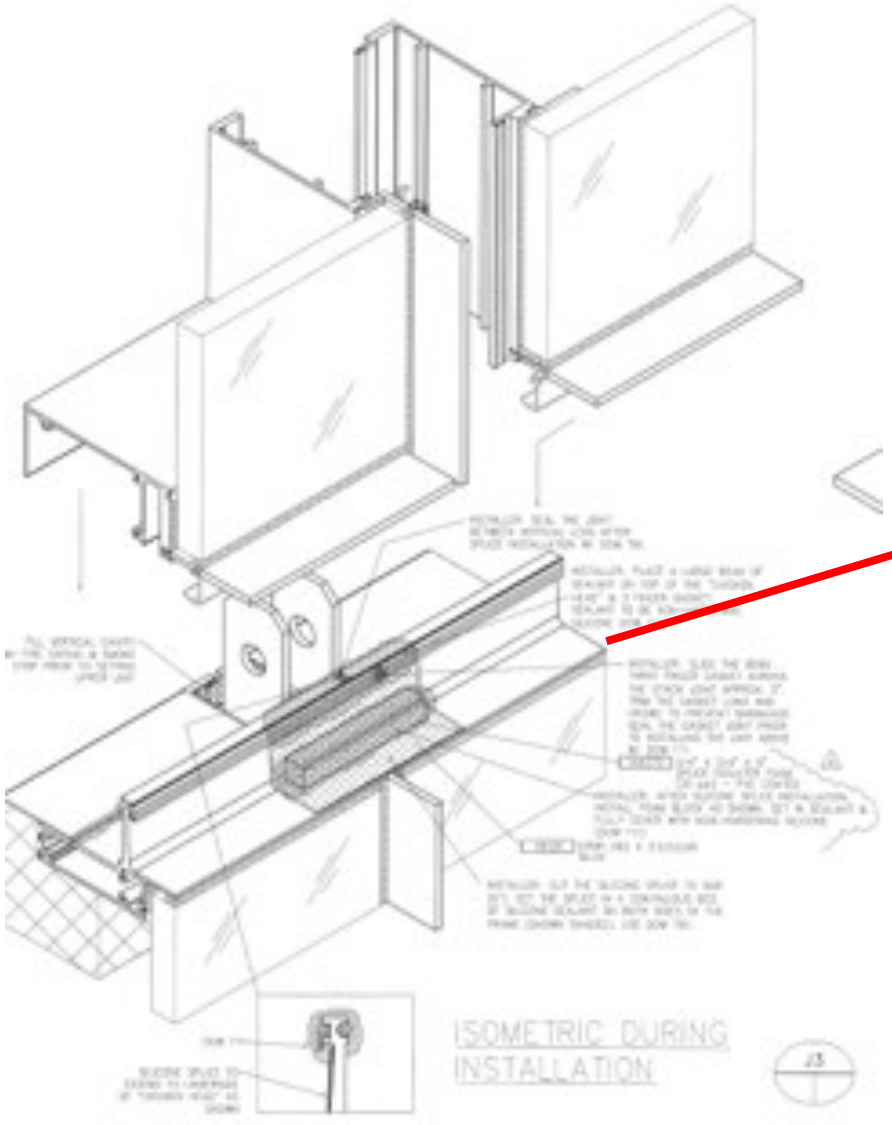


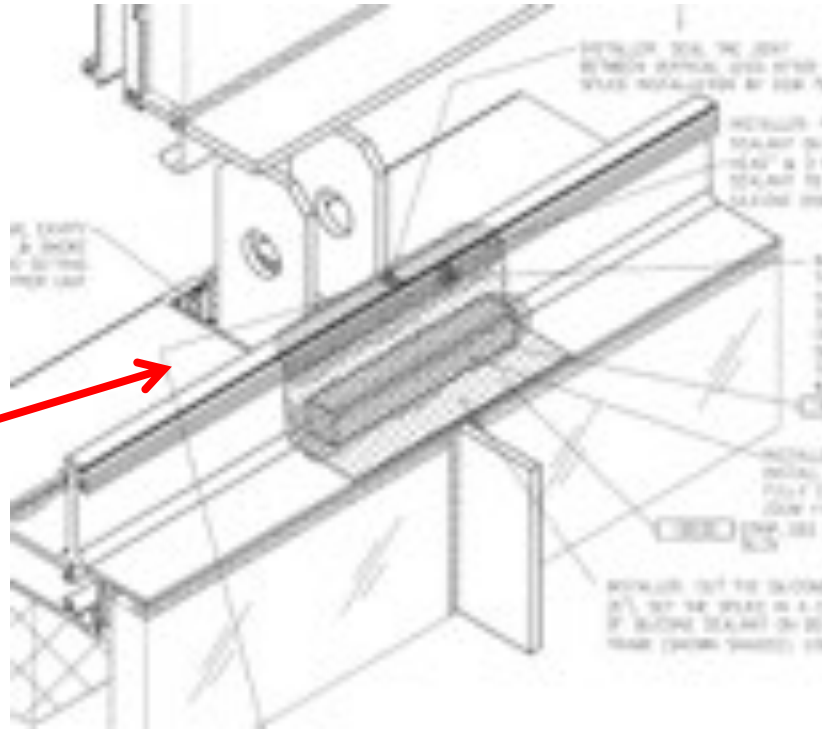
Vertical Stack Joint



Horizontal Stack Joint

Unitized Curtain Wall Joints



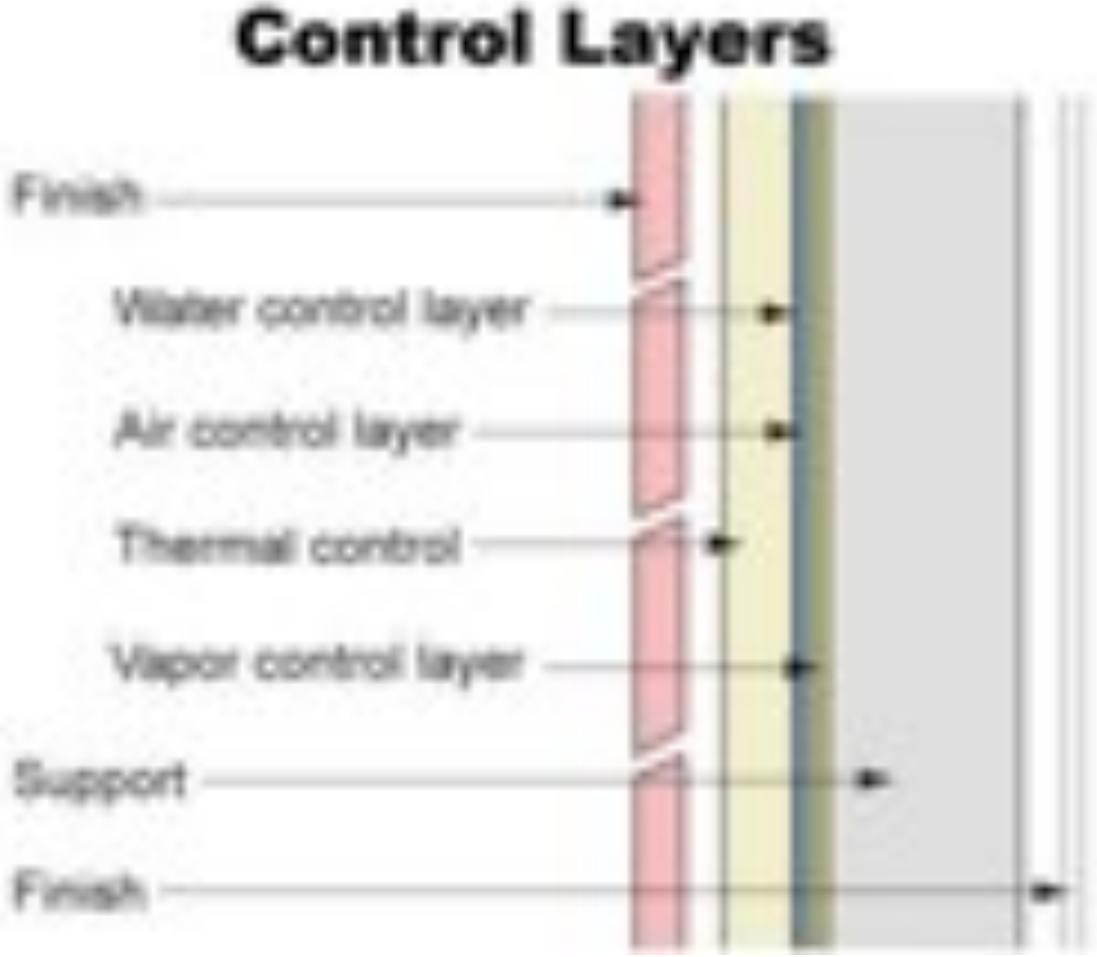


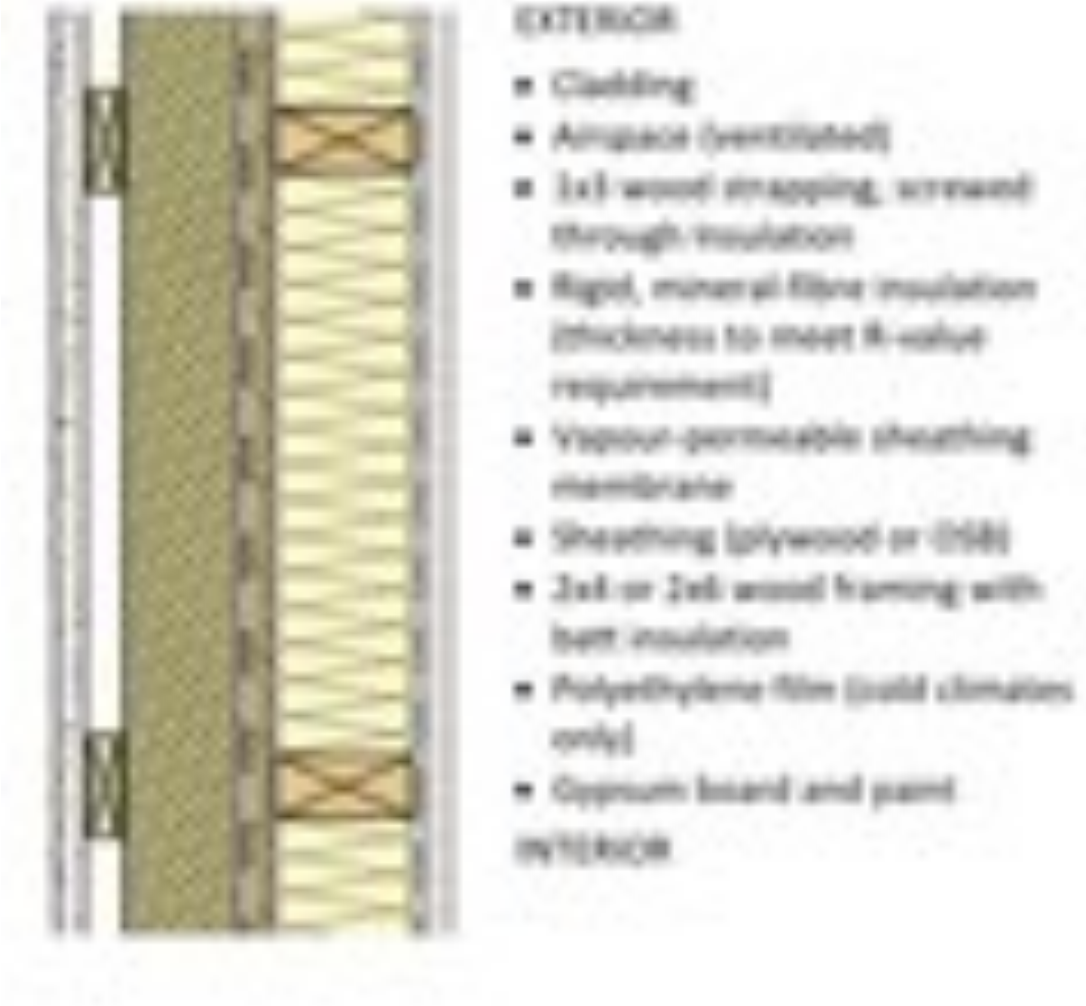
Wausau Curtain Wall
Isometric Detail of 4-Way Intersection

Which is more Complicated?

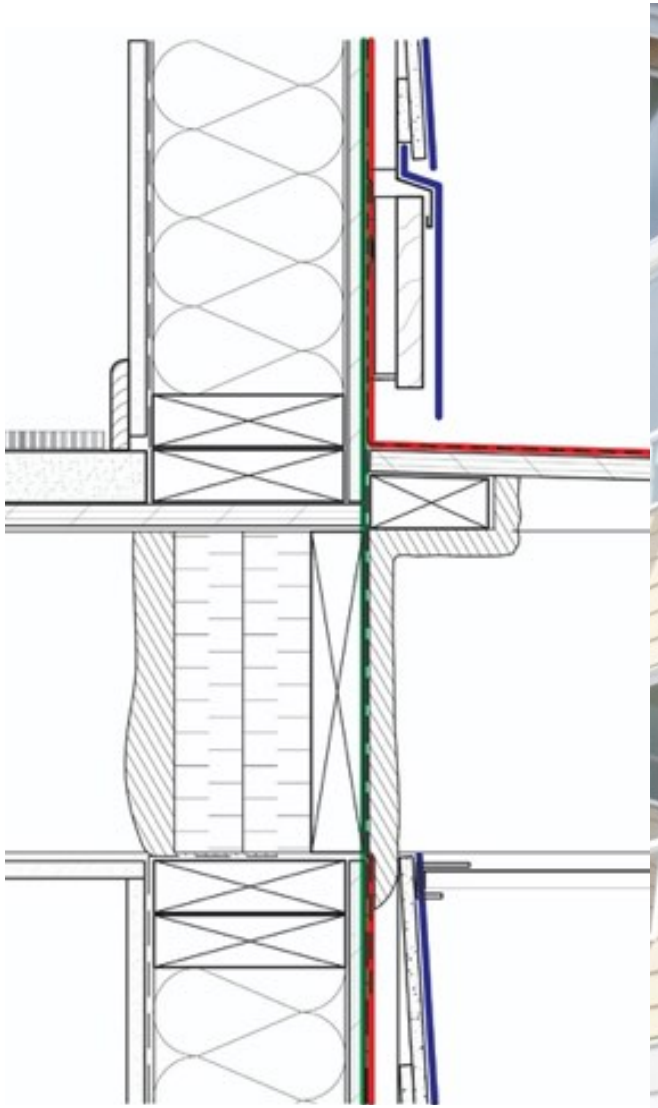
versus

Building Science Control Functions



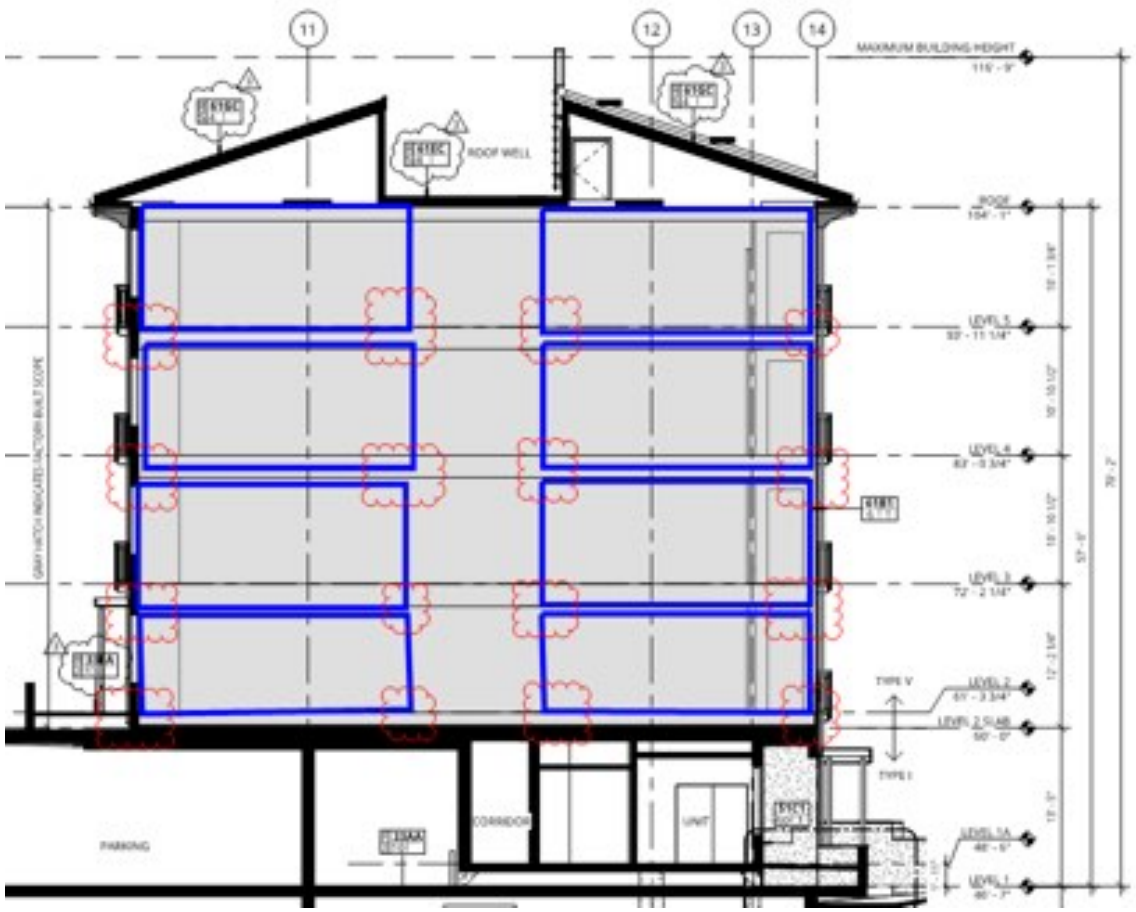


Continuity of Control Layers is Critical



Building Enclosure Challenges of Modular Construction

1. What control layers are installed in the factory and on site?
2. How is continuity of the air/water barrier achieved between modules?
3. How to protect modules from rain before air/water barrier between units is made continuous?
4. How is detailing different from traditional construction?
5. Dimensional tolerances and on-site layout coordination
6. Structural coordination (waterproofing o/connection details)



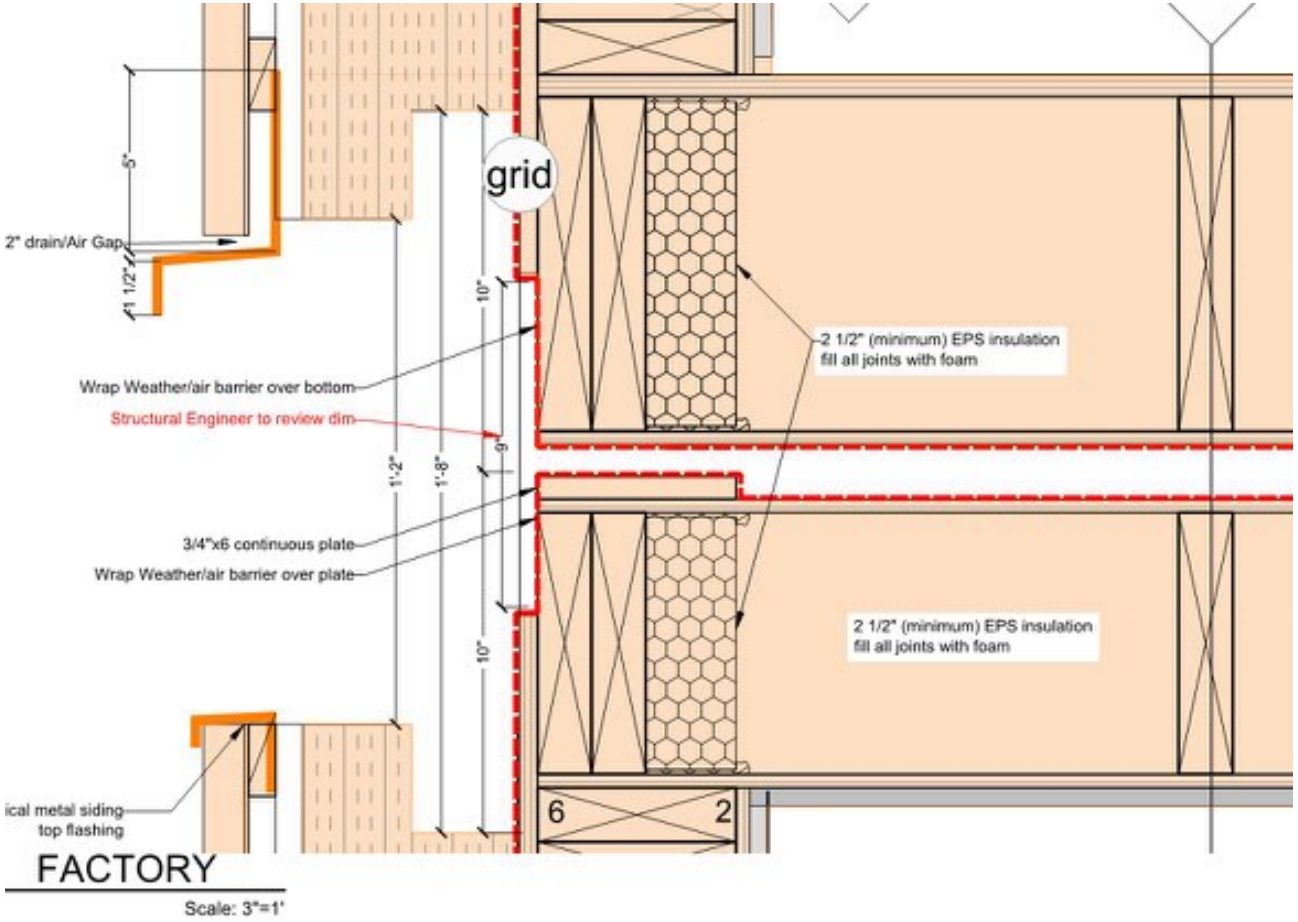
PART 2 – Modular Building Enclosures: Detailing Strategies & Case Studies

Cladding Considerations

1. Module alignment – coordinating factory and field tolerances to prevent misalignment.

2. Choosing a cladding system and attachment method that can accommodate misalignment when it happens.

3. Cladding installation in the factory or field.



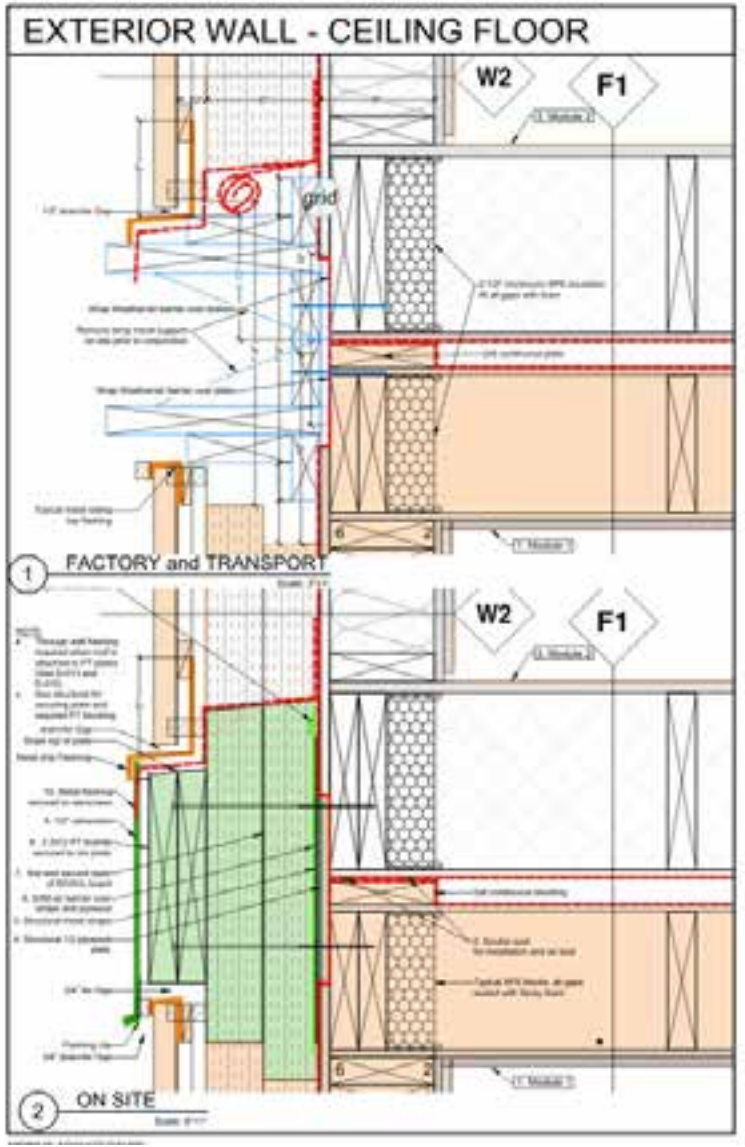
What Enclosure Control Layers are Installed in Factory and On Site?

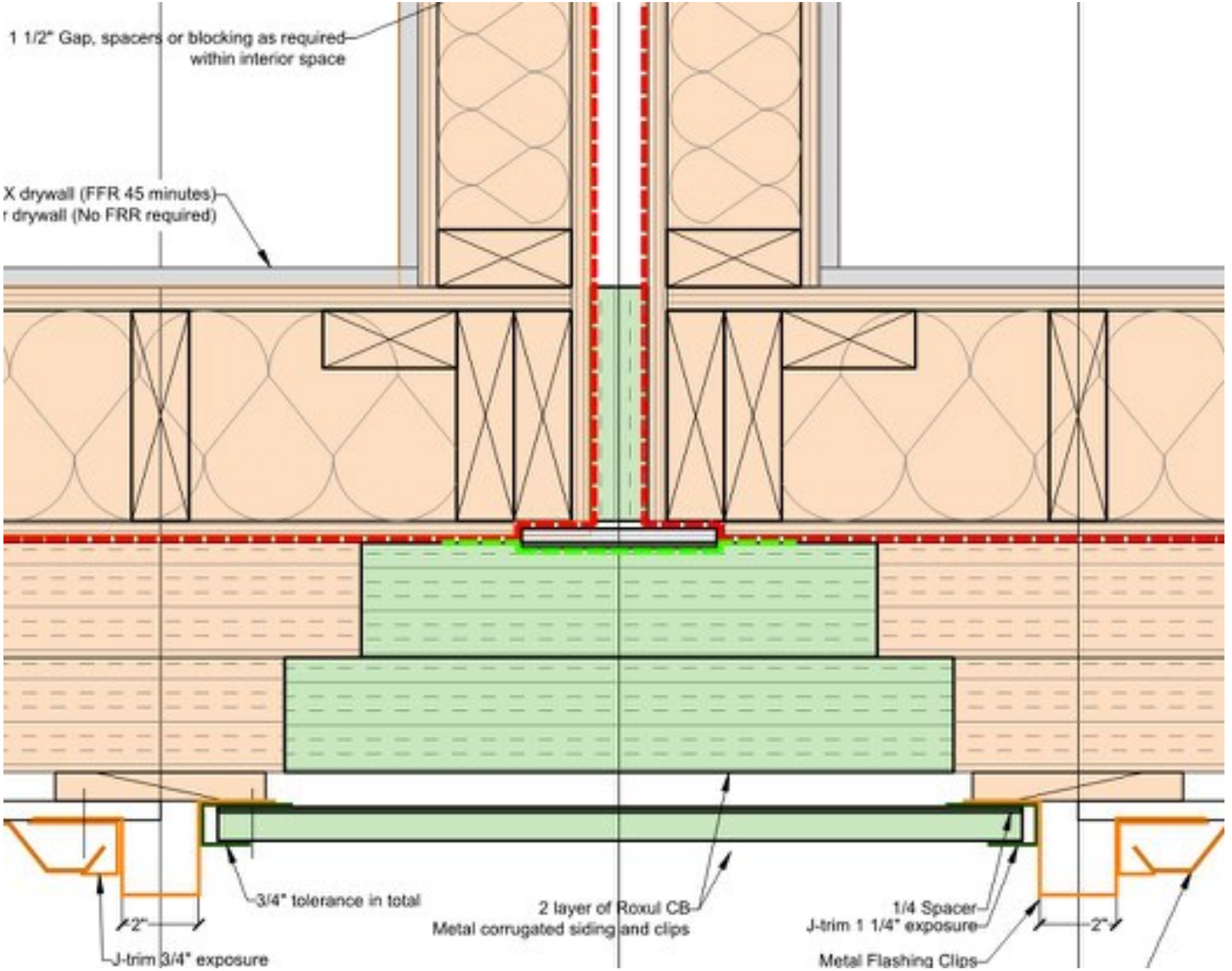
1. Air, water, thermal barrier continuity – plan for laps.

2. Expect the worse and hope for the best! At a minimum, install WRB, window/penetration flashings and a self-adhered membrane “roof” for weather protection.

3. Consider self-adhered or fluid-applied WRB to resist wind exposure and to minimize risk of water through holes and tears

4. Wrap all 6-sides of box for rain protection but also air barrier continuity.




1 1/2" Gap, spacers or blocking as required within interior space
X drywall (FFR 45 minutes)
r drywall (No FRR required)
3/4" tolerance in total
2"
J-trim 3/4" exposure
2 layer of Roxul CB
Metal corrugated siding and clips
1/4 Spacer
J-trim 1 1/4" exposure
2"
Metal Flashing Clips


SOPREMA

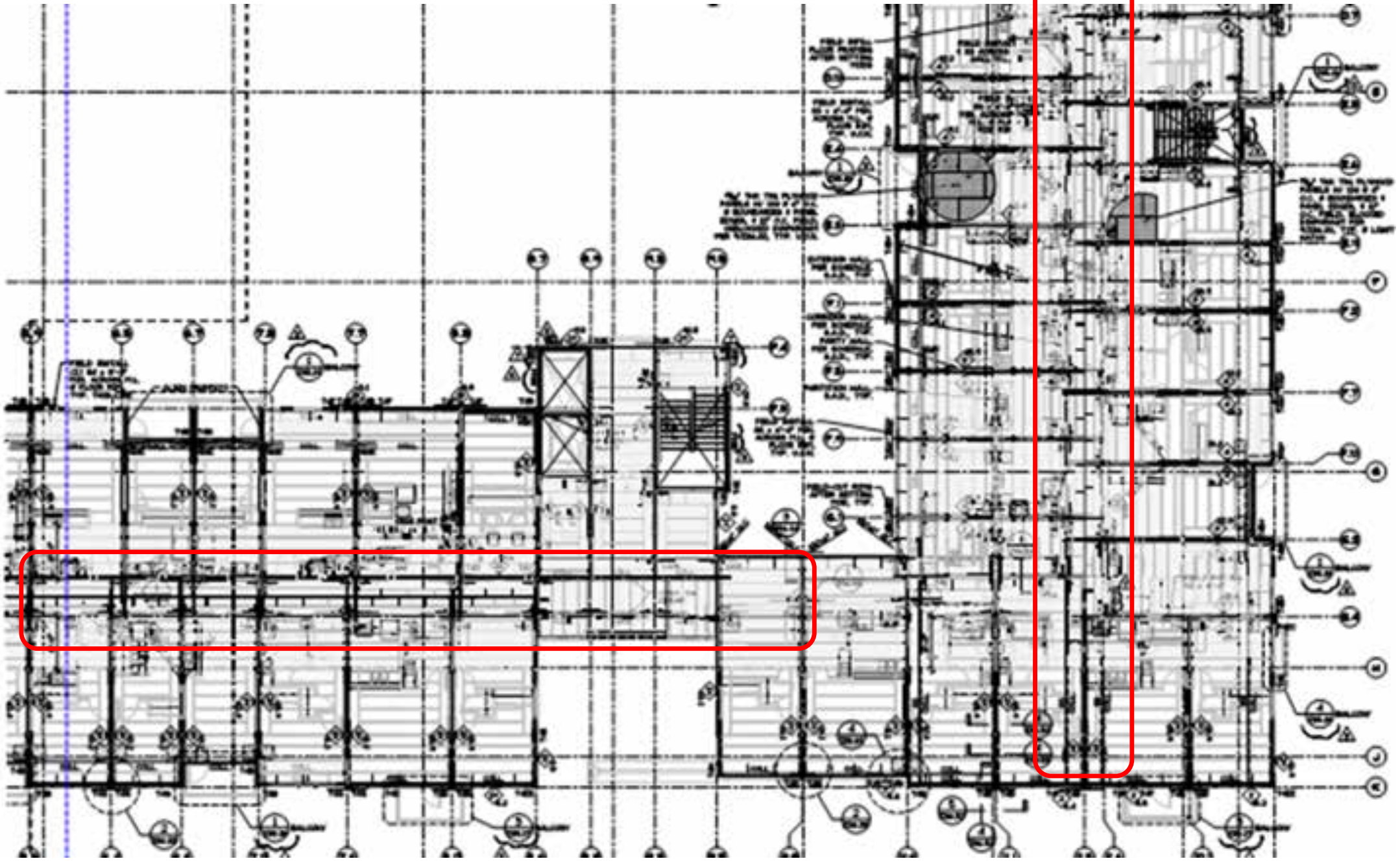
How to Protect Modules from Rain before Air/Water Barrier is made Continuous?

1. Protect from water intrusion within modules and between modules

2. Allow water to drain if it does get in

3. Avoid creating bathtubs at module roofs and under the modules


What’s
wrong with
this picture?



How is Continuity of the Air/Water barrier Achieved between Modules?

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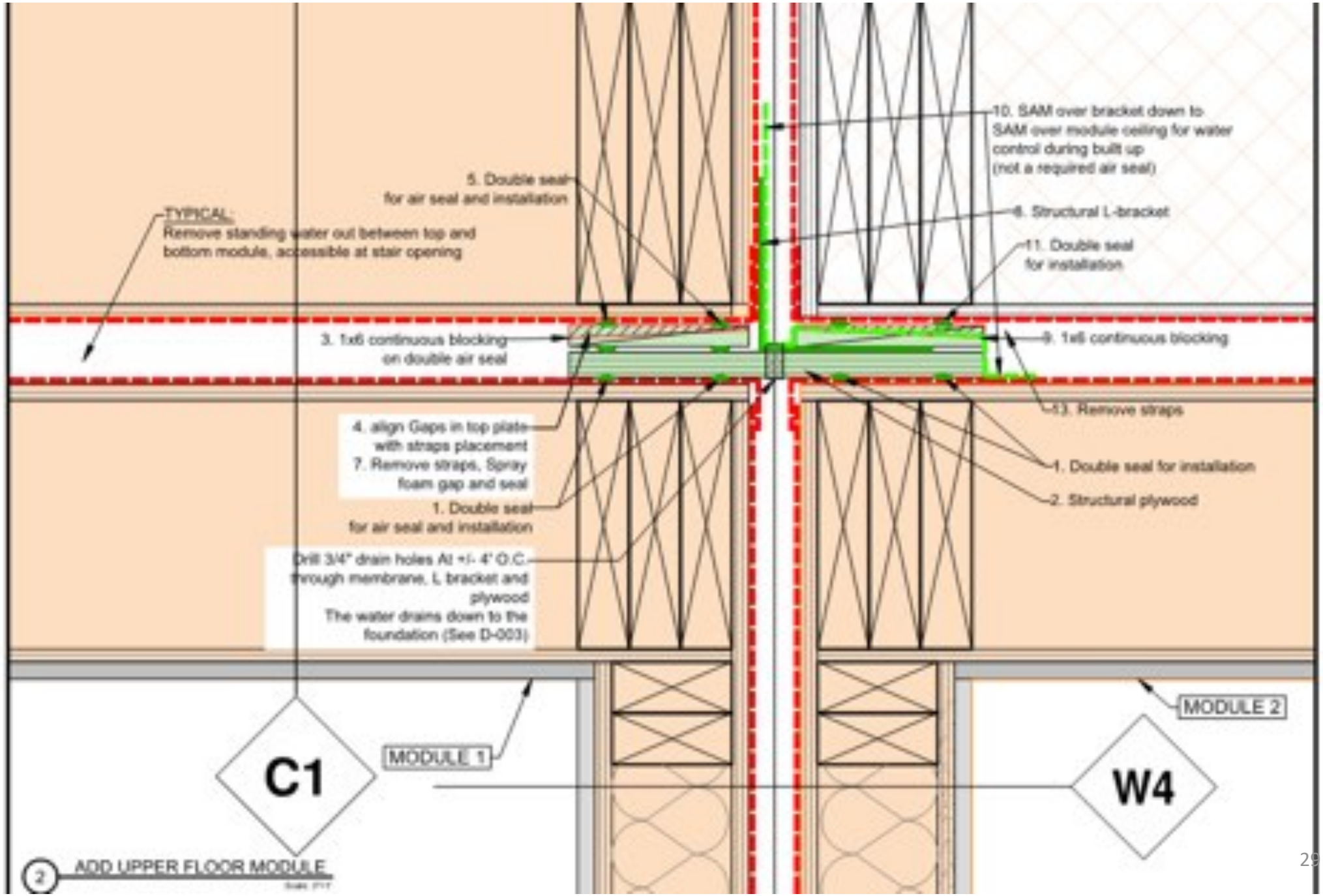
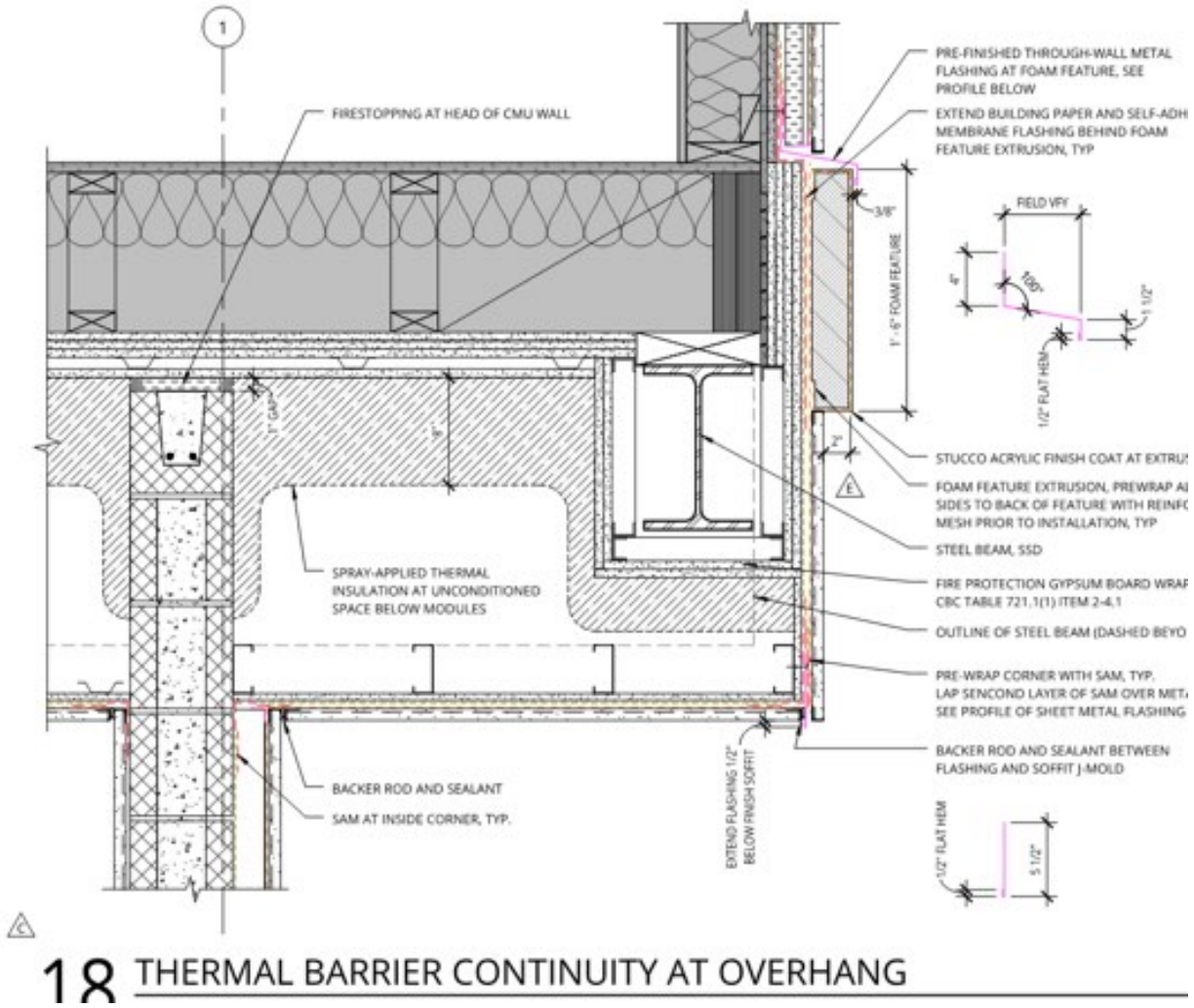

10. SAM over bracket down to SAM over module ceiling for water control during built up (not a required air seal)
5. Double seal for air seal and installation
TYPICAL:
Remove standing water out between top and bottom module, accessible at stair opening
8. Structural L-bracket
11. Double seal for installation
3. 1x6 continuous blocking on double air seal
9. 1x6 continuous blocking
13. Remove straps
4. align Gaps in top plate with straps placement
7. Remove straps, Spray foam gap and seal
1. Double seal for installation
2. Structural plywood
1. Double seal for air seal and installation
Drill 3/4" drain holes At +/- 4" O.C. through membrane, L bracket and plywood
The water drains down to the foundation (See D-003)
MODULE 1
MODULE 2
C1
W4
2 ADD UPPER FLOOR MODULE

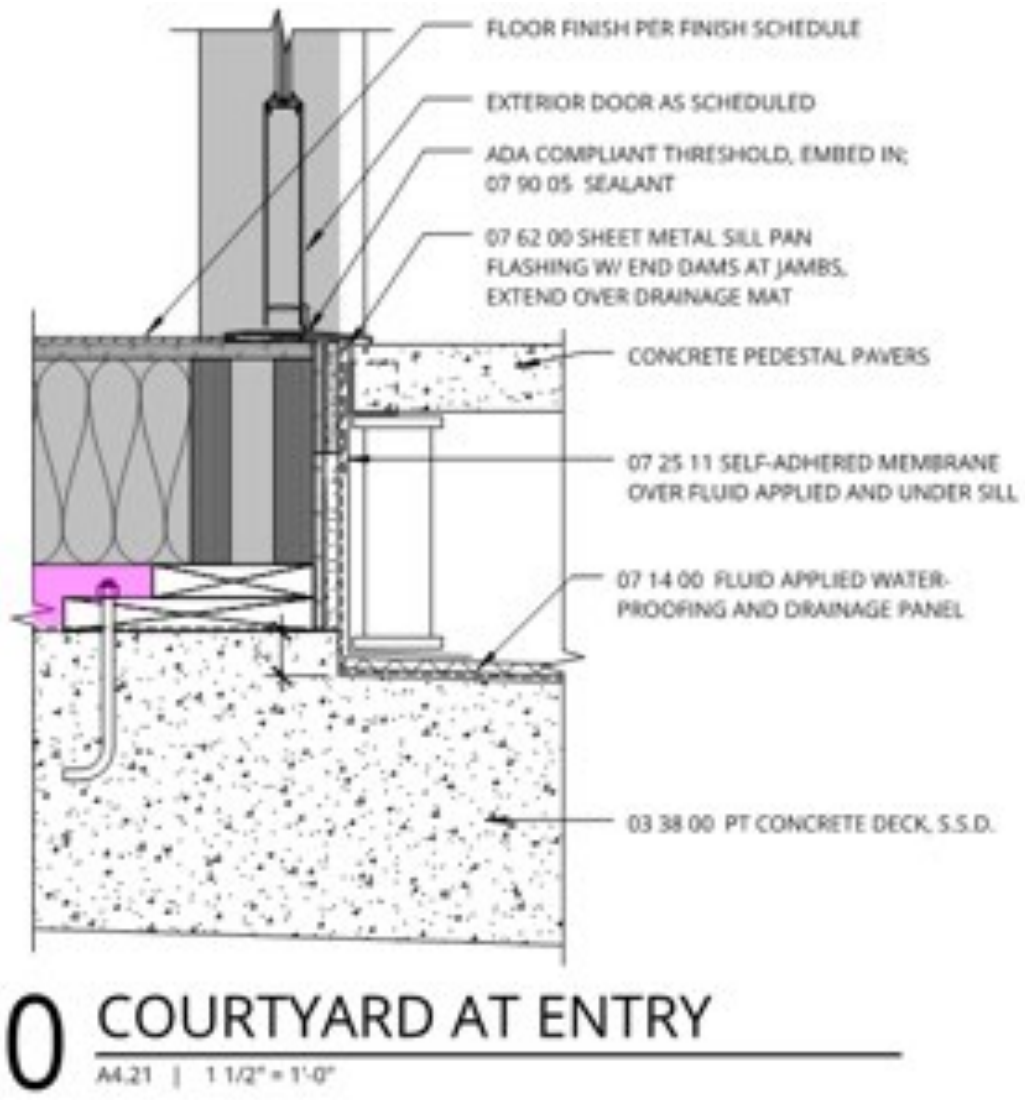
Façade Details must Accommodate Tolerances

- Modular unit set onto site-built CMU and steel structure.
- Express joint with detail that allows tolerance.



Foundation Crawl Space needs Planning

Rain Water that enters between modular units can get trapped in crawl space.

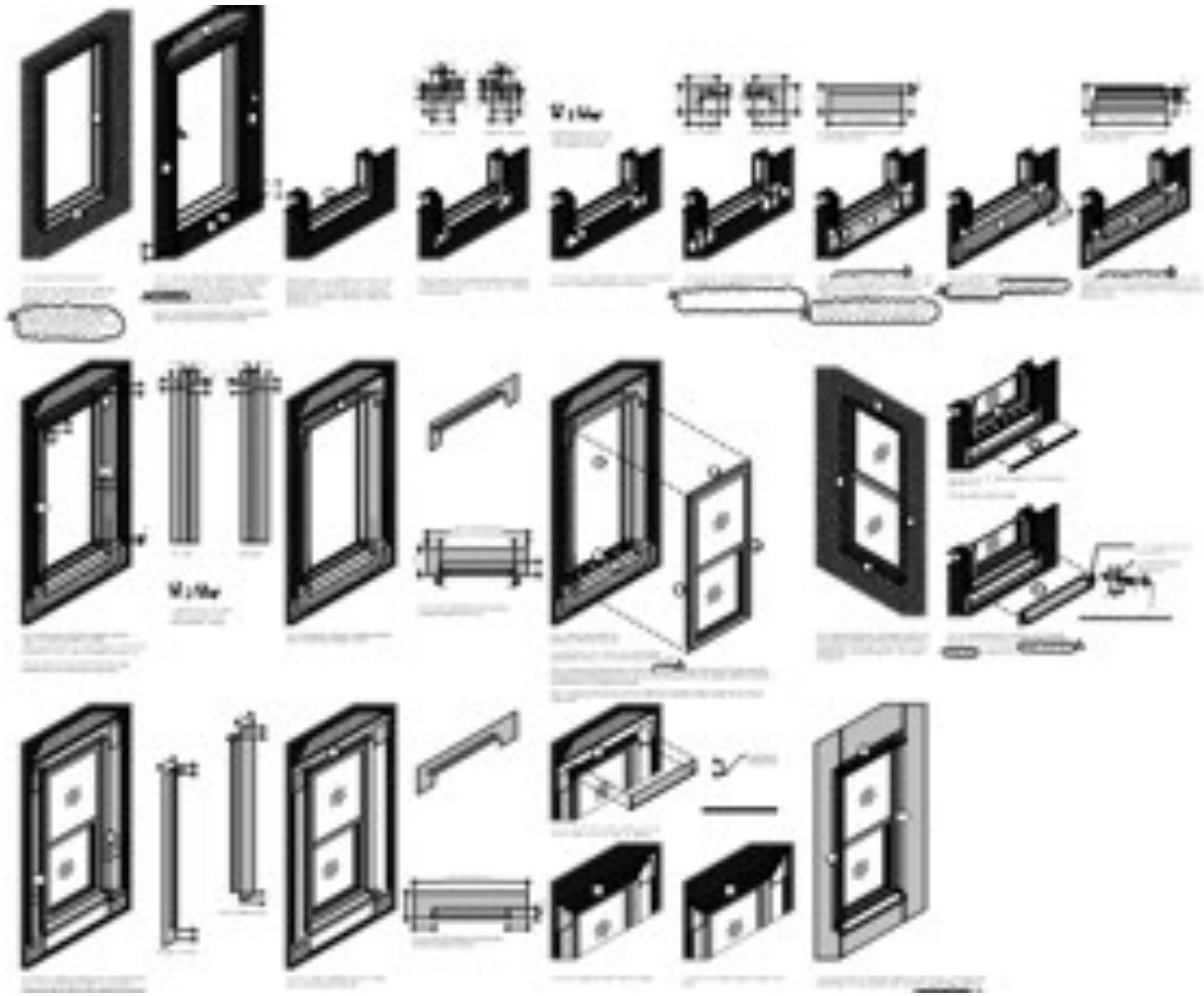


Factory QA / QC is Critical

1. Is a 15-Step Window Flashing Sequence installed in 1-hour reasonable?

2. Considered what will be installed in factory and field and allow tie-in and tails as well as temporary weatherproofing – doors, bolt-on balcony knife plates, etc.

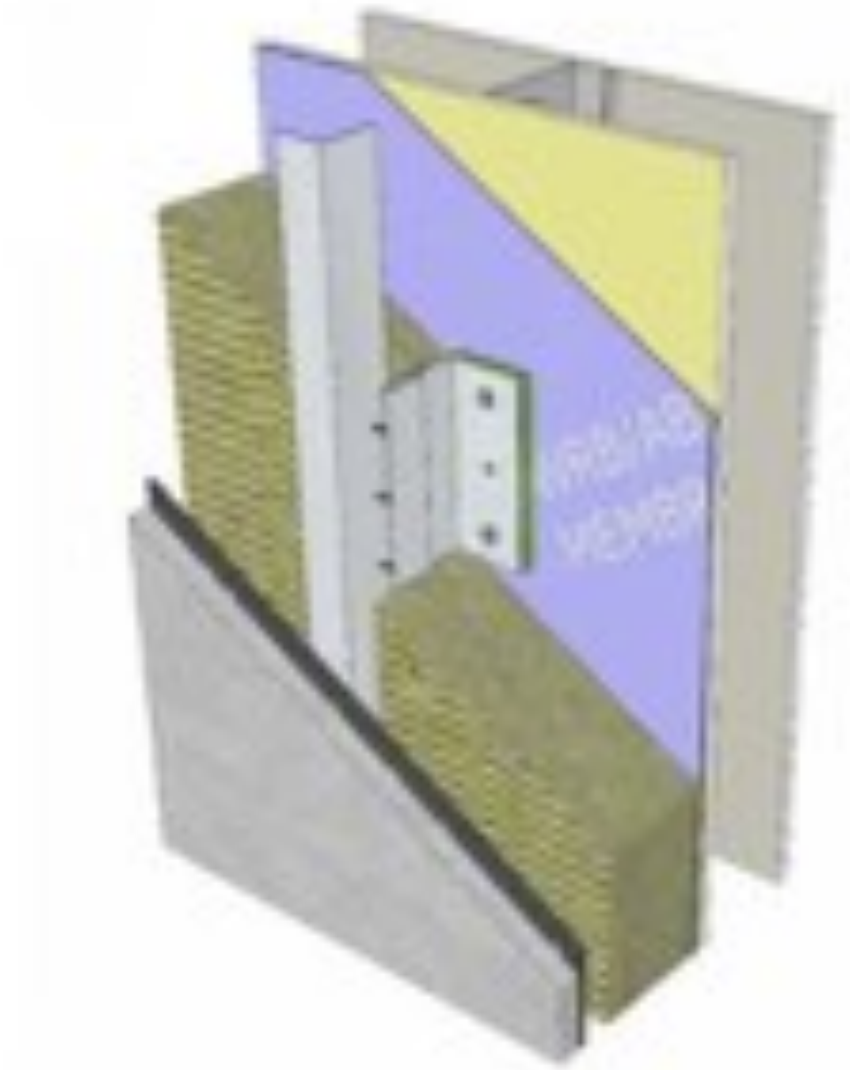
3. Do Mock-Ups and Performance Testing in the Factory



Factory QA / QC is a Must!

Cladding Tolerance Considerations

Choose cladding attachments that will accommodate misalignment such as furring or clip and rail system.



Cladding Tolerance Considerations

Summary of Lessons Learned

1. Consider using an integrated design process that includes builders, architects, modular manufacturer, installers, owners, and consultants early in the design process.

2. Wrap all six sides of modules with water resistive barrier (WRB) with roofing grade membrane on top of units.

3. Carefully plan how joints between units will be protected during construction. It is important to not allow water between units during construction even though units are protected.
   *Consider what will happen to water that reaches the foundation crawl space.
   *Consider moisture and relative humidity meters within interstitial spaces.

4. In-factory and field review QA / QC is critical. Do mock-ups and performance testing in factory prior to full production. Field correction of factory errors is very costly.

5. Design exterior insulated rainscreen claddings for optimal ability to accommodate tolerances.

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

Joseph Piñon

RDH Building Science

415-713-8584

jpinon@rdh.com

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