BUILDINGENERGY BOSTON

Addressing Thermal Bridges that Arise During Construction

Laura Bashaw, Nouha Javed, and Cynthia Staats,
Building Enclosure Science

Curated by Frank Stone and Geetha Kanthasamy

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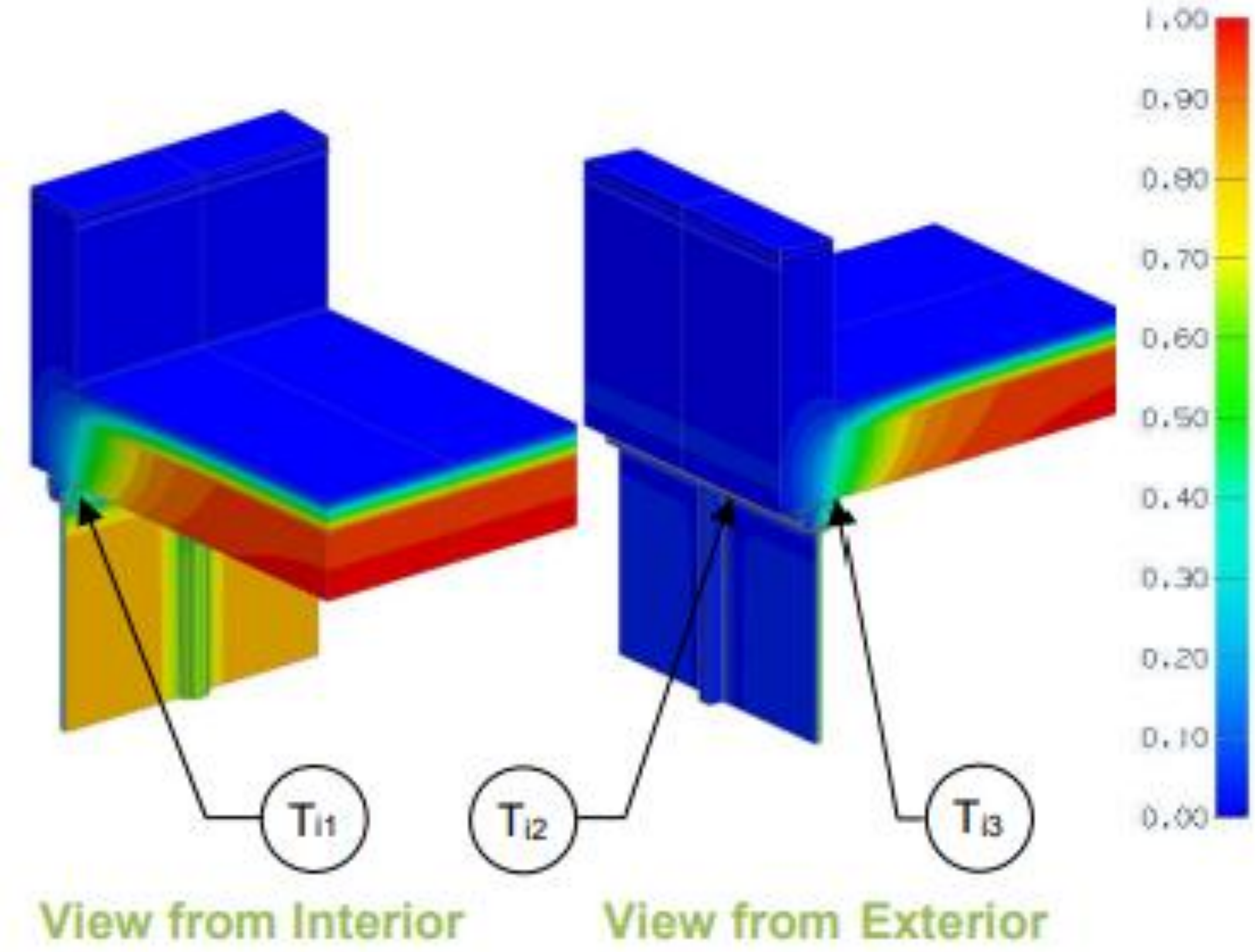
BES



Source: BC Hydro

Learning Objectives

- Identify thermal bridges in the building enclosure that arise during construction.
- Analyze solutions to mitigate thermal bridging challenges during the construction phase.
- Identify strategies to proactively communicate with stakeholders regarding design and construction coordination related to thermal bridging.
- Define how to execute complex geometry in accordance with models and details in the context of new energy codes and best practices for sequencing work in the field.

Agenda

- Review of thermal bridges.
- Code requirements for thermal bridging.
- Reasons thermal bridges may arise during construction.
- **Examples:** Multiple projects in the Greater Boston area
- Structural Thermal Breaks.
- **Case study:** Lab/office building in Boston suburbs.
- Conclusion.

Laura Bashaw, P.E.

Building Enclosure - Consultant IV

- 16 years experience enclosure consulting.
- Works with architects, owners, and property managers.
- Cornell BS in Civil Engineering.
- Loves cooking and baking and home improvement projects.

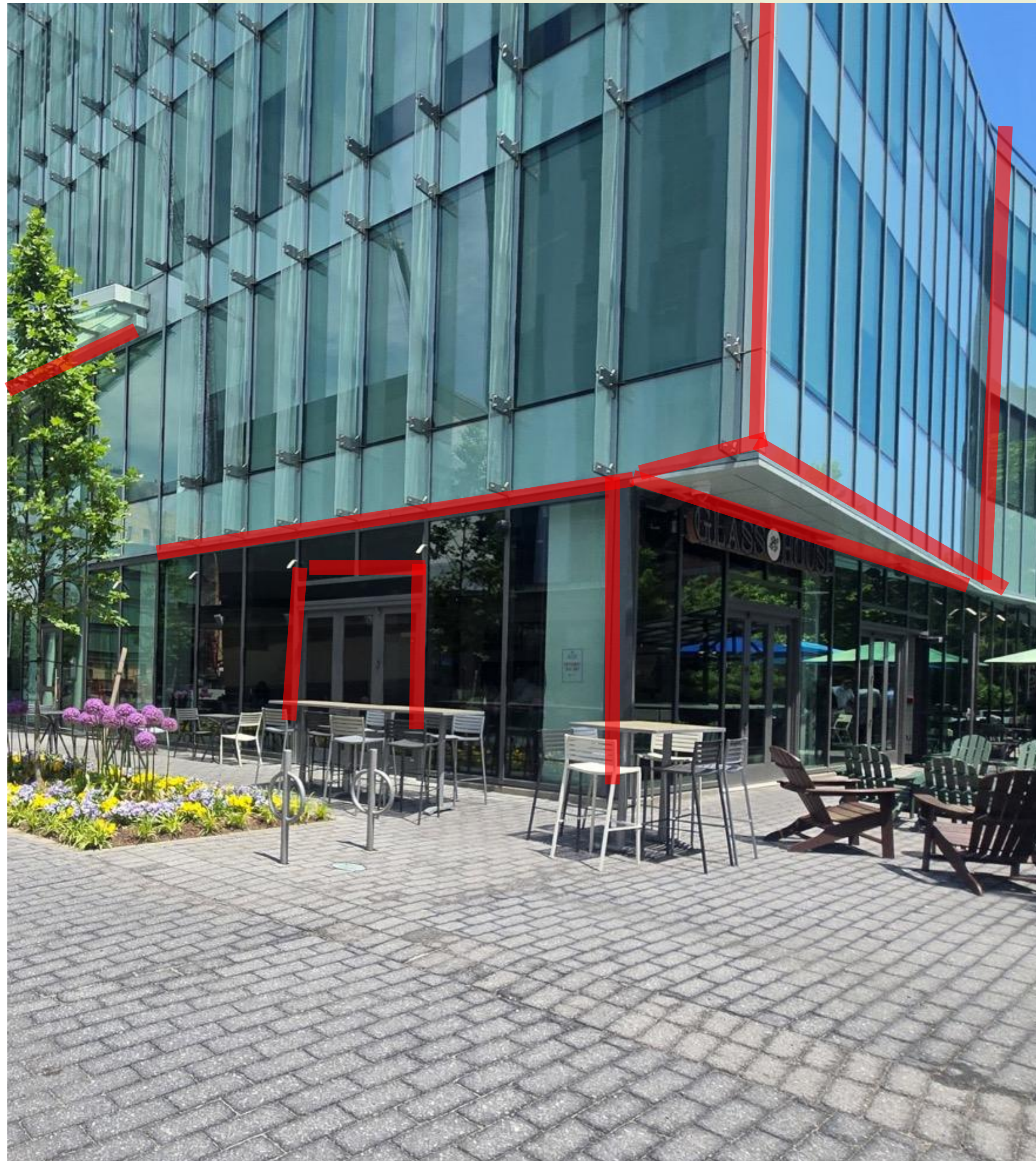
What is a Thermal Bridge?

- Weak spot in a thermal envelope system that allows heat to pass more easily.
- Can include thinner insulation or total lack of insulation.

Linear Thermal Bridge

- Slab Extensions (e.g., balconies)
- Relieving angles
- Changes in envelope systems
- Corners
- Interior wall intersections
- Roof to wall intersections (e.g., parapets)
- Translons to grade
- Changes in plane

- Typically, derated with a PSI (Ψ) value



Point Thermal Bridge

- Discrete locations
- Beam penetrations
- Plumbing penetrations

- Typically, derated with CHI (X) factors

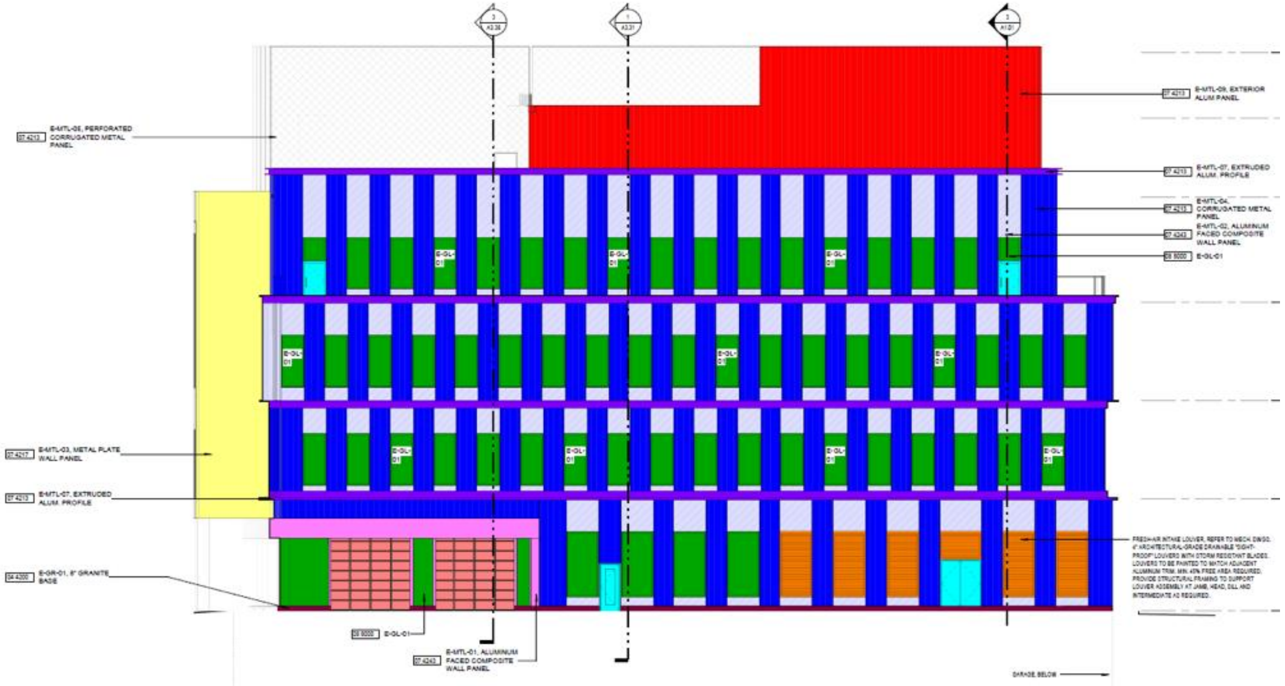
Code Requirements for Thermal Bridges

- Envelope backstop with de-rating

$$U_T = \frac{\Sigma(\Psi \cdot L) + \Sigma(\chi)}{A_{Total}} + U_o$$

Where:

U_T =	total effective assembly thermal transmittance (Btu/hr·ft²·°F or W/m²K)
U_o =	clear field thermal transmittance (Btu/hr·ft²·°F or W/m²K)
A_{total} =	the total opaque wall area (ft² or m²)
Ψ =	heat flow from linear thermal bridge (Btu/hr·ft °F or W/mK)
L =	length of linear thermal bridge, i.e. slab width (ft or m)
χ =	heat flow from point thermal bridge (Btu/hr· °F or W/K)



Consequences of Thermal Bridges

CONDENSATION

INCREASED ENERGY USAGE

Source: iStock

Cynthia L. Staats, P.E., LEED AP

Associate Principal

- Building Enclosure Consultant for 17 years.
- Works with architects, owners, property managers, construction managers, and contractors.
- Pennsylvania State University, Architectural Engineering, B.A.E./M.A.E.
- Interests: Homesteading, nature-related activities.

Reasons Thermal Bridges Arise During Construction

VALUE ENGINEERING

CONSTRUCTION SEQUENCING

CONSTRUCTABILITY

COMPETING PRIORITIES

Reasons Thermal Bridges Arise During Construction

VALUE ENGINEERING

CONSTRUCTION SEQUENCING

CONSTRUCTABILITY

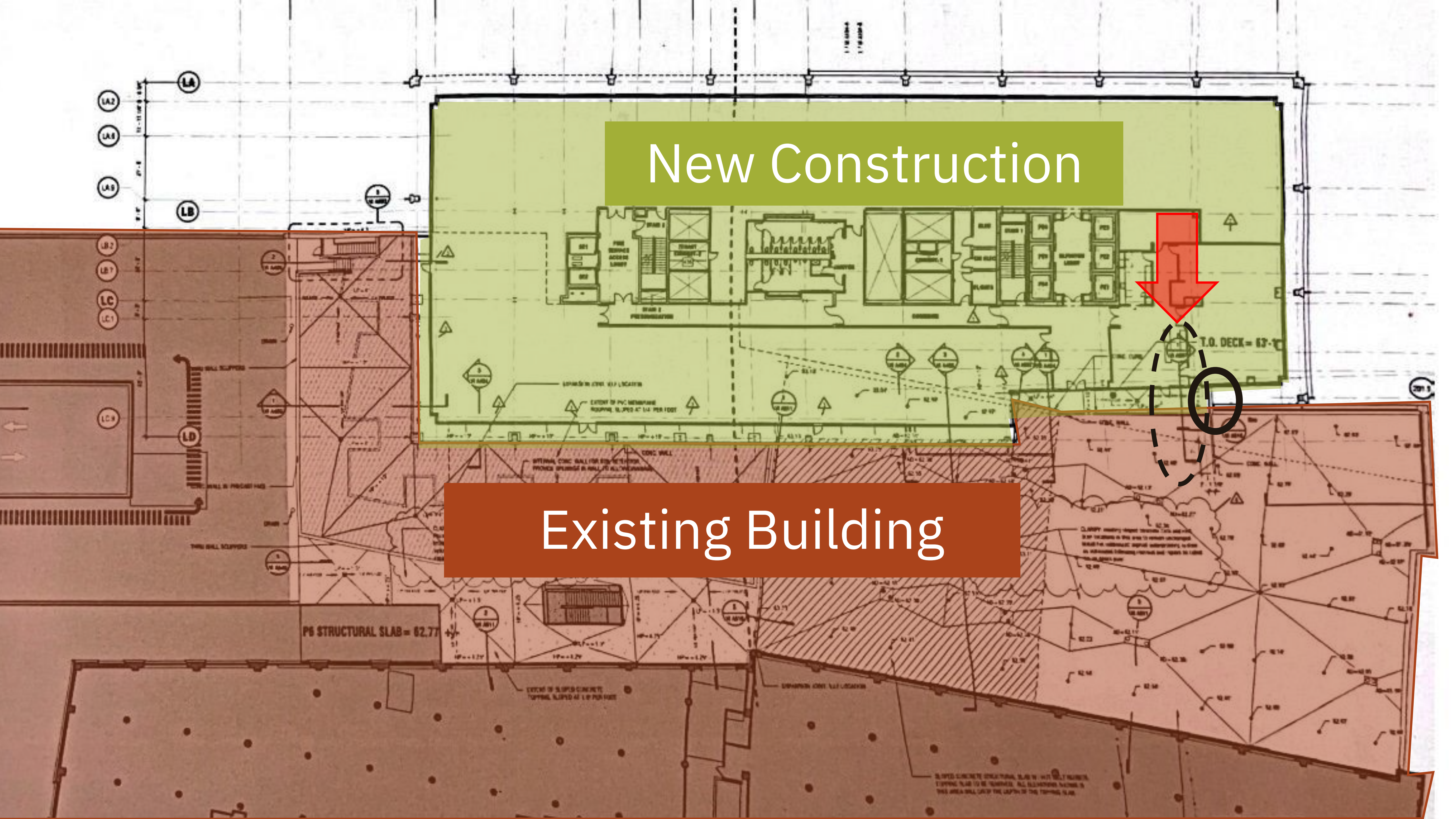
COMPETING PRIORITIES

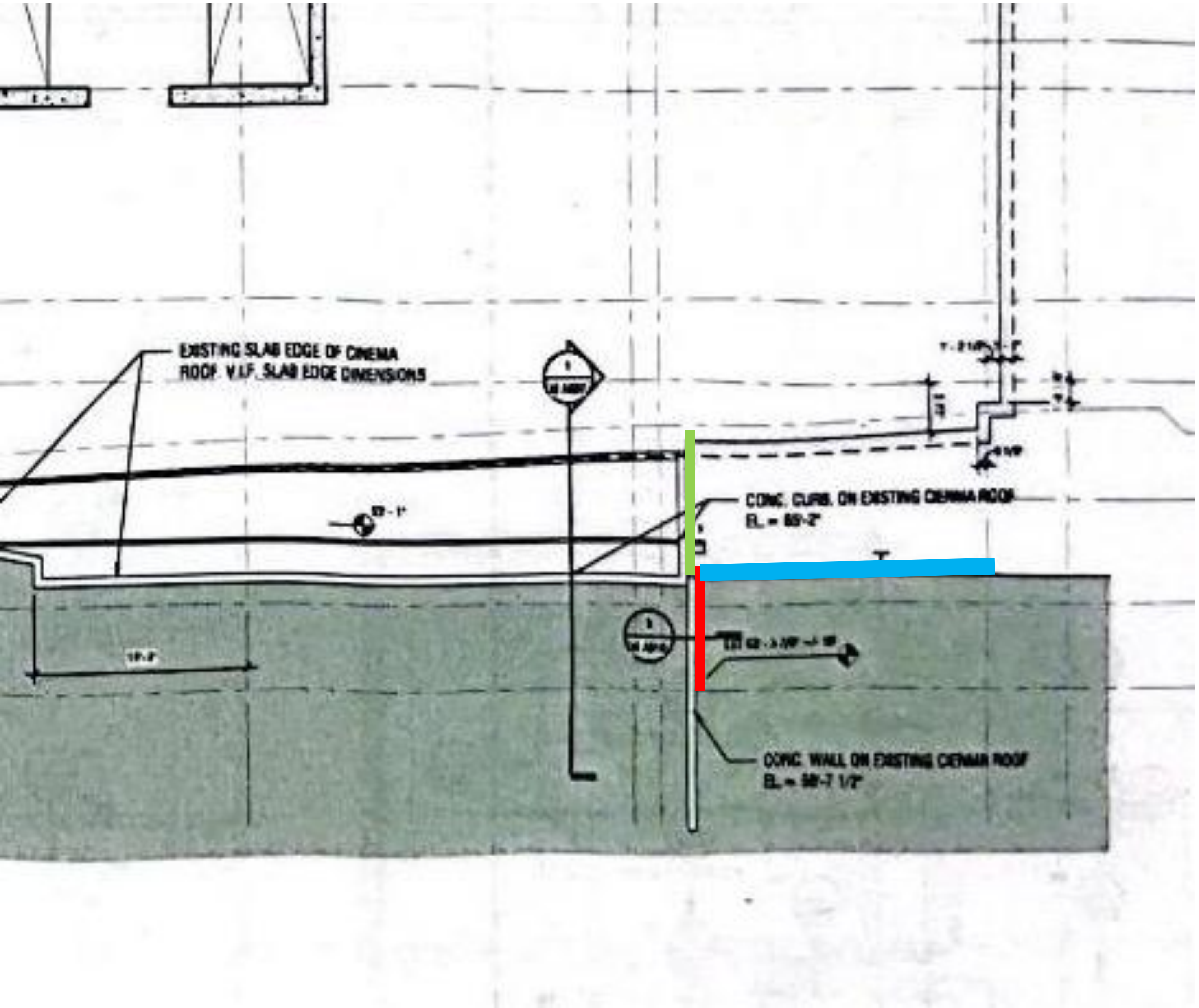
ASSUMPTIONS IN DRAWINGS DO NOT MATCH REALITY

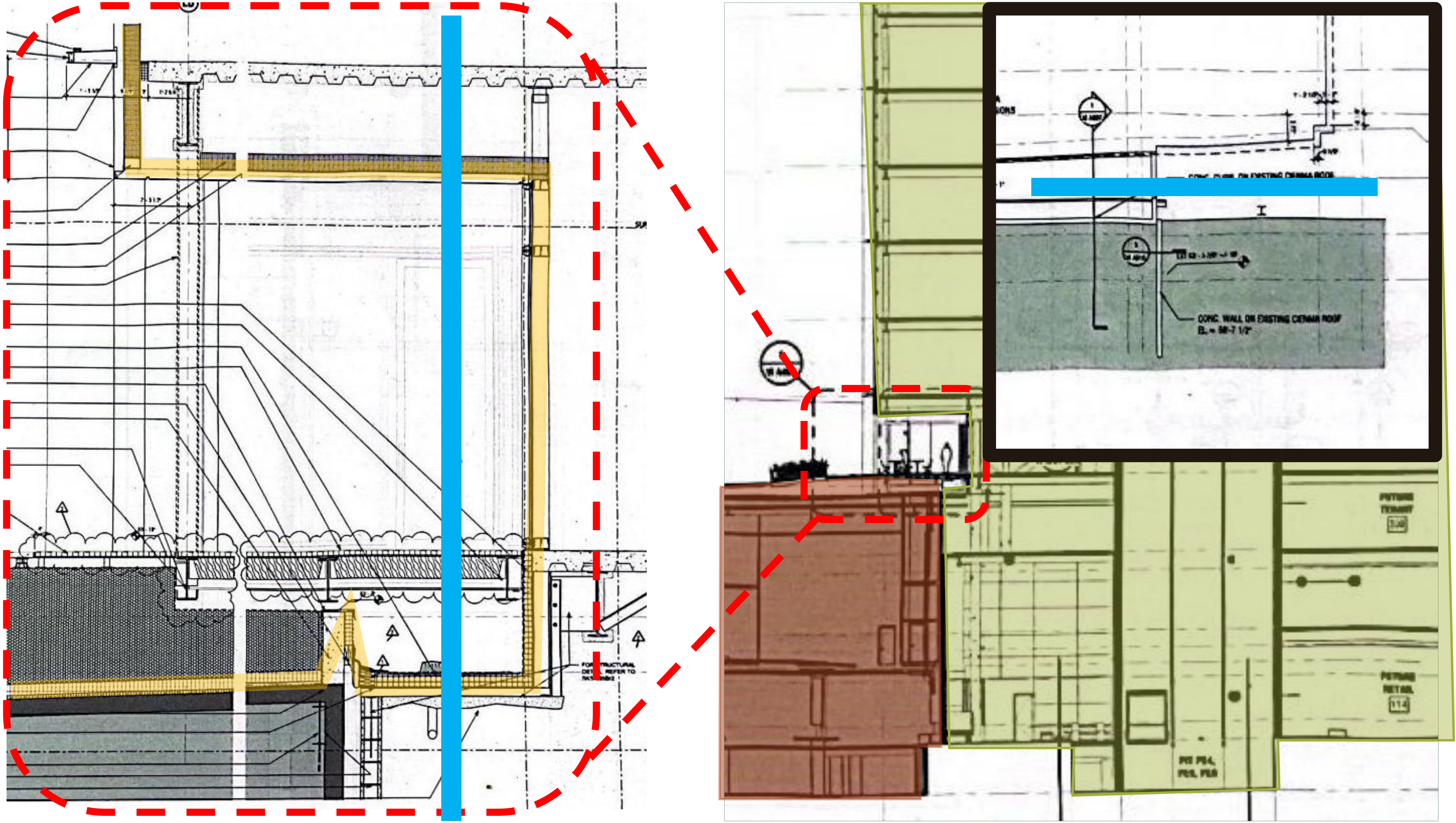
EXISTING CONSTRUCTION

SYSTEM LIMITATIONS

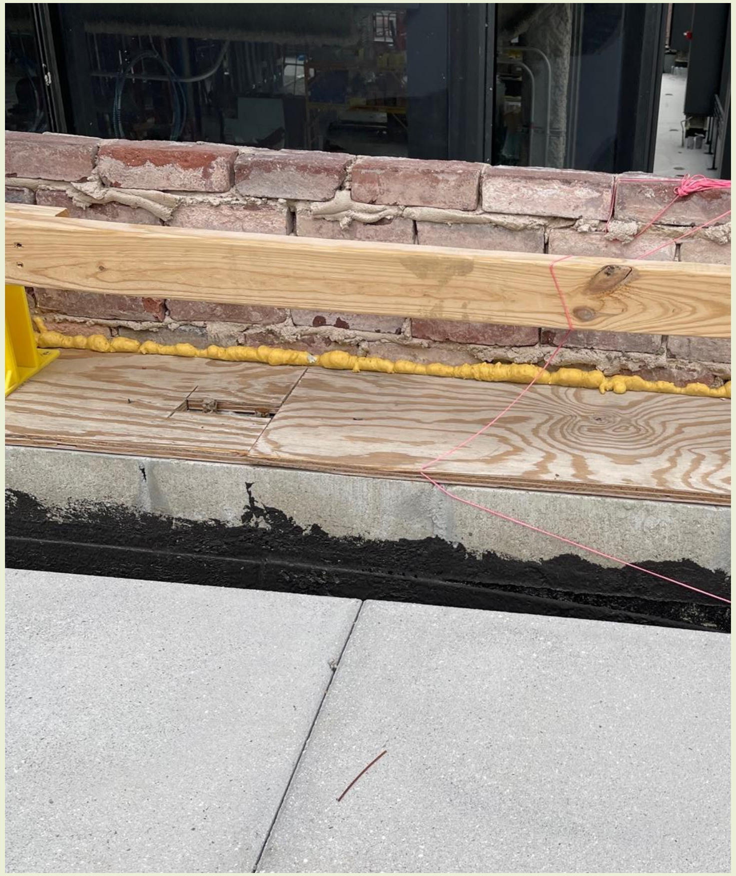
LIMITED TIME FOR THE DETAILS


New Construction
Existing Building
T.O. DECK= 63'-1"
P6 STRUCTURAL SLAB= 62.77


EXISTING SLAB EDGE OF CINEMA
ROOF. V.I.F. SLAB EDGE DIMENSIONS
CONC. CURB. ON EXISTING CIENMA ROOF
CONC. WALL ON EXISTING CIENMA ROOF


CONC. CURB ON EXISTING CINEMA ROOF
CONC. WALL ON EXISTING CINEMA ROOF
FUTURE TENANT
FUTURE RETAIL
114


PYRO

SHEATHING


Reasons Thermal Bridges Arise During Construction

VALUE ENGINEERING

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ASSUMPTIONS IN DRAWINGS DO NOT MATCH REALITY

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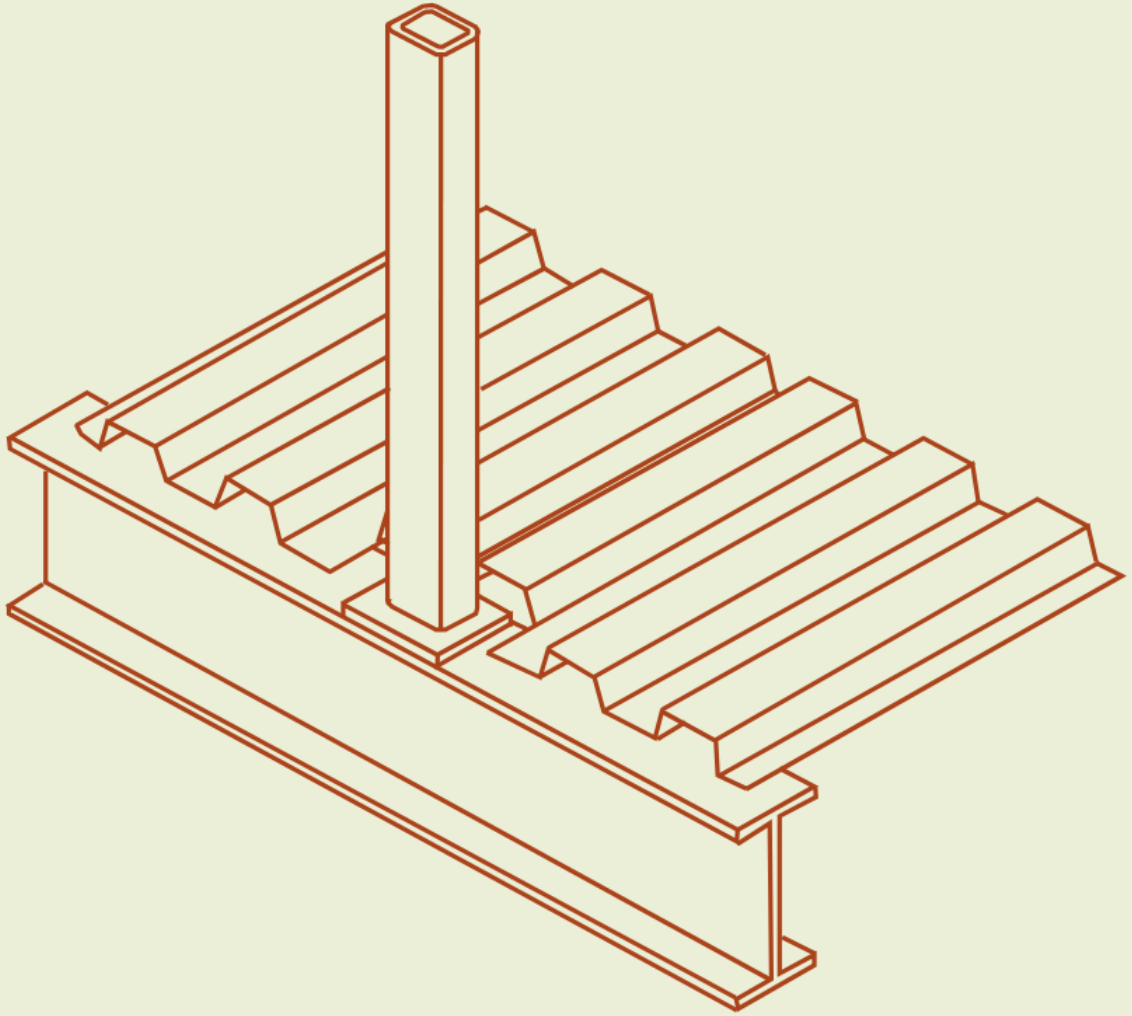
NO TIME FOR THE DETAILS

CONSTRUCTION TOLERANCES

LATE DESIGN CHANGES

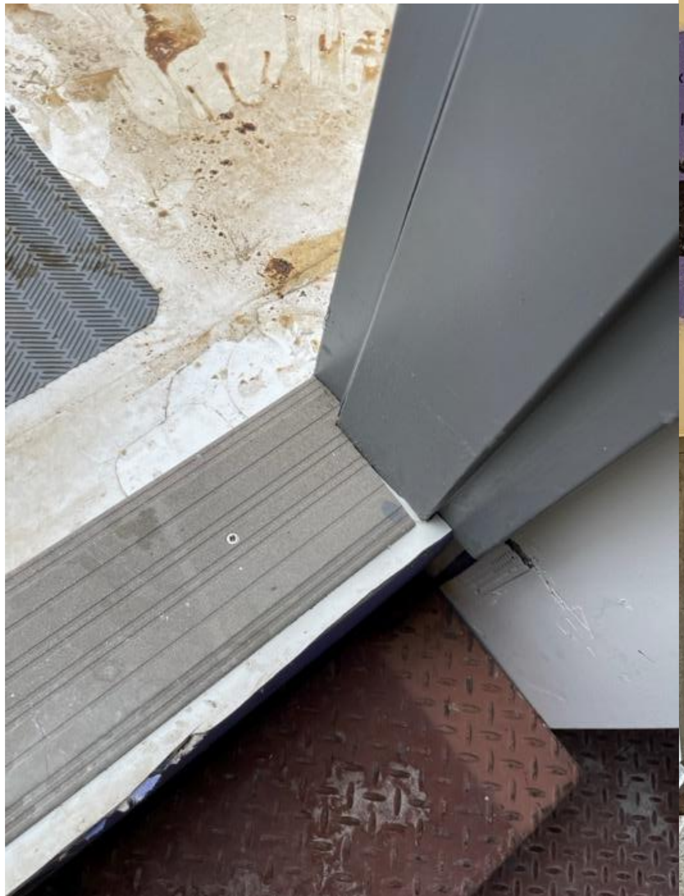
TENANT OR BUYER SPECIAL REQUESTS



Easily Remedied Thermal Bridges

HOLLOW METAL DOORS IN PENTHOUSES

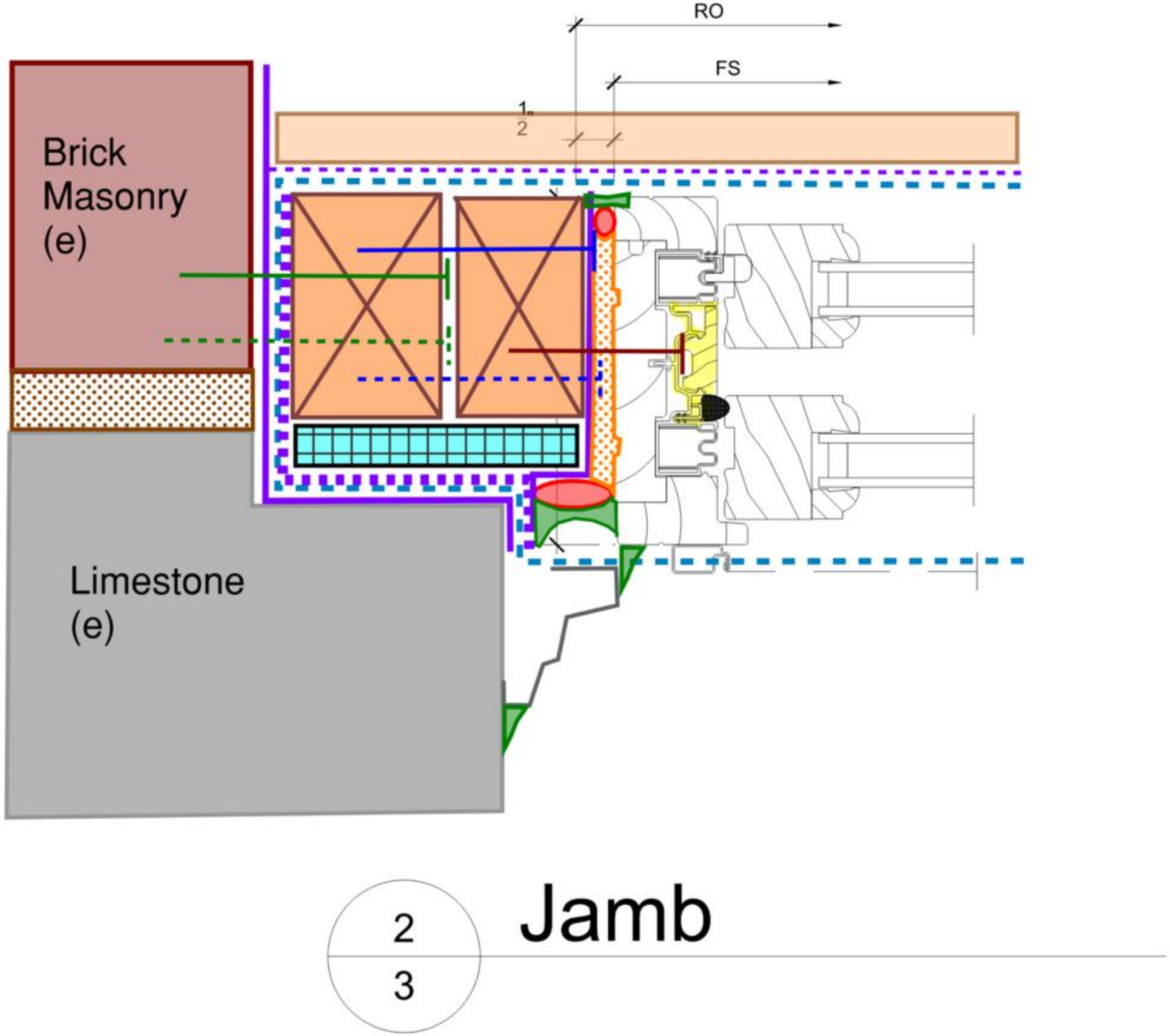
- Solution: Swap out for terrace-style doors
  - Egress option – Thermally broken door



Easily Remedied Thermal Bridges

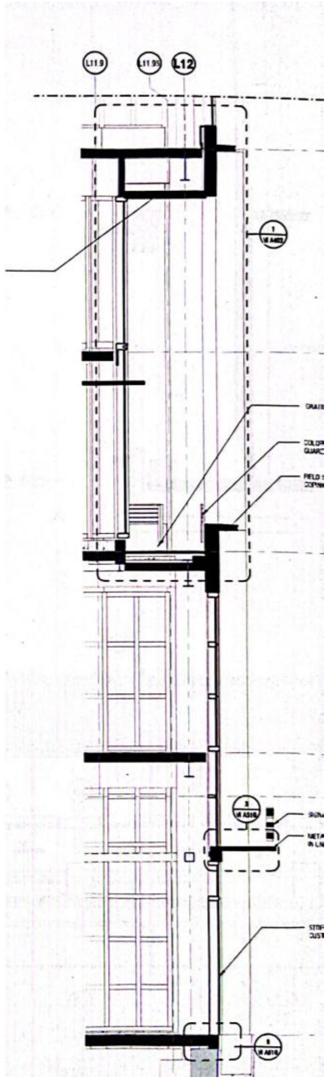
WINDOWS & DOOR ROUGH OPENINGS

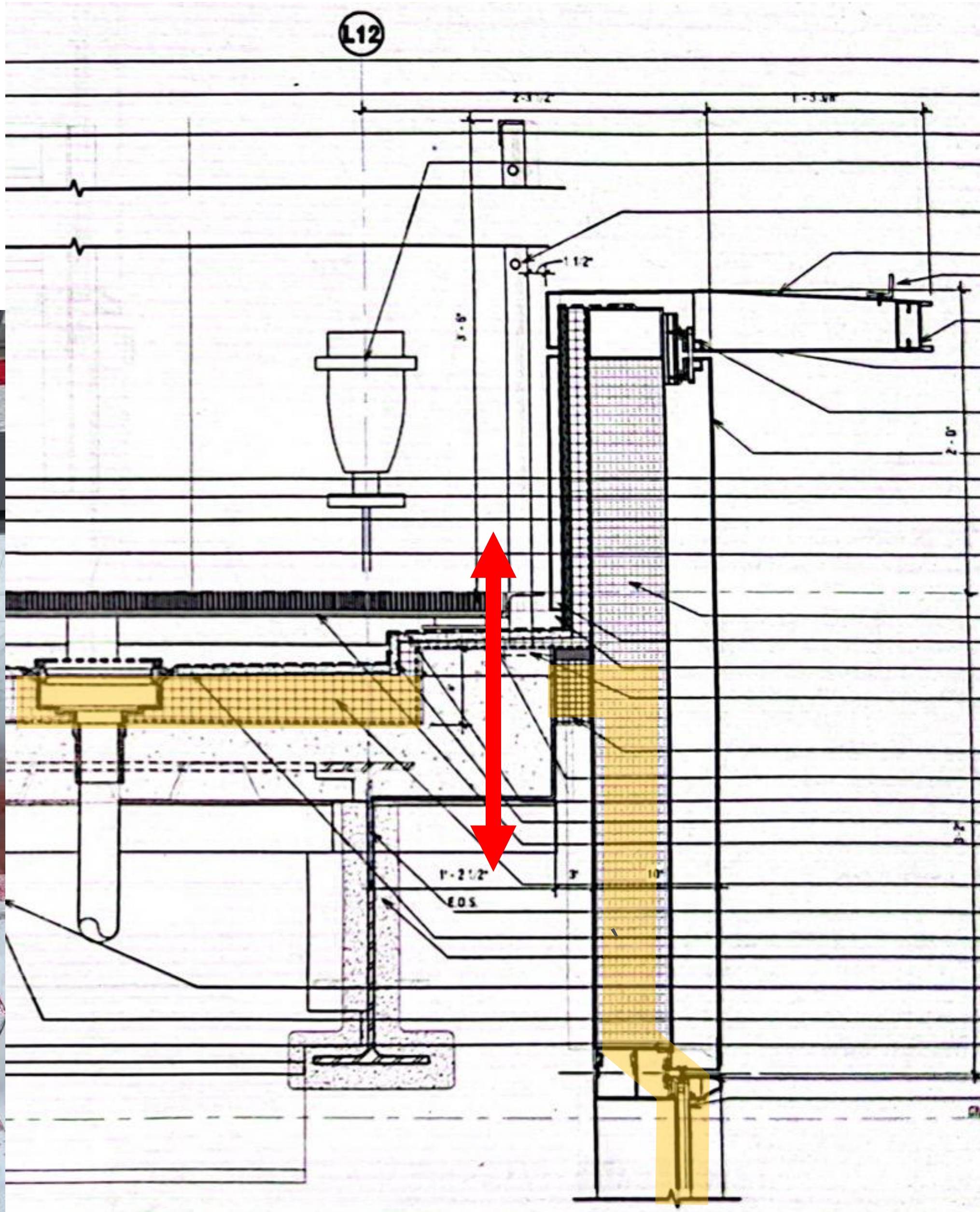
- Solution: Provide space for insulation on cold side of blocking.



Easily Remedied Thermal Bridges

CURTAIN WALLS THAT EXTEND INTO PARAPETS





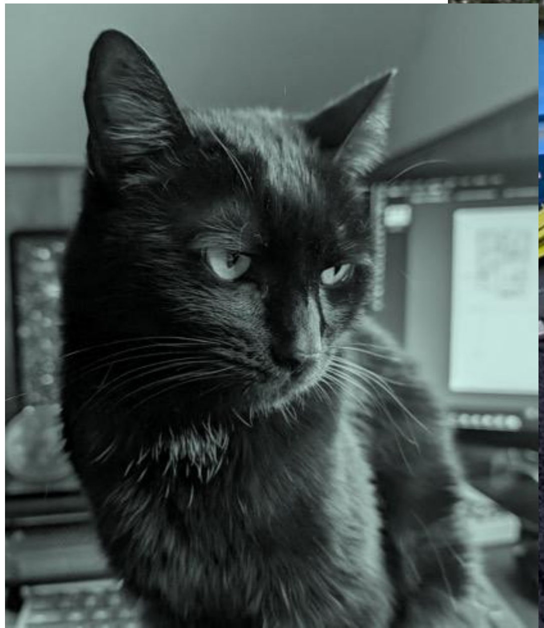
Beware of solving one concern and inadvertently creating another challenge.



Nouha Javed, P.E.

Structural Engineer – Consultant III

- 9 years of structural repair of existing buildings and building enclosures.
- University of Waterloo (B.Sc) and University of Toronto (M.Eng).
- Loves video games, reading, and hanging out with her design partner, Billi!



Overview

- What are structural thermal bridges?
- Mitigation in structural steel and reinforced concrete.
- Thermal Break Pads (TBPs).
- Communication strategies with project team.

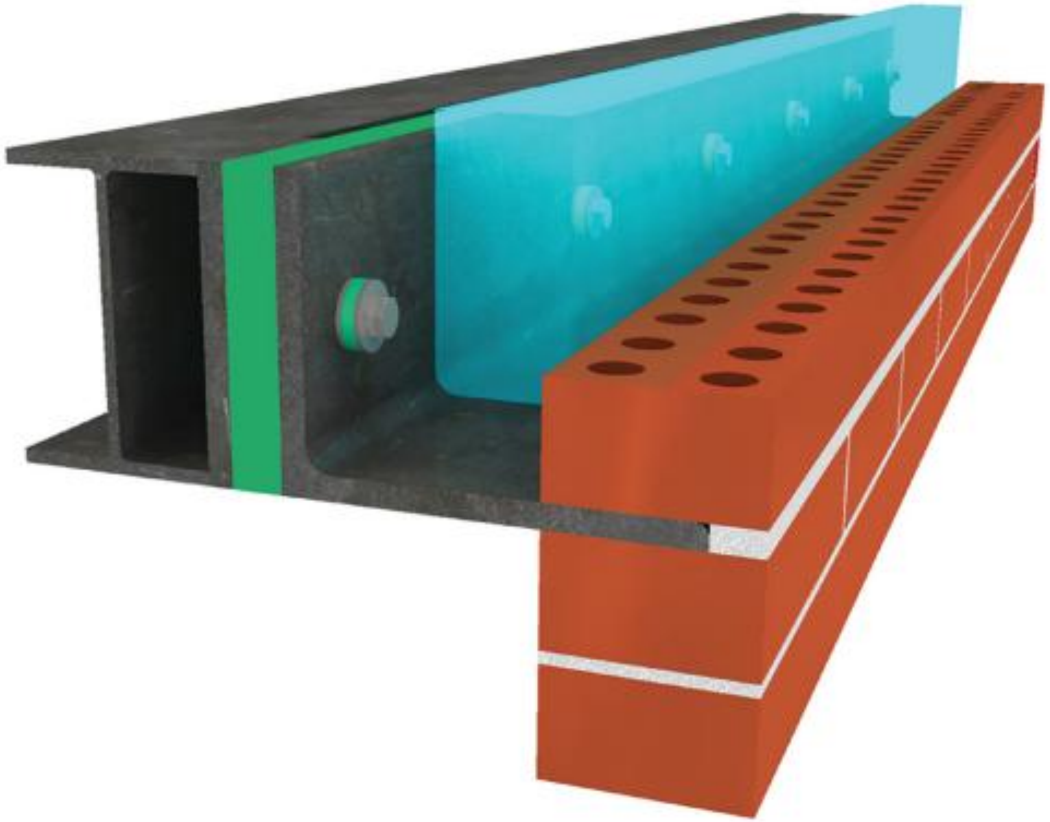
Structural Thermal Bridges

- Balcony/canopy supports (point bridges)
- Steel lintel (linear bridges)
- Dunnage roof supports/fall protection systems
- External staircases

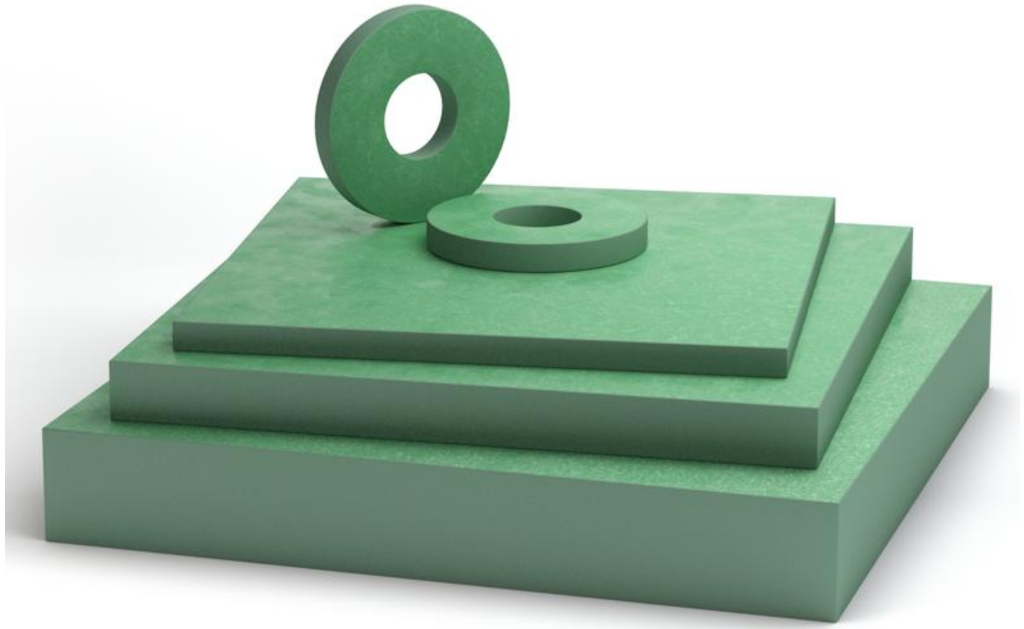
Source: Fabreeka

Mitigating Structural Thermal Bridges

STRUCTURAL STEEL



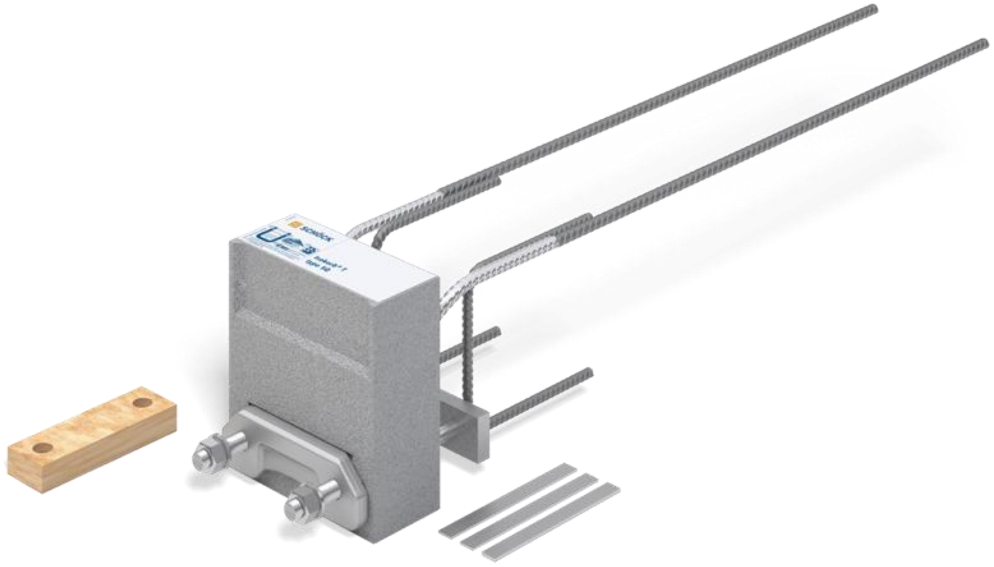
Source: Fabreeka



Source: Fabreeka

Mitigating Structural Thermal Bridges

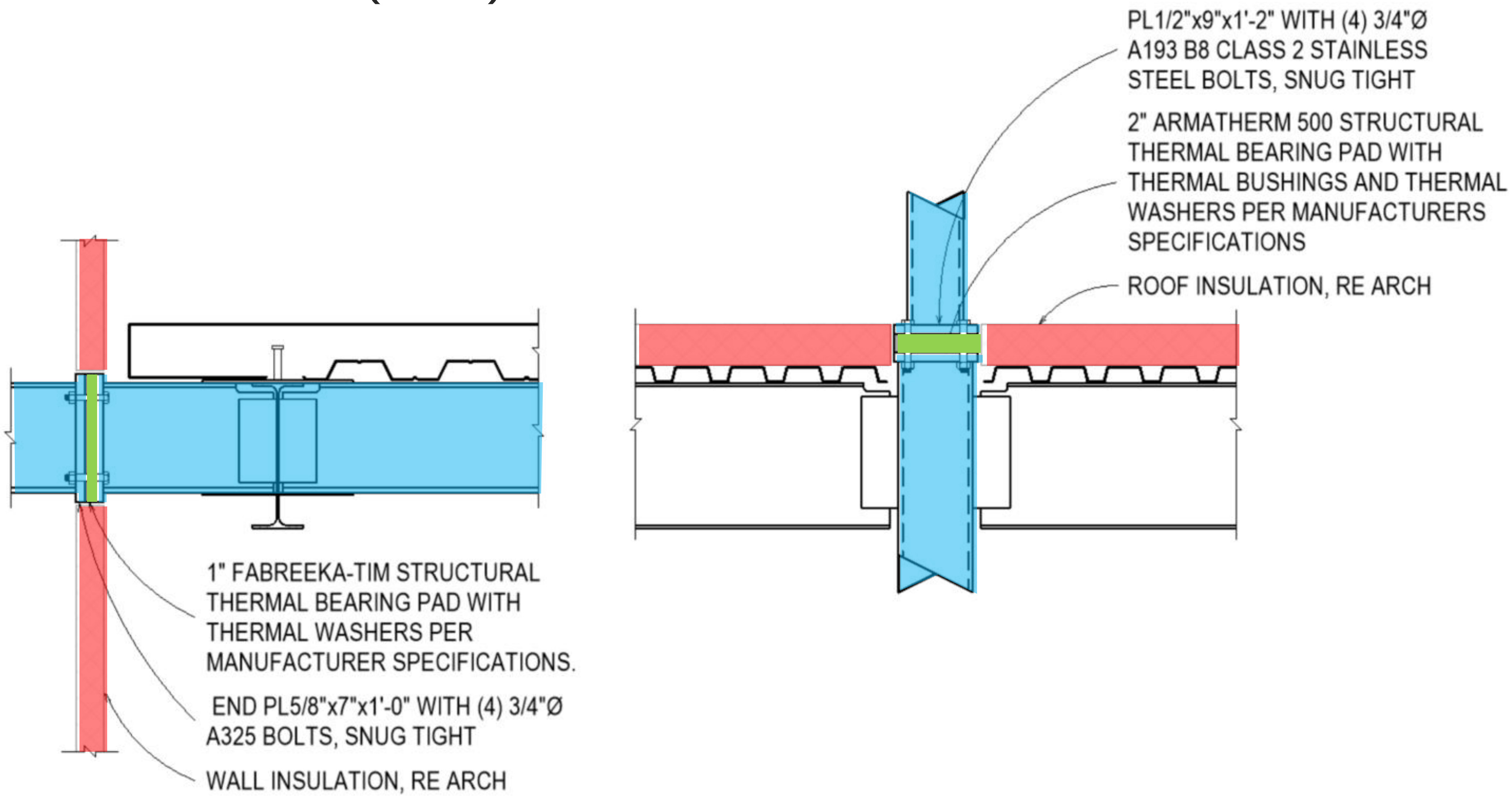
REINFORCED CONCRETE



Source: Schöck USA, Inc.

Source: Beodom.com

Thermal Break Pads (TBPs)



Source: “Thermal Breaks In Structural Steel” by SEAC/RMSCA Steel Liaison Committee

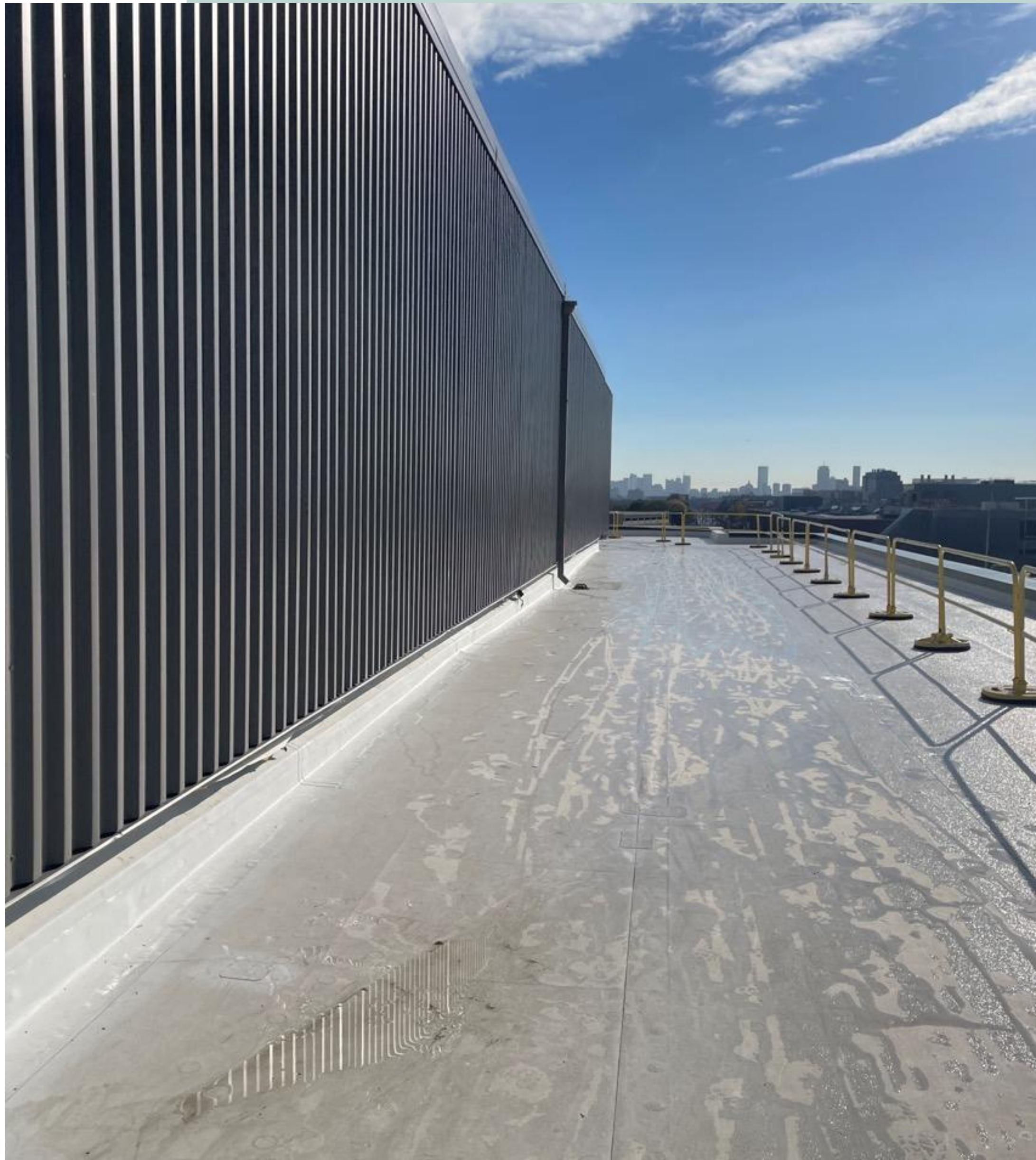
Strategies with Other Design Partners

- Architects/Enclosure Consultants
  - Design phases may not be concurrent
  - Material and thickness of TBP impacts structural connection design
- Manufacturers
  - Design of products is evolving
- General Contractors/Fabricators
  - In-field modifications can be difficult

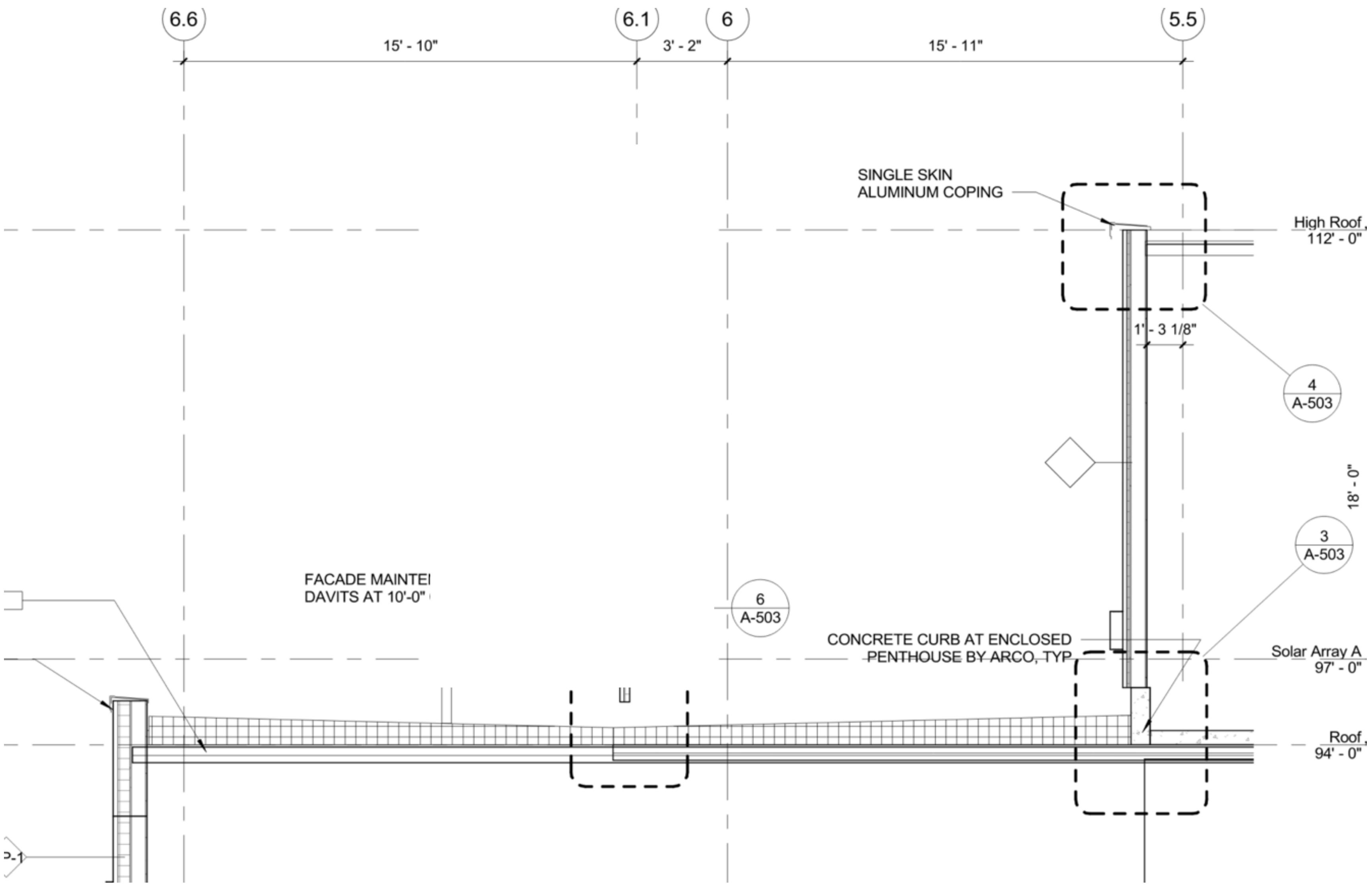
Source: “Structural Thermal Break” by Jake Miller, published on Green Building Advisor

Case Study – Roof to PH Wall

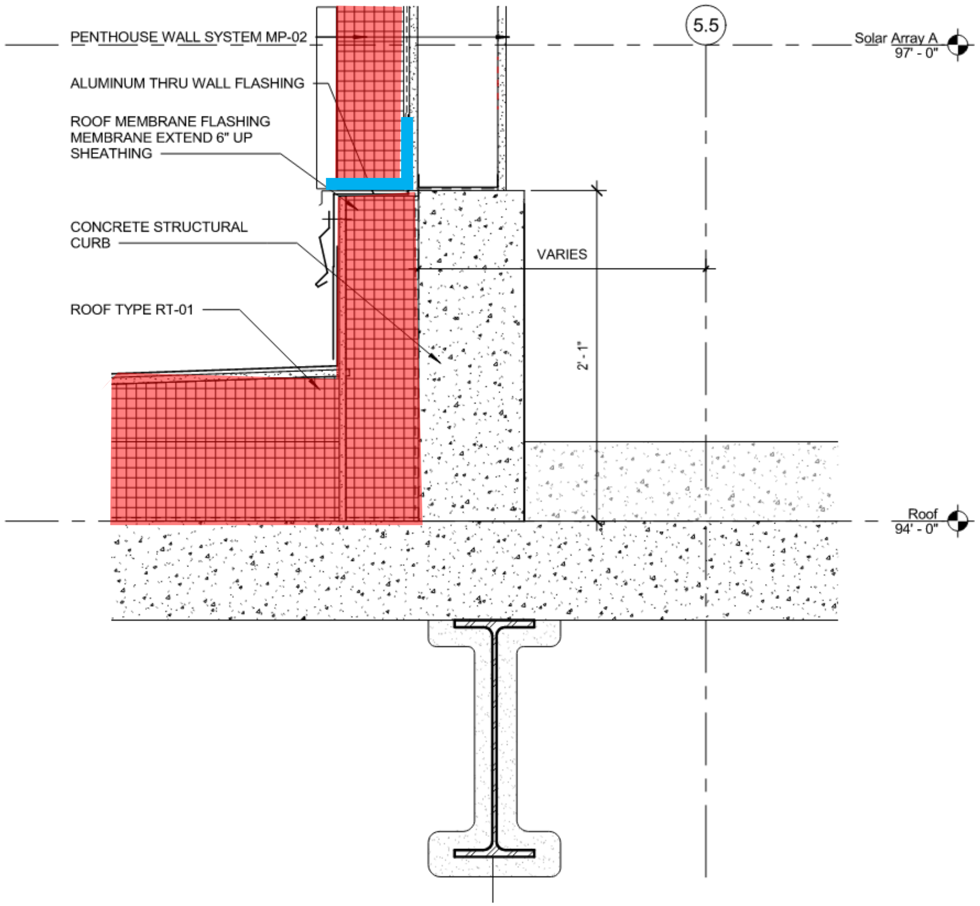
- Roof installed after penthouse walls
- Required installing under existing materials
- Warranty requirements for wall termination



Case Study – Overview

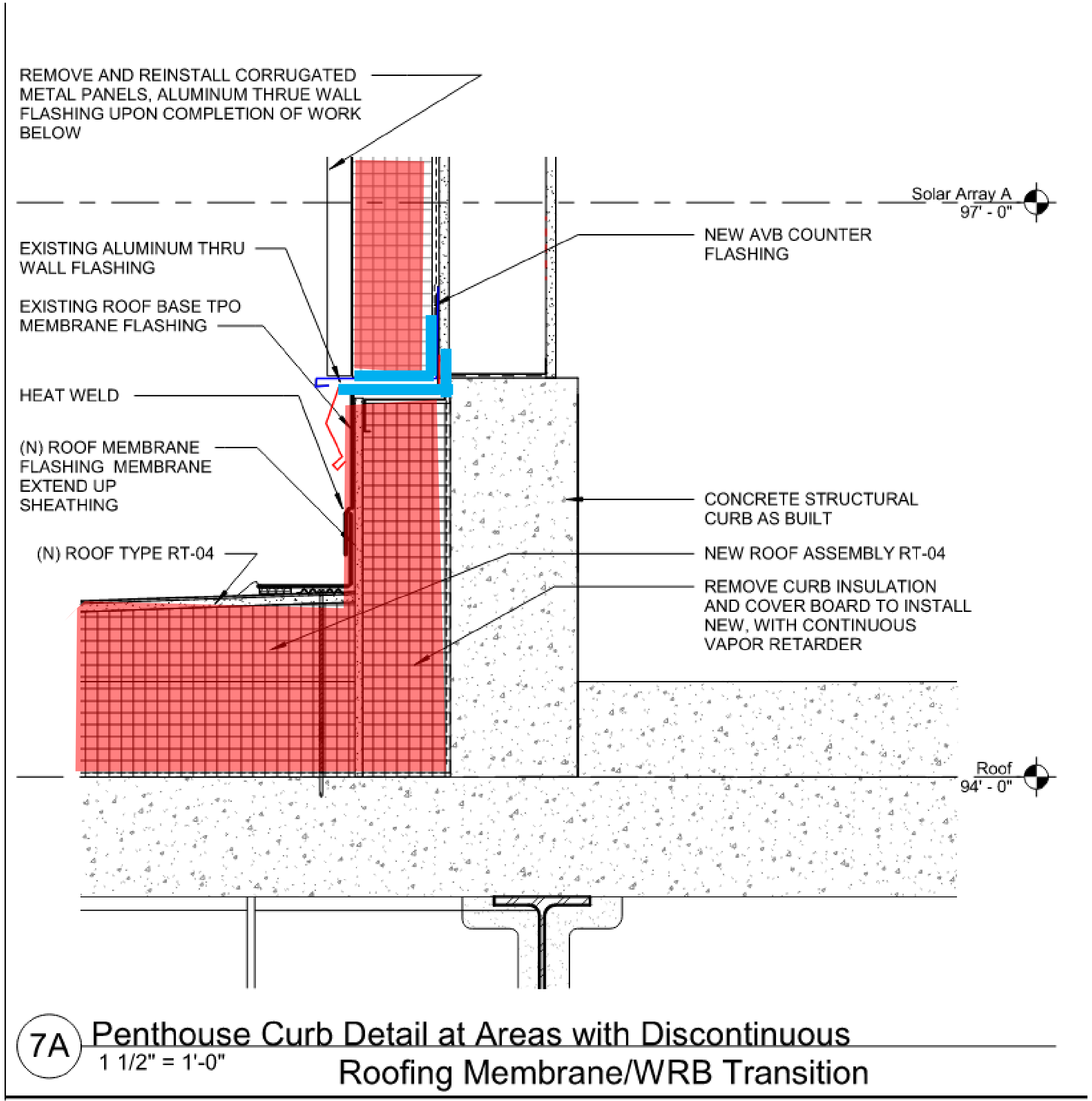


Case Study – Roof to PH Wall - Original



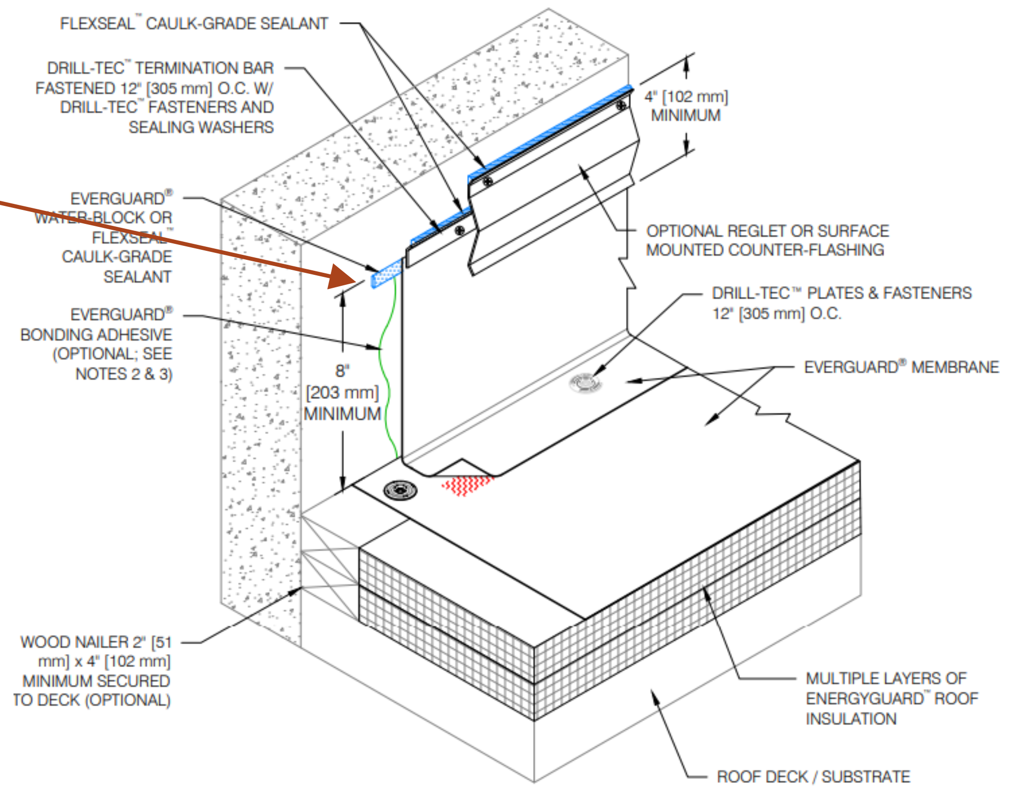
3 Section Detail Penthouse wall/floor
1 1/2" = 1'-0"

Case Study – Roof to PH Wall – Re-Order



Case Study – Manufacturer’s Requirements

Manufacture requires direct attachment to back-up wall



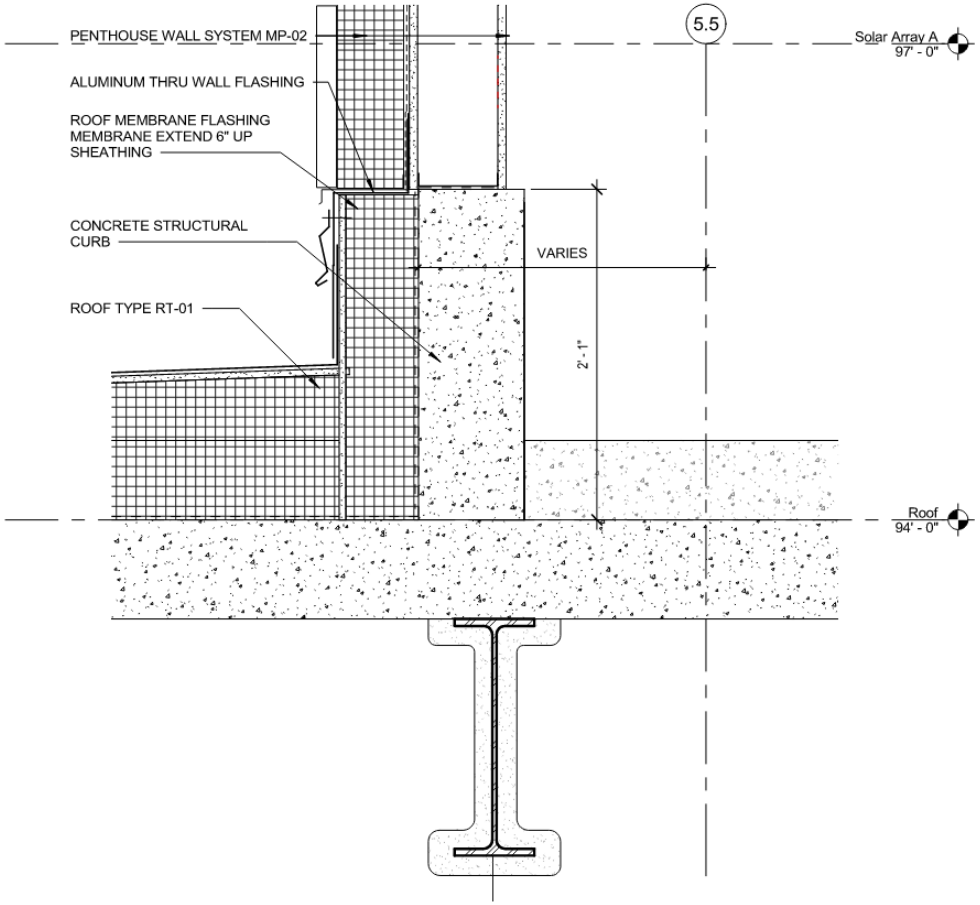
NOTES:

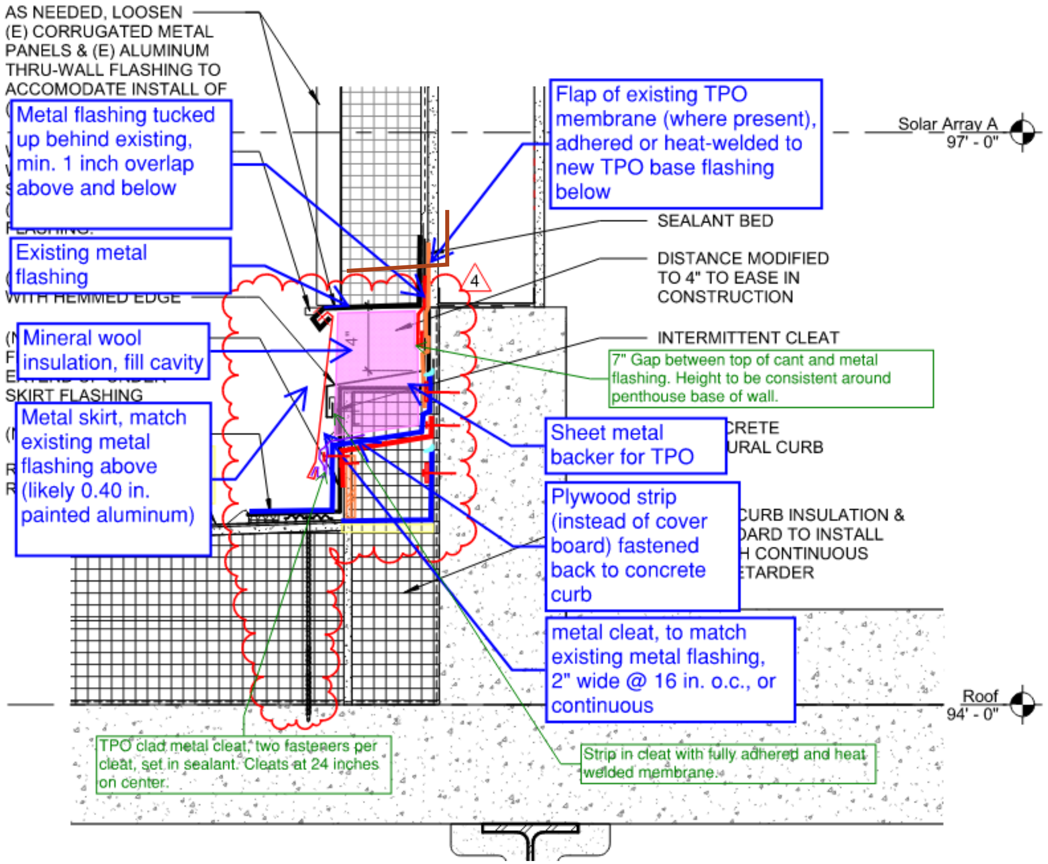
1. EXISTING REGLET IS ACCEPTABLE IF METAL IS IN GOOD CONDITION.
2. IF EVERGUARD® SA MEMBRANE IS USED, BONDING ADHESIVE IS NOT NEEDED AND WALL MUST BE PRIMED.
3. IF EVERGUARD® SMOOTH BACK MEMBRANE IS USED FOR WALL FLASHING, ADHESIVE IS REQUIRED FOR HEIGHTS 30" - 66" [762 mm - 1.68 m].
4. EXPOSED WALLS/CURBS MUST BE WATERPROOFED AND MAINTAINED ABOVE THE BASE FLASHING IN ORDER FOR ANY SURFACE-MOUNTED TERMINATION TO BE EFFECTIVE.

Case Study – Contractor Proposal

Case Study – Roof to PH Wall – Mock-up

Case Study – Roof to PH Wall – Side by Side





3 Section Detail Penthouse wall/floor
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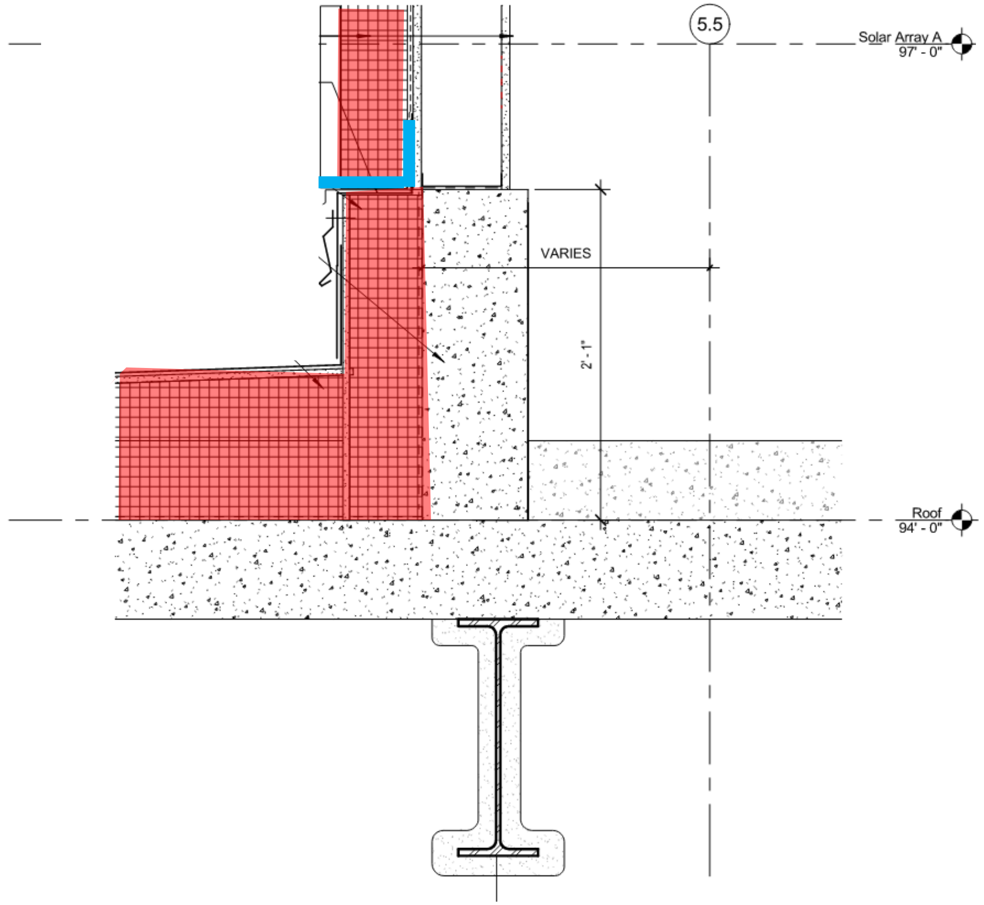
Case Study – Roof to PH Wall – Side by Side



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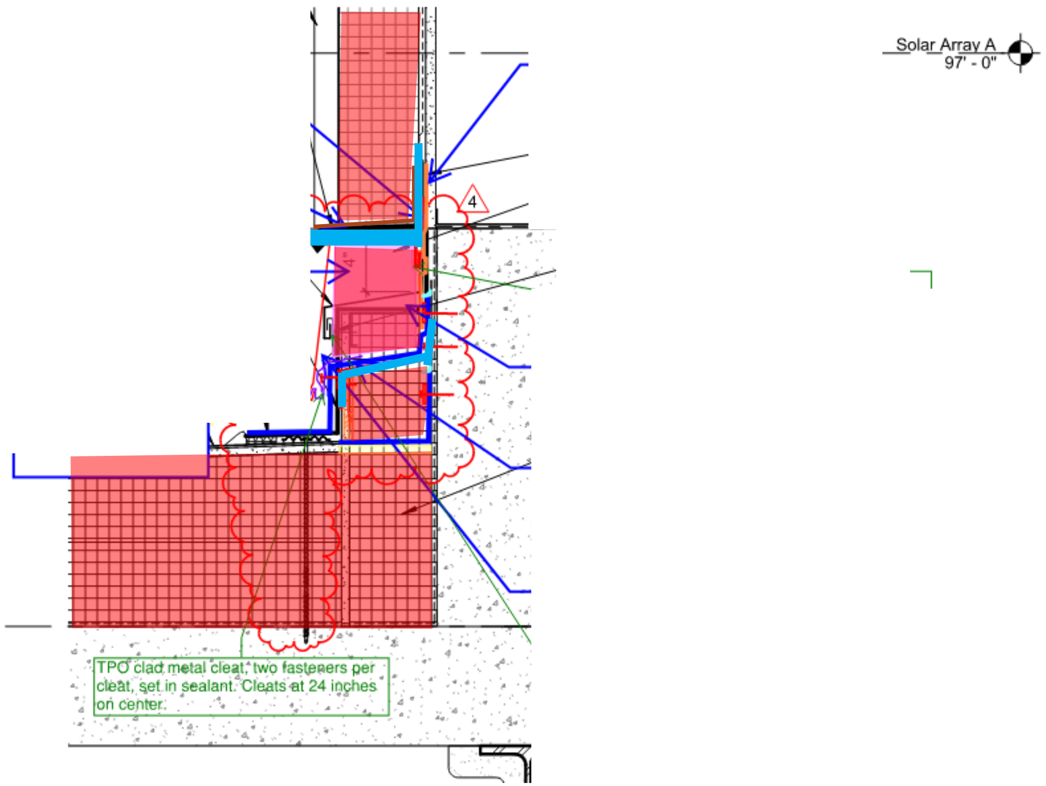

Case Study – Roof to PH Wall – Installation

Case Study – Roof to PH Wall – Wrap Up

- Order of operations matters.
- Apparently simple construction can become complex.
- Resolution may require multiple trades and non-traditional materials for envelope systems.
- Mock-ups to verify constructability.

Learning Objectives

- Identify thermal bridges in the building enclosure that arise during construction.
- Analyze solutions to mitigate thermal bridging challenges during the construction phase.
- Identify strategies to proactively communicate with stakeholders regarding design and construction coordination related to thermal bridging.
- Define how to execute complex geometry in accordance with models and details in the context of new energy codes and best practices for sequencing work in the field.

Let’s Talk!

Laura K. Bashaw
Building Enclosure - Consultant IV

(617) 633-4998
lbashaw@BuildingES.com

Nouha Javed
Structural Engineer - Consultant III

njaved@BuildingES.com

Cynthia L. Staats
Building Enclosure - Associate Principal

(617) 633-3270
cstaats@BuildingES.com