Durability, Termites, and Moisture

FLORIDA BUILDING ENCLOSURE DESIGN

WOODWORKS, MAY 2019

COLIN SHANE | PRINCIPAL

RDH BUILDING SCIENCE

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

Course Description

- Building enclosures are responsible for controlling heat flow, air flow, vapor flow and a number of other elements. In Florida, they are also essential for termite prevention. This presentation will explore design considerations associated with wood-frame building enclosures and the role of control layers in addressing items such as durability, termite prevention and control, and thermal continuity.

Learning Objectives

- → Review building science fundamentals and building enclosure design considerations for wood-frame buildings in hot and humid regions.
- → Explore the role of control layers in building enclosures for elements such as heat flow, bulk water intrusion and air flow.
- → Identify the types of termites found in Florida and understand their paths of entry into building structures and the damage they may cause.
- → Understand and apply the termite protection requirements of the Florida Building Code for multi-family and commercial projects.

Typical Details

Water, Air, Heat, Vapor… and Insects

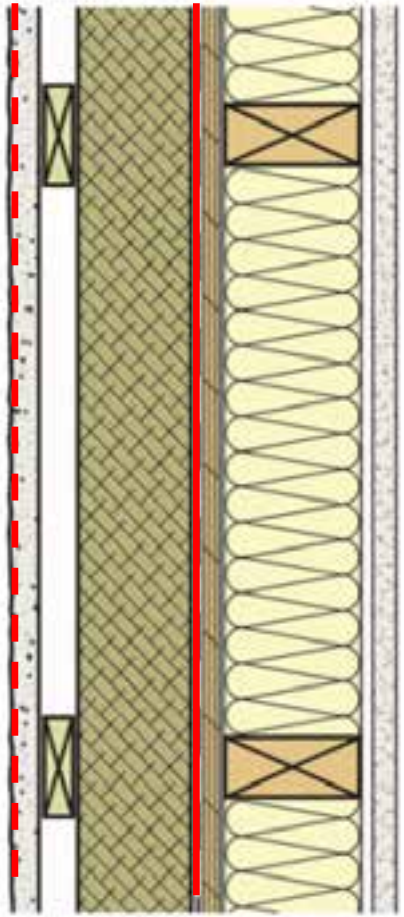
Building Enclosure Design Fundamentals

- → **Support**
  - → Structural loads
  - → Structural movements
- → **Control**
  - → Water penetration
  - → Air flow
  - → Vapor diffusion / condensation
  - → Heat flow
  - → Insects
  - → Light and solar radiation
  - → Noise, fire, and smoke
- → **Finish**

Assemblies

→ Systems (often multiple layers) that support, control, and finish – heat, air, water, insects, etc.

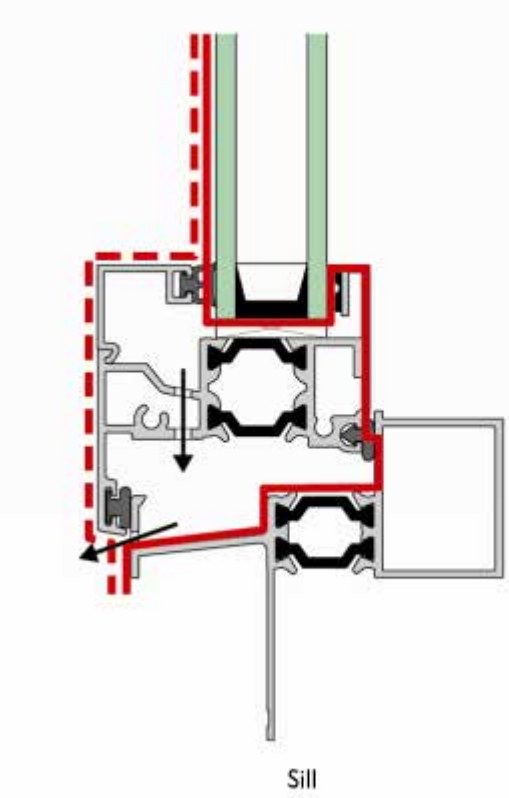
→ Define layer in each assembly



EXTERIOR

- Cladding
- Airspace (ventilated)
- 1x3 wood strapping, screwed through Insulation
- Rigid, mineral-fibre insulation (thickness to meet R-value requirement)
- Vapor impermeable sheathing membrane
- Sheathing (plywood or OSB)
- 2x4 or 2x6 wood framing with batt insulation
- Gypsum board and paint

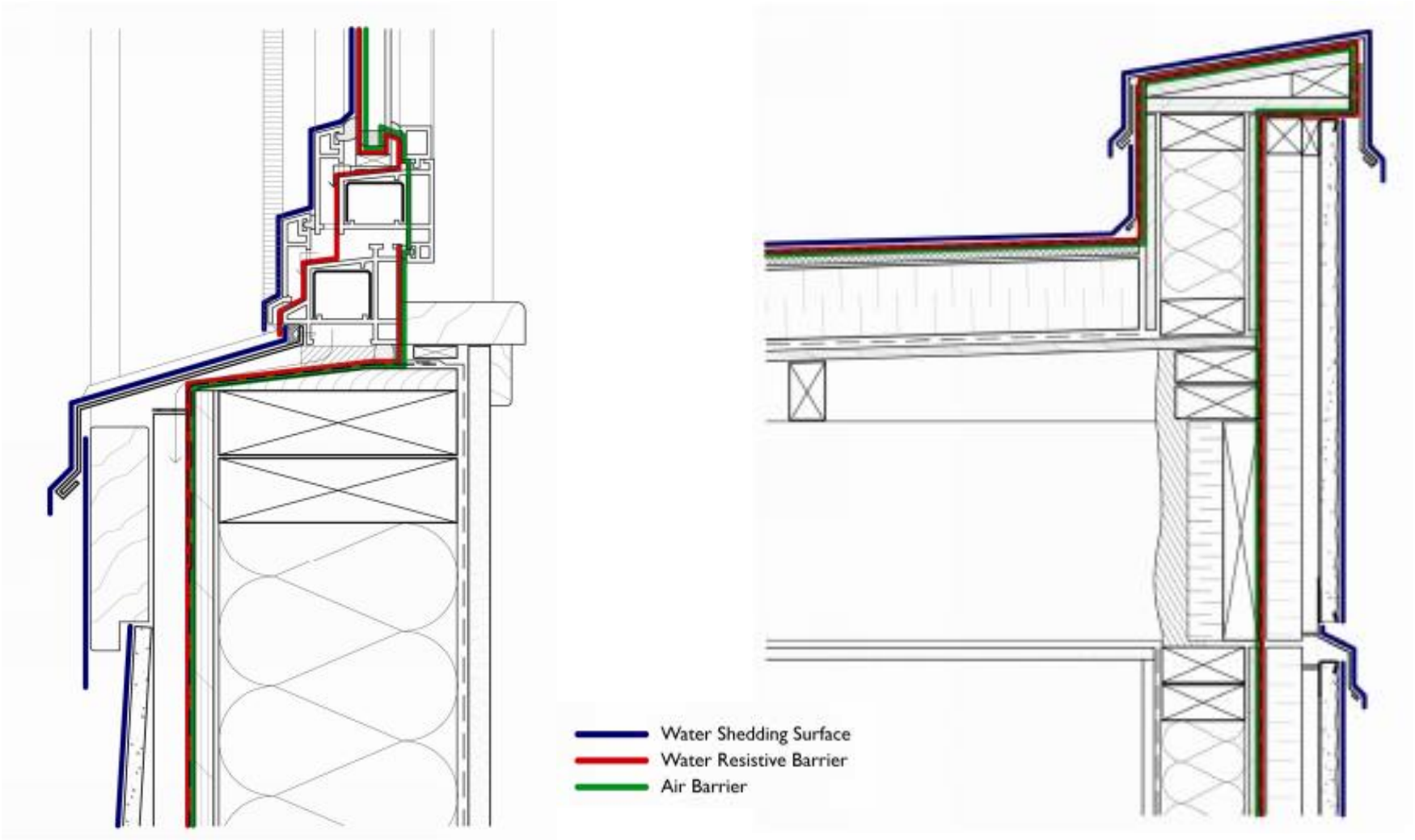
INTERIOR



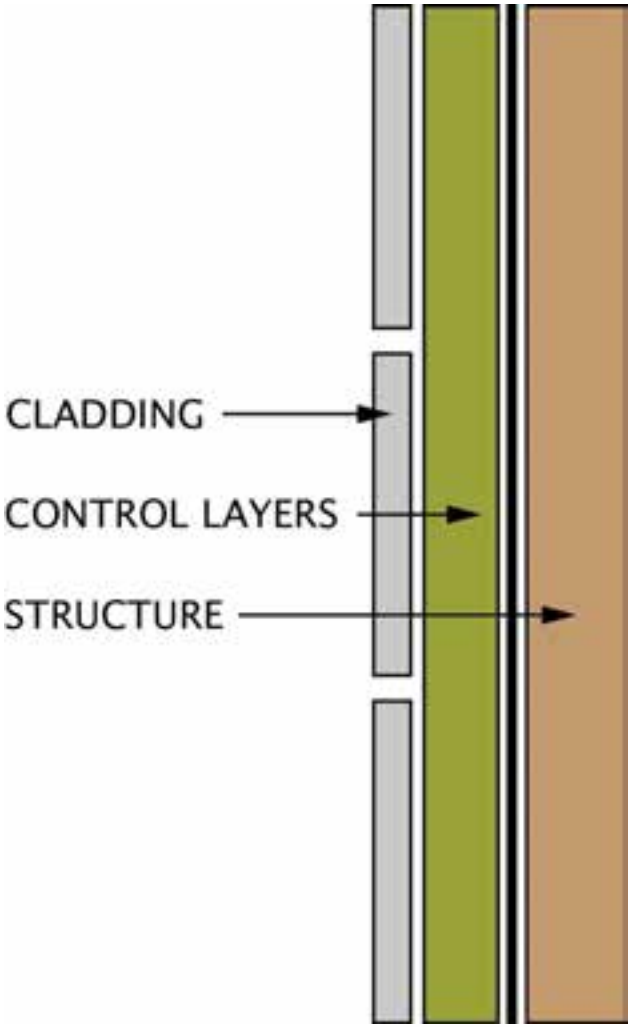
Sill

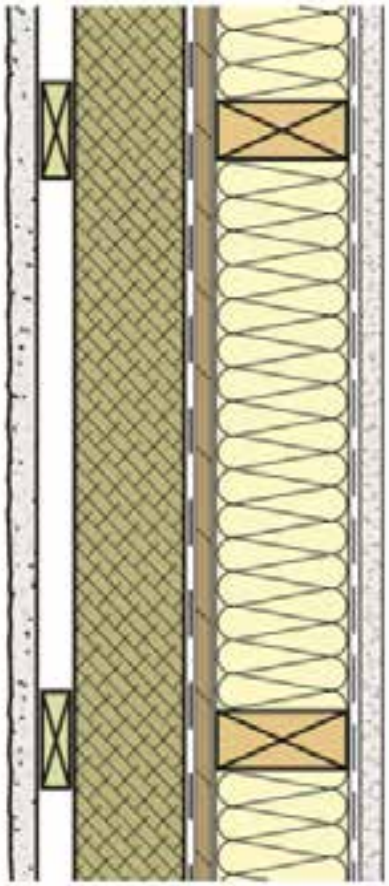
Details – Assemblies Coming Together

→ Then connect the lines



Wood-Frame Assemblies – 'Really Good' Wall



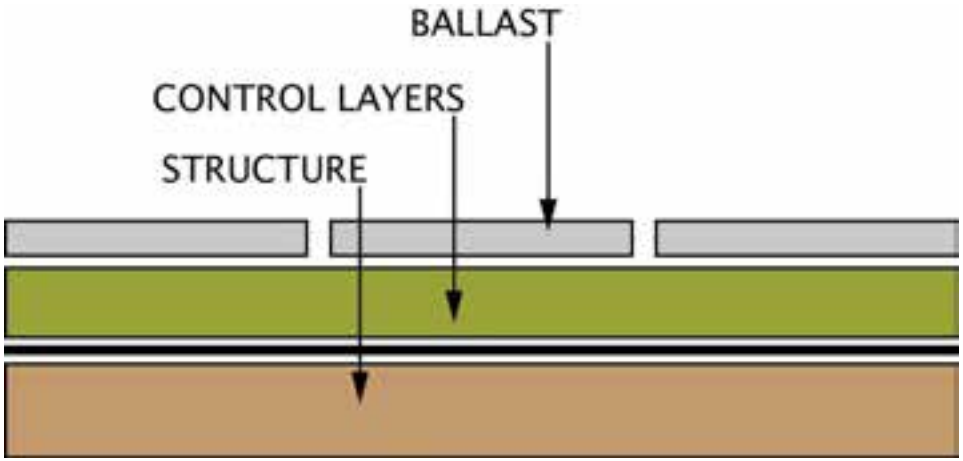


EXTERIOR

- Cladding
- Airspace (ventilated)
- 1x3 wood strapping, screwed through Insulation
- Rigid, mineral-fibre insulation (thickness to meet R-value requirement)
- Vapour-permeable sheathing membrane
- Sheathing (plywood or OSB)
- 2x4 or 2x6 wood framing with batt insulation
- Polyethylene film (cold climates only)
- Gypsum board and paint

INTERIOR

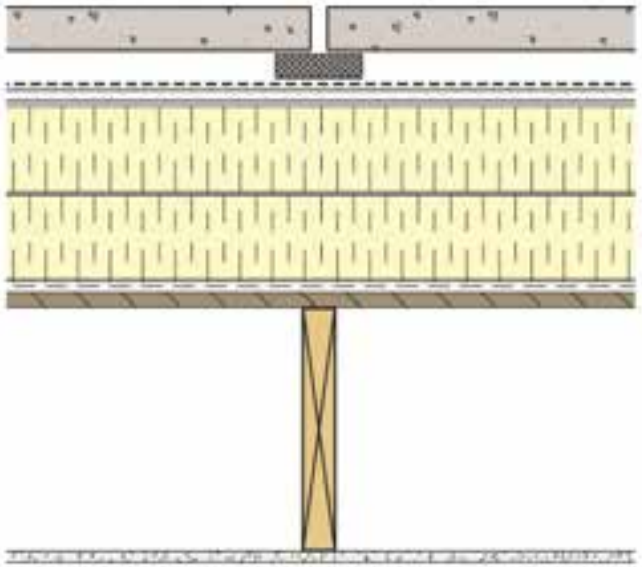
Wood-Frame Assemblies – 'Perfect' Roof



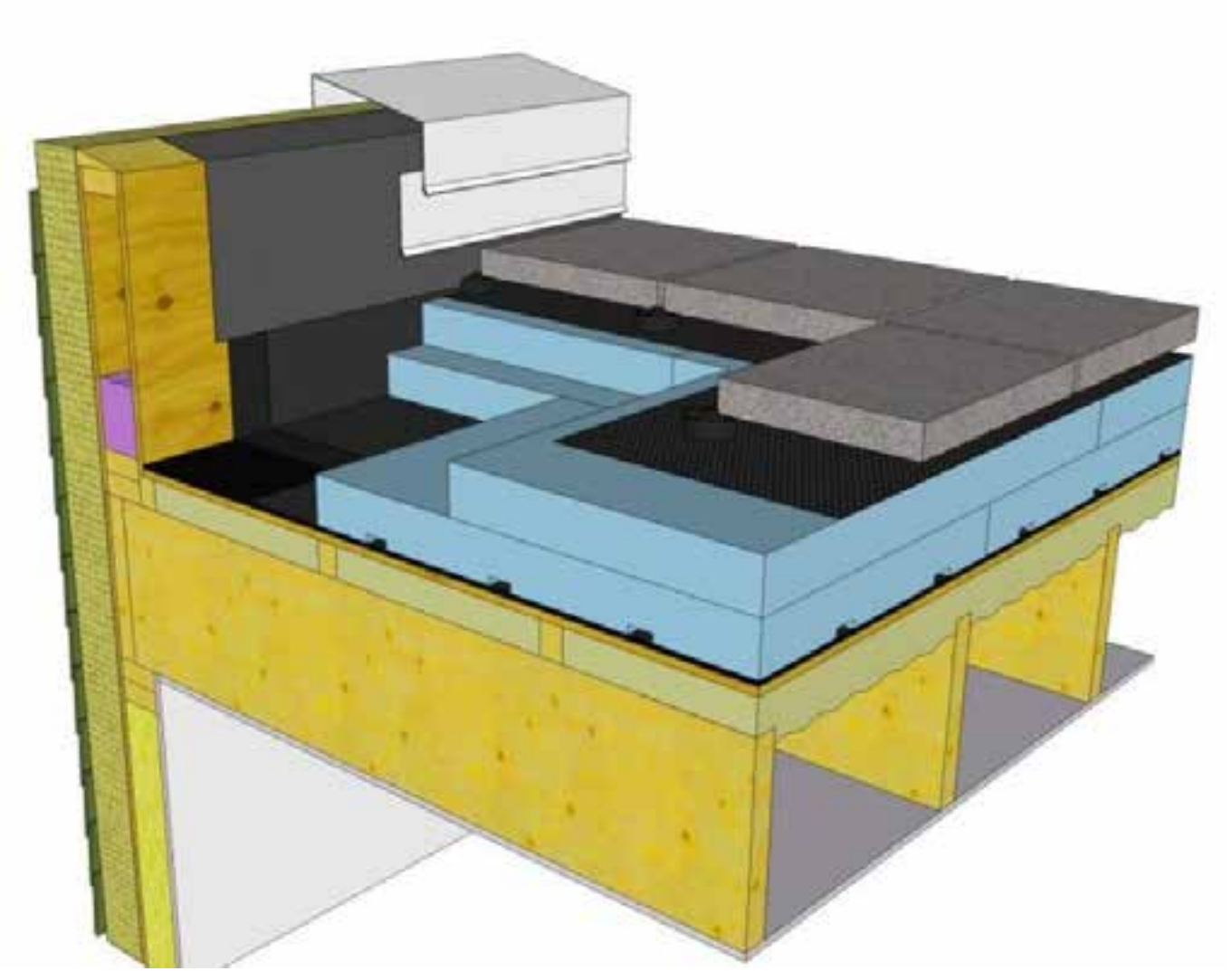
EXTERIOR

- Pavers and pedestal system (roof deck)
- Waterproof roof membrane system
- Protection board
- Rigid insulation layers
- SAM air/vapour barrier
- Roof sheathing
- Roof joists
- Interior gypsum board

INTERIOR



Wall-to-Roof Detail - Continuity



Control Layer Materials

- → Water Control Materials
  - → Water resistive barrier membranes
  - → Glass, metal, concrete, roof membranes
- → Air Control Materials
  - → Air barrier membranes
  - → Glass, metal, concrete, roof membranes
- → Vapor Control Materials
  - → Kraft paper, foil, closed cell foam
- → Heat Control Materials
  - → Insulation
- → Termite Control Materials?
  - → Metal, concrete, various membranes

Continuity is Key

- → Very often, continuity of air control layer materials can also serve as termite barrier continuity
- → Challenge with termites is that small deficiencies can lead to problems
  - → Small air leak a relatively low risk on its own
- → Couple good airtightness details with the 6 S's
  - → Suppression
  - → Site management
  - → Soil barrier
  - → Slab/foundation
  - → Structure durability
  - → Surveillance

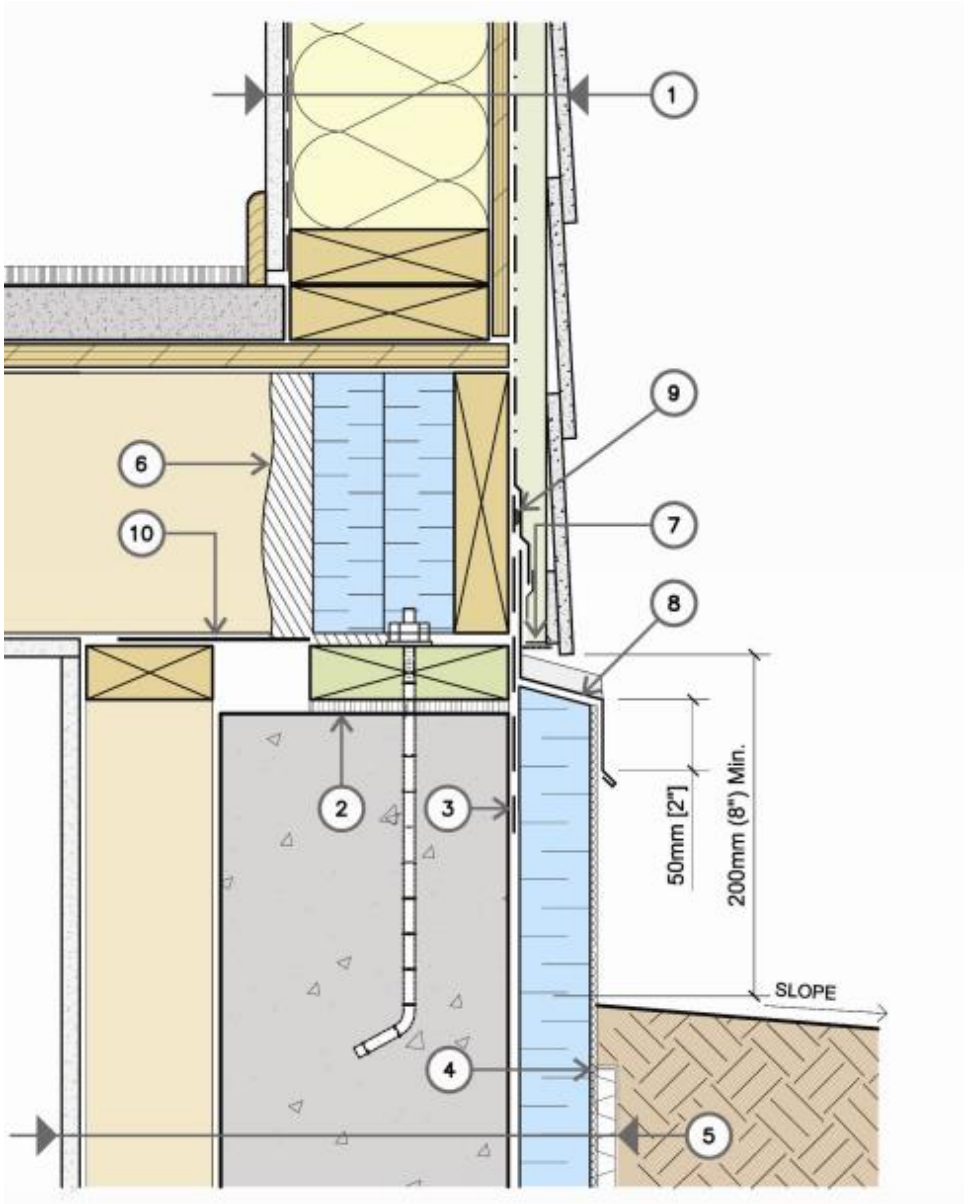
Base of Wall: Non-Termite Area

→ Good continuity of control layers

→ Note membrane and metal flashing connecting wood-frame to concrete

  → This can be termite-proof if installed continuously

→ But foam at foundation violates “Surveillance” and “Slab” principles

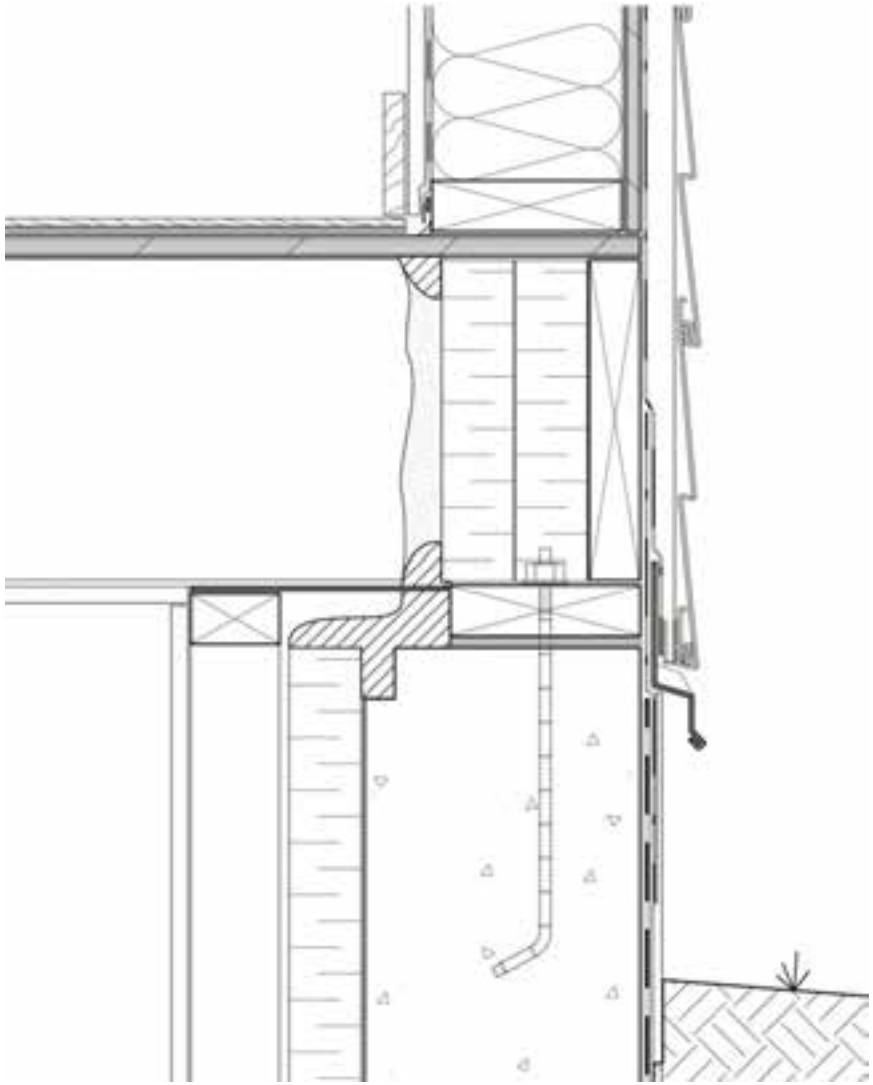


Base of Wall: Termite Area

→ Allow for “surveillance” of perimeter concrete slab

→ Provide airtight membrane continuity between base of wood and concrete.

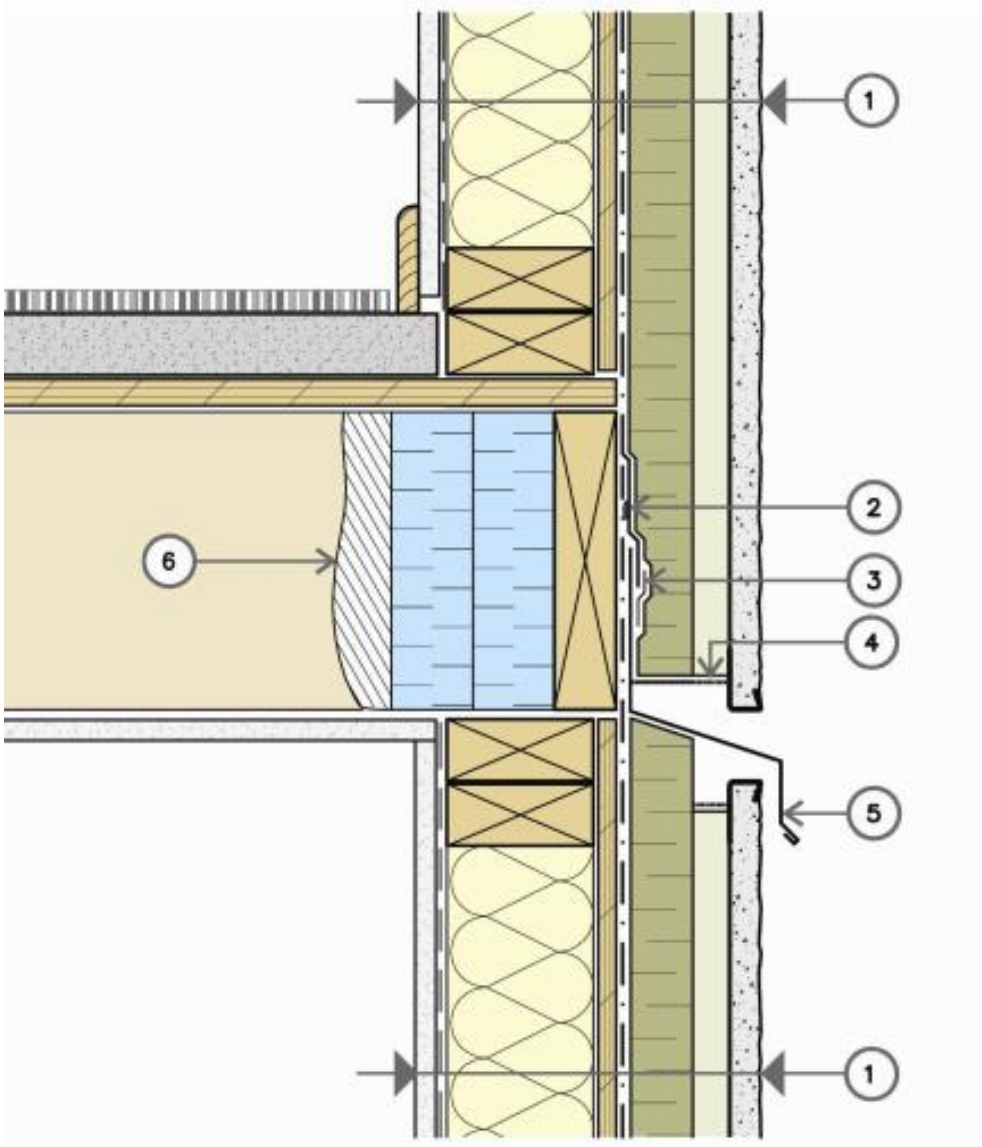
→ Cover membrane with metal flashing that also acts as termite shield



Base of Wall: Termite Area

Outlet Flashing Detail

- → No exposed wood at cladding transition
- → Continuity of air/water barrier outboard of wood structure
- → Addition of exterior insulation doesn't change the concept
- → Insect screen above and below metal flashing



Window Interfaces

→ Biggest challenge is identifying location of control layers within the window assembly

  → Where is air/water tight later in window frame?

→ Air / water tight plane most commonly found at inner plane of window frame

→ Connect the lines with appropriate materials

→ Need to think in 3D

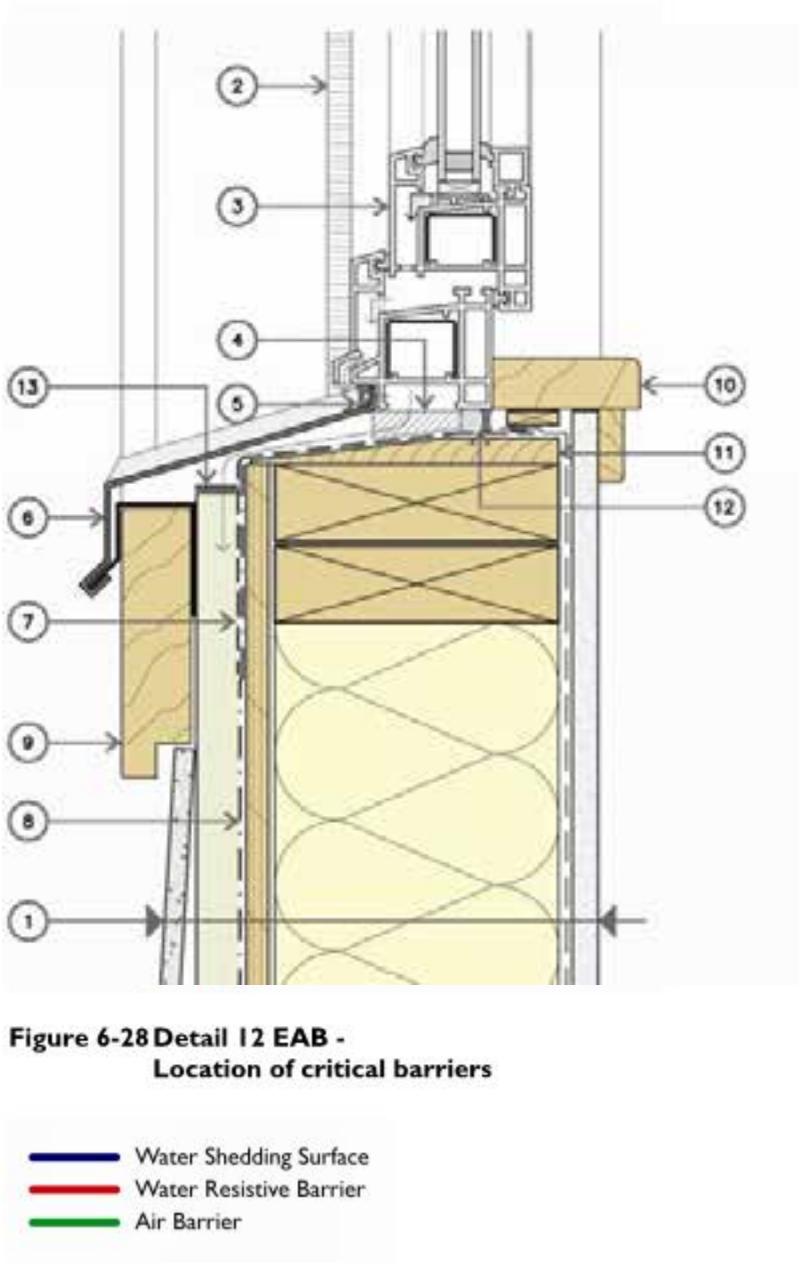
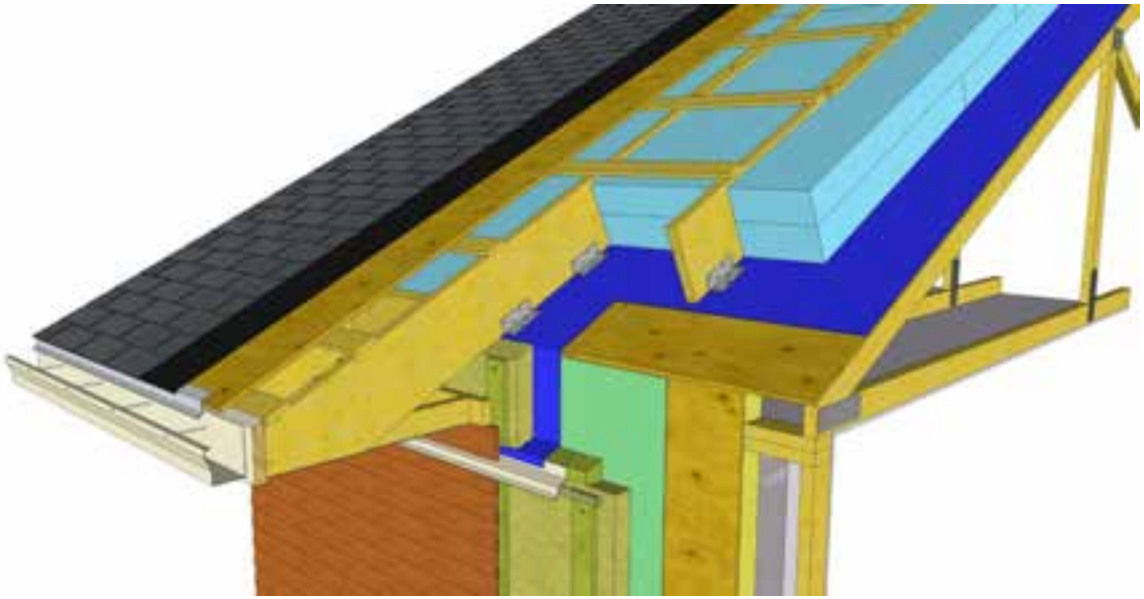
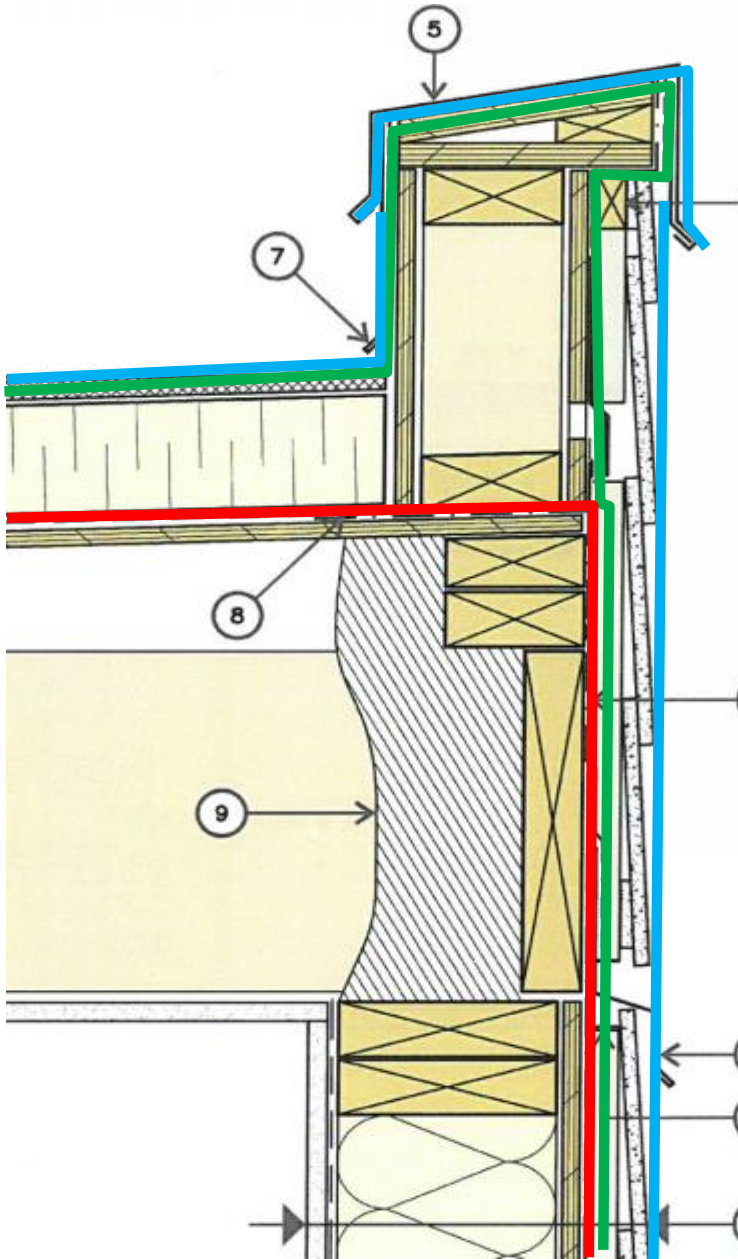


Figure 6-28 Detail 12 EAB - Location of critical barriers

Roof-to-Wall Detail – Perfect Wall & Roof





Roof-to-Wall Detail – Vented Attic

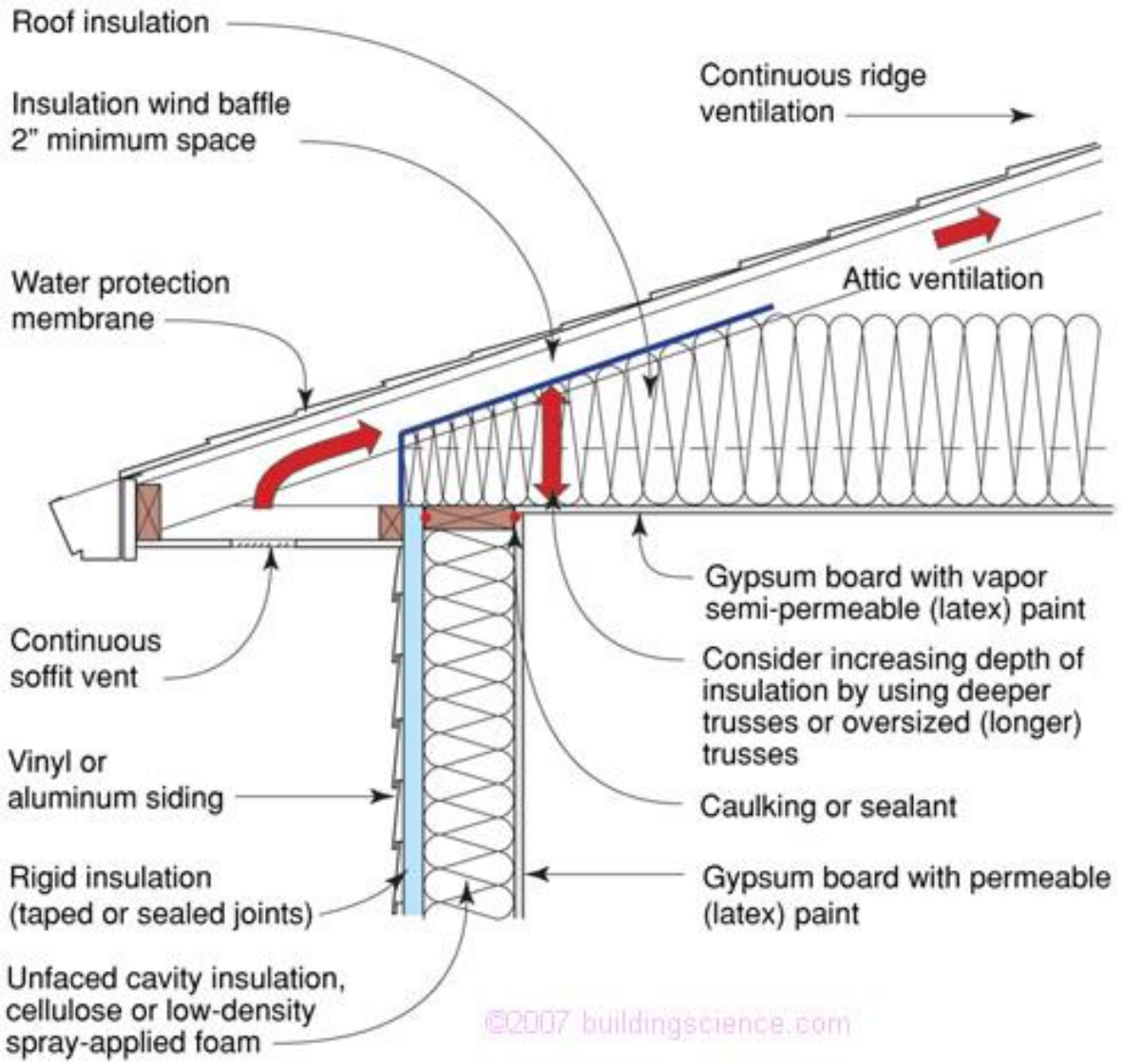


Figure Reference: Building Science Corporation

Roof-to-Wall Detail – Compact Roofs

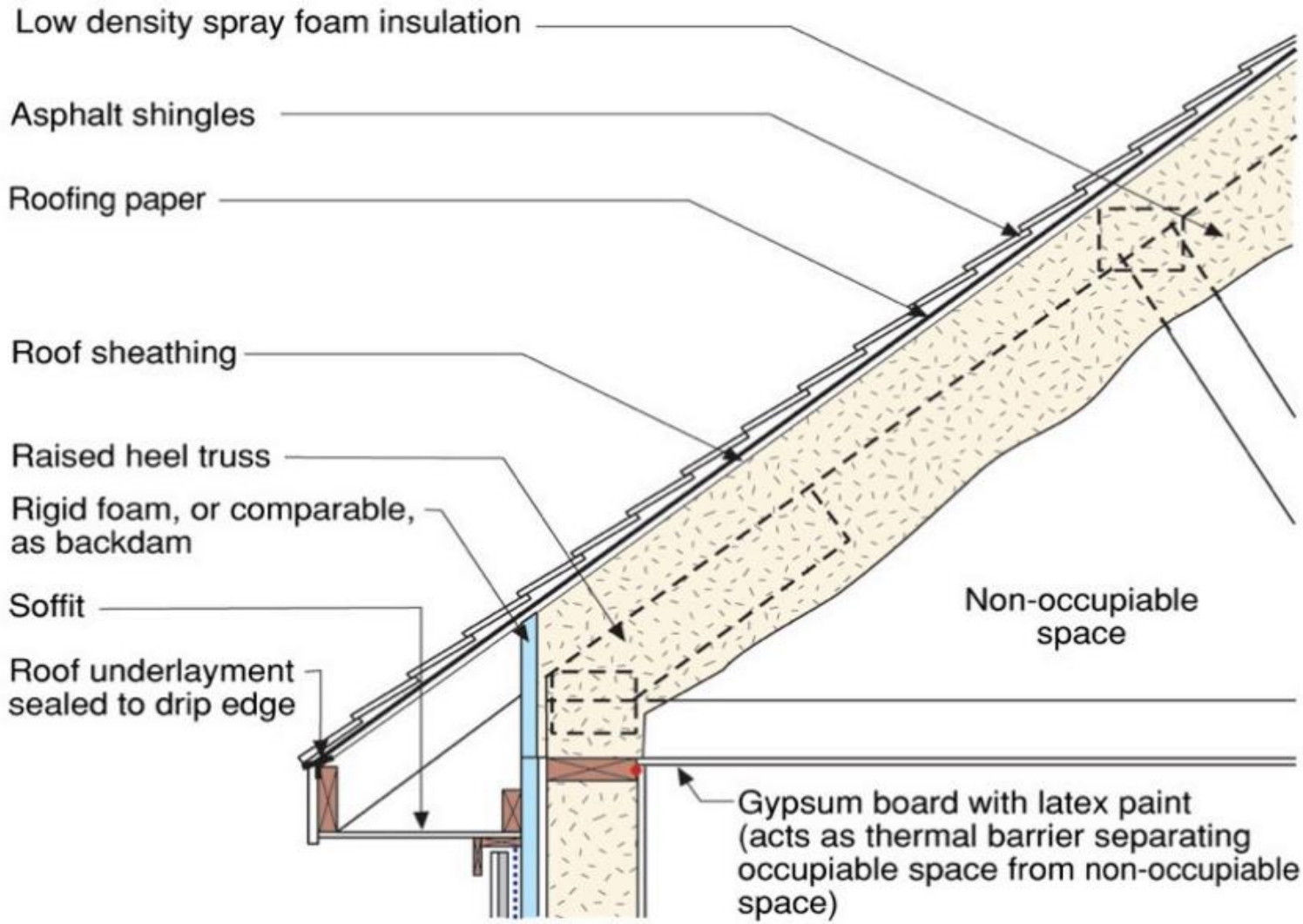


Figure Reference: Building Science Corporation

Roof-to-Wall Detail – Compact Roofs

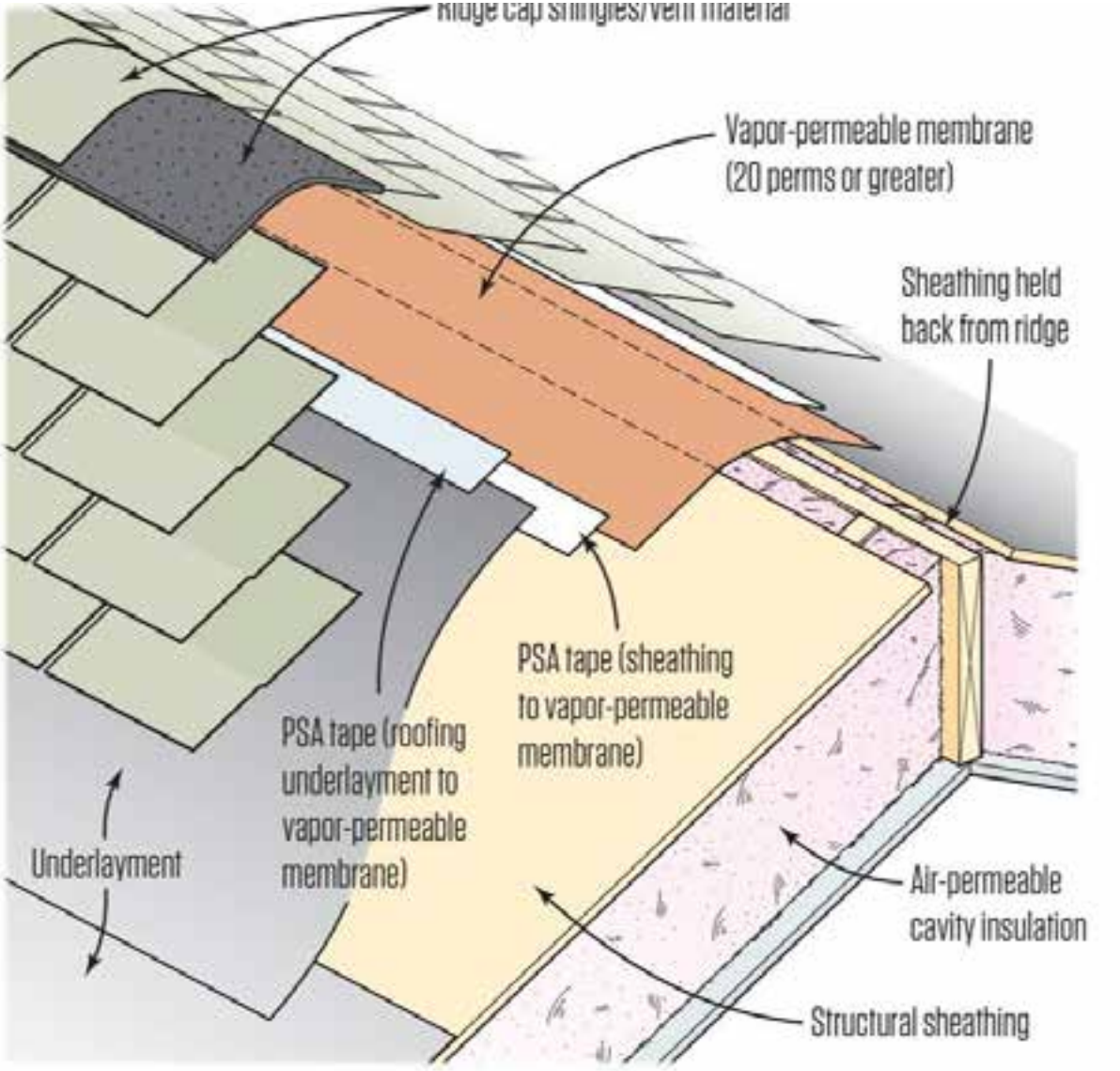


Figure Reference: Building Science Corporation

Crawlspaces

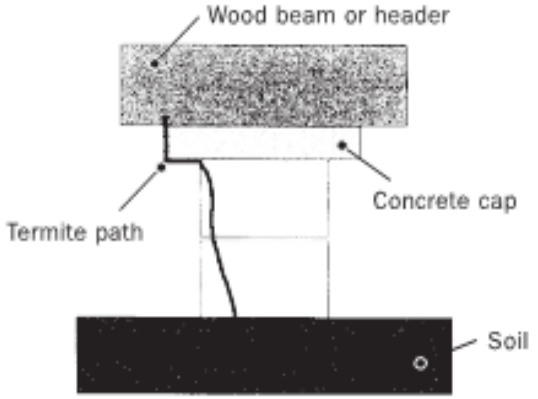
→ Ideally, fully condition these spaces and make them part of interior space (non-vented to exterior) to avoid moisture problems

→ Continuity of control layers around perimeter of space

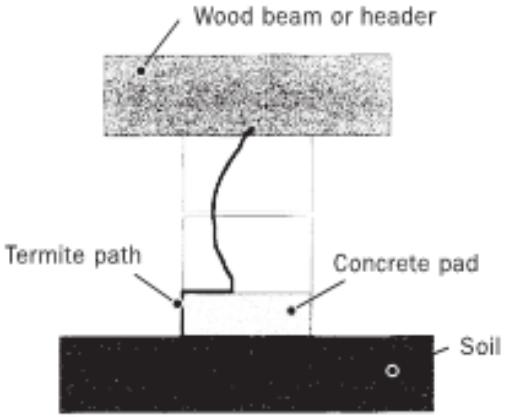
→ Allow for full surveillance of wood floor

→ If intermediate piers are used, provide solid concrete tops and/or metal termite shields

FIGURE 2: Caps and Pads – A Building Tip for Pier Construction



Brick and hollow block piers can be made more termite resistant through the use of solid concrete caps. Caps force termites tunneling within the hollow blocks to move to the exterior of the cap where they can be detected.



Solid concrete pads also force termites to build exterior mud tubes for easy detection. Pads are easiest to treat since only the soil around the perimeter needs treatment, not the interior of the pier. The pad should have no cracks and extend above the soil.

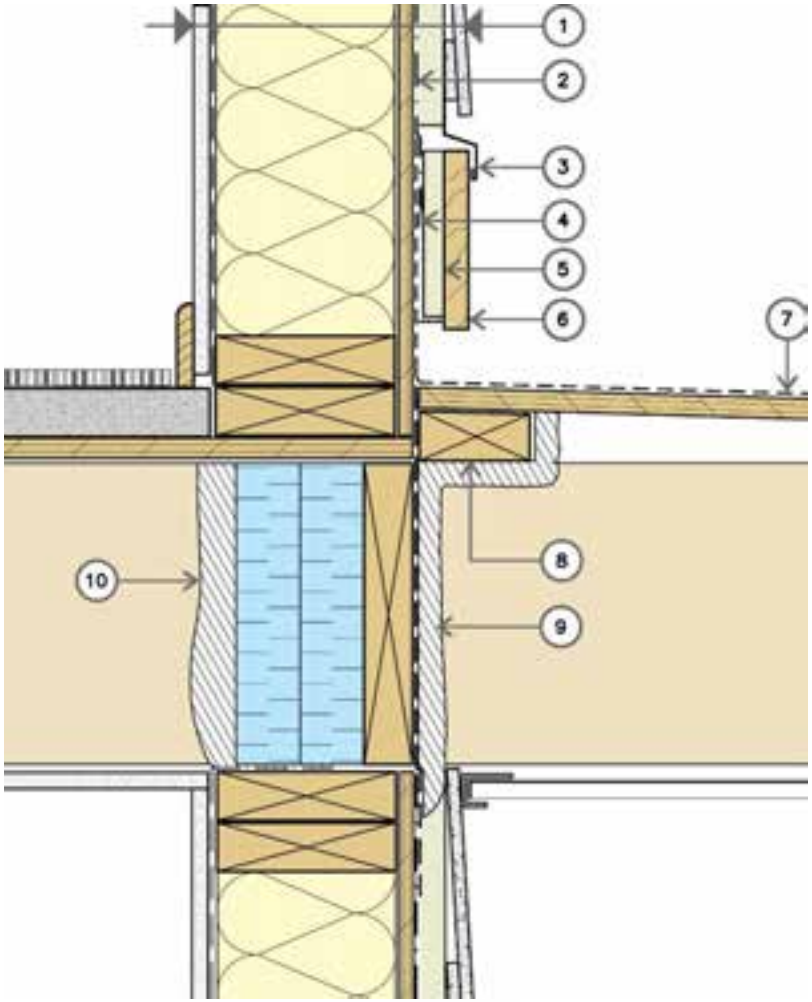
Figure Reference: AWPA

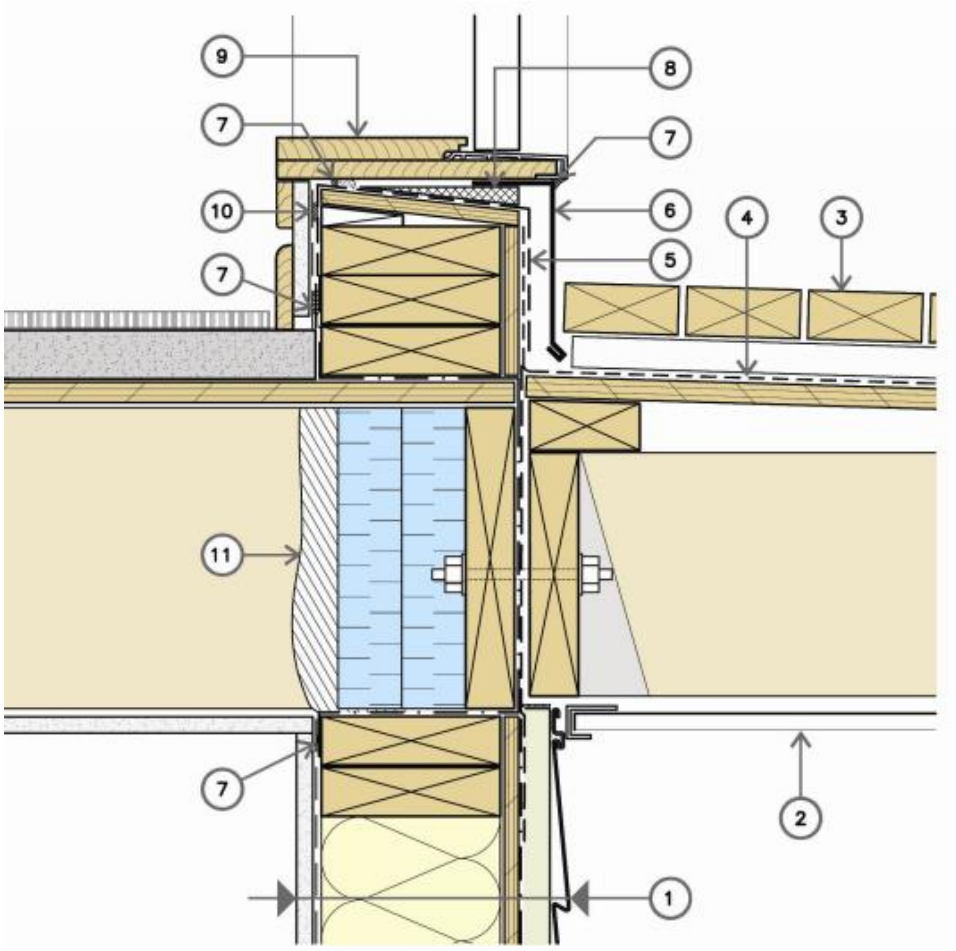
Balconies

Continuity of Control Layers

- → Balconies typically project through the vertical wall and interrupt the control layers
- → What happens to the control layers at the interface?
  - → Where is the air barrier?
  - → Thermal barrier?
  - → Water barrier?
  - → Vapor barrier?
- → Very common source of water leakage

Typical Balcony Configurations





Some Recent California History

Berkeley balcony collapse

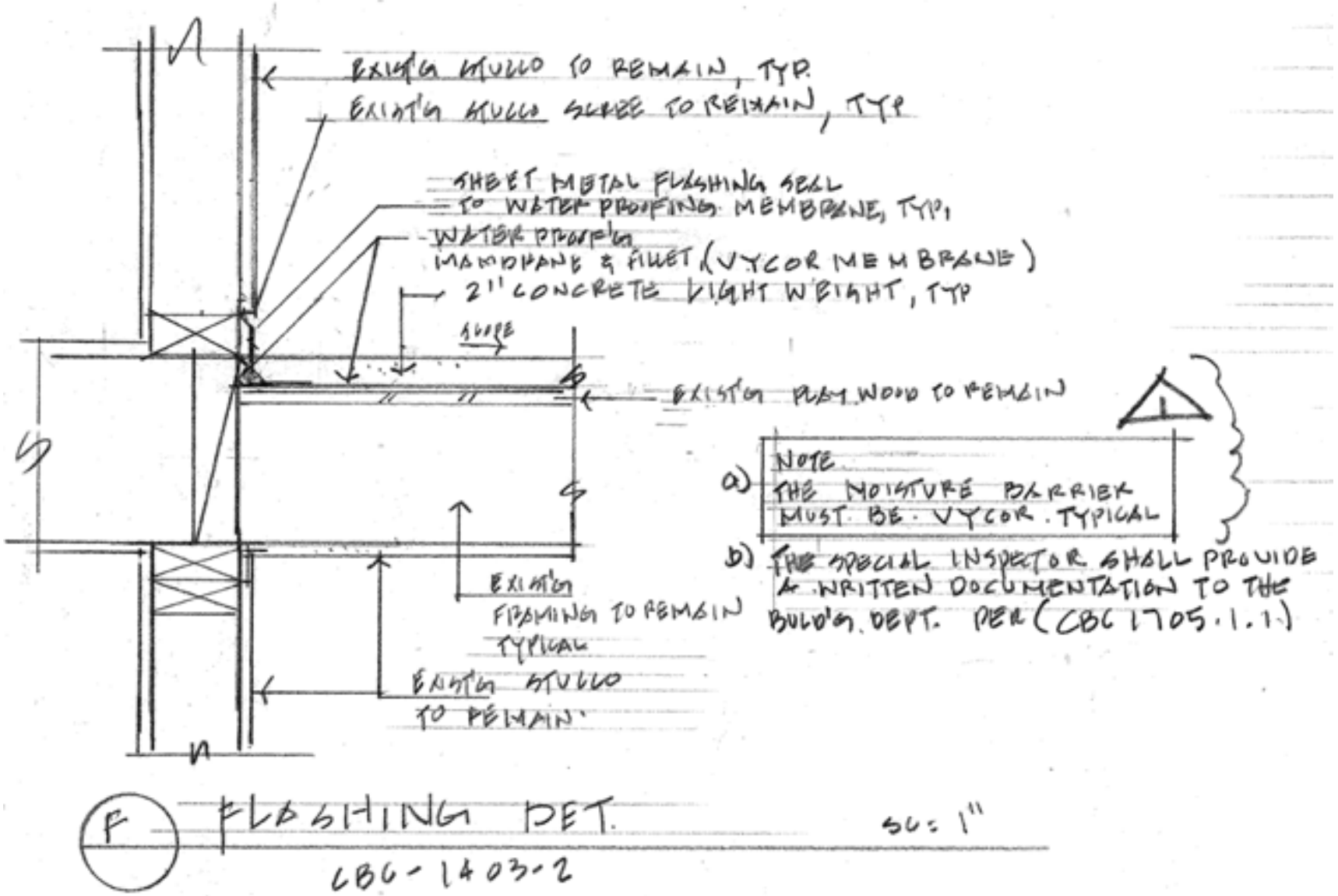
From Wikipedia, the free encyclopedia

On June 16, 2015, shortly after midnight, five Irish J-1 visa students and one Irish-American died and seven c were standing collapsed.[1] The group was celebrating a 21st birthday party in Berkeley, California. The balco building at 2020 Kittredge Street in Berkeley, then called Library Gardens. The district attorney of Alameda Co incident.[2]

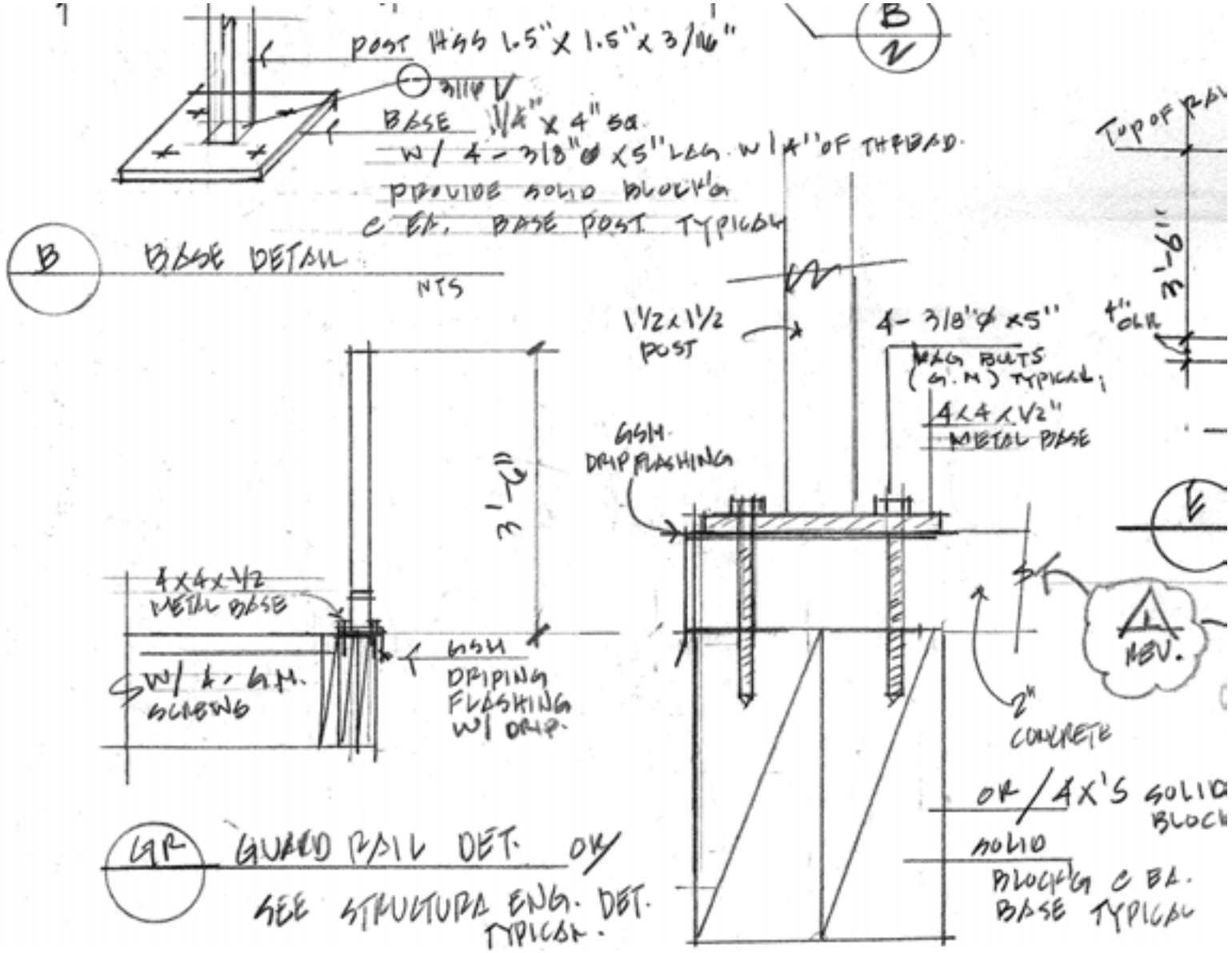
In June 2015, Mayor Tom Bates of Berkeley promised a broad and wide ranging investigation into the cause o the balcony of the building was not constructed properly leading to dry rot developing, leading to the balcony Overwhelming evidence points to dry rot as having caused the collapse, and not the weight of the 13 students

Contents [hide]

The Reality


EXIST'G STUCCO TO REMAIN, TYP.
EXIST'G STUCCO SCREED TO REMAIN, TYP
SHEET METAL FLASHING SEAL TO WATER PROOFING MEMBRANE, TYP.
WATER PROOFING MEMBRANE & FILLET (VYCOR MEMBRANE)
2" CONCRETE LIGHT WEIGHT, TYP
SLOPE
EXIST'G PLYWOOD TO REMAIN
NOTE
a) THE MOISTURE BARRIER MUST BE VYCOR. TYPICAL
b) THE SPECIAL INSPECTOR SHALL PROVIDE A WRITTEN DOCUMENTATION TO THE BUILD'G. DEPT. PER (CBC 1705.1.1)
EXIST'G FRAMING TO REMAIN TYPICAL
EXIST'G STUCCO TO REMAIN
F
FLASHING DET.
SC: 1"
CBC-1403-2

The Reality


POST HSS 1.5" X 1.5" X 3/16"
BASE 1/4" X 4" SQ.
W/ 4 - 3/8" Ø X 5" LGG. W/ 4" OF THREAD.
PROVIDE SOLID BLOCKING
C/L BASE POST TYPICAL
B BASE DETAIL
NTS
1 1/2 x 1 1/2 POST
4 - 3/8" Ø x 5"
MACH BOLTS (G.M.) TYPICAL
4 x 4 x 1/2" METAL BASE
GSM DRIP FLASHING
4 x 4 x 1/2 METAL BASE
W/ 4 - G.M. SCREWS
GSM DRIPING FLASHING W/ DRIP.
3'-2"
2" CONCRETE
REV.
OR 4X'S SOLID BLOCK
SOLID BLOCKING C BA. BASE TYPICAL
GR GUARD RAIL DET. OR SEE STRUCTURAL ENG. DET. TYPICAL.

Building Enclosure Functions

→ Support:

→ Loads – structural and environmenta

→ Finish:

→ Look good?

→ Control:

→ Heat flow – thermal barrier

→ Air flow – air barrier

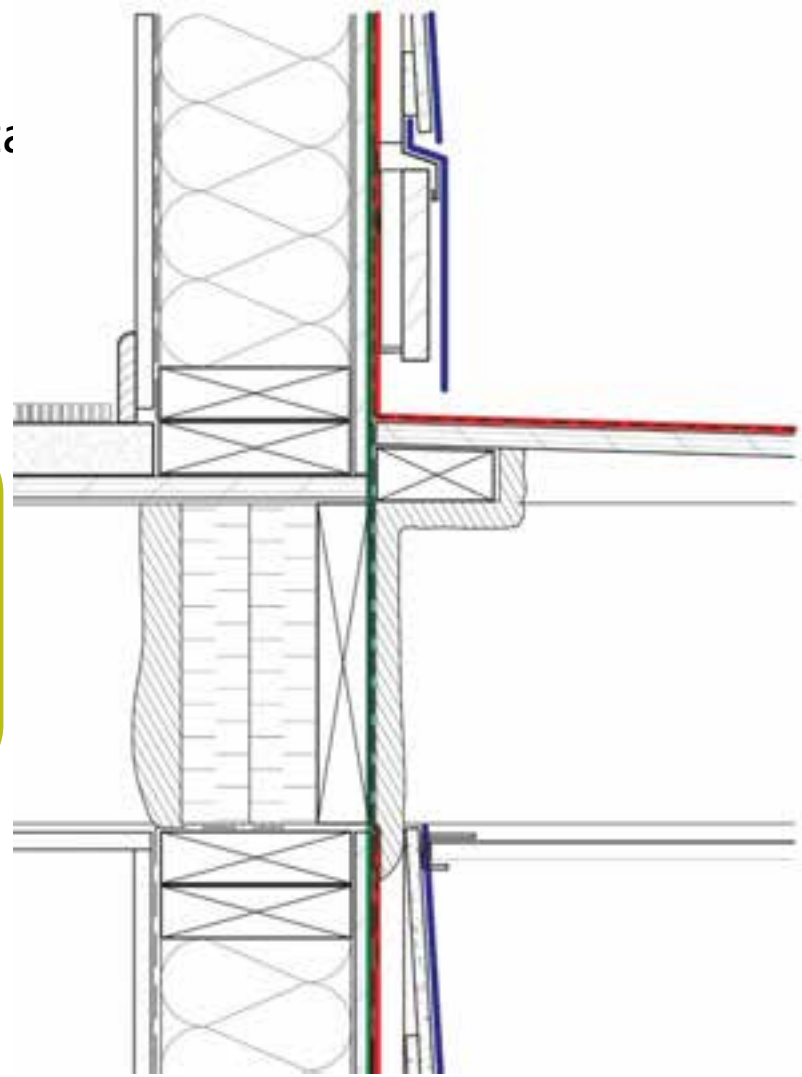
→ Vapor diffusion – vapor barrier

→ Water penetration – water barrier

→ Light and solar radiation

→ Noise, fire, and smoke

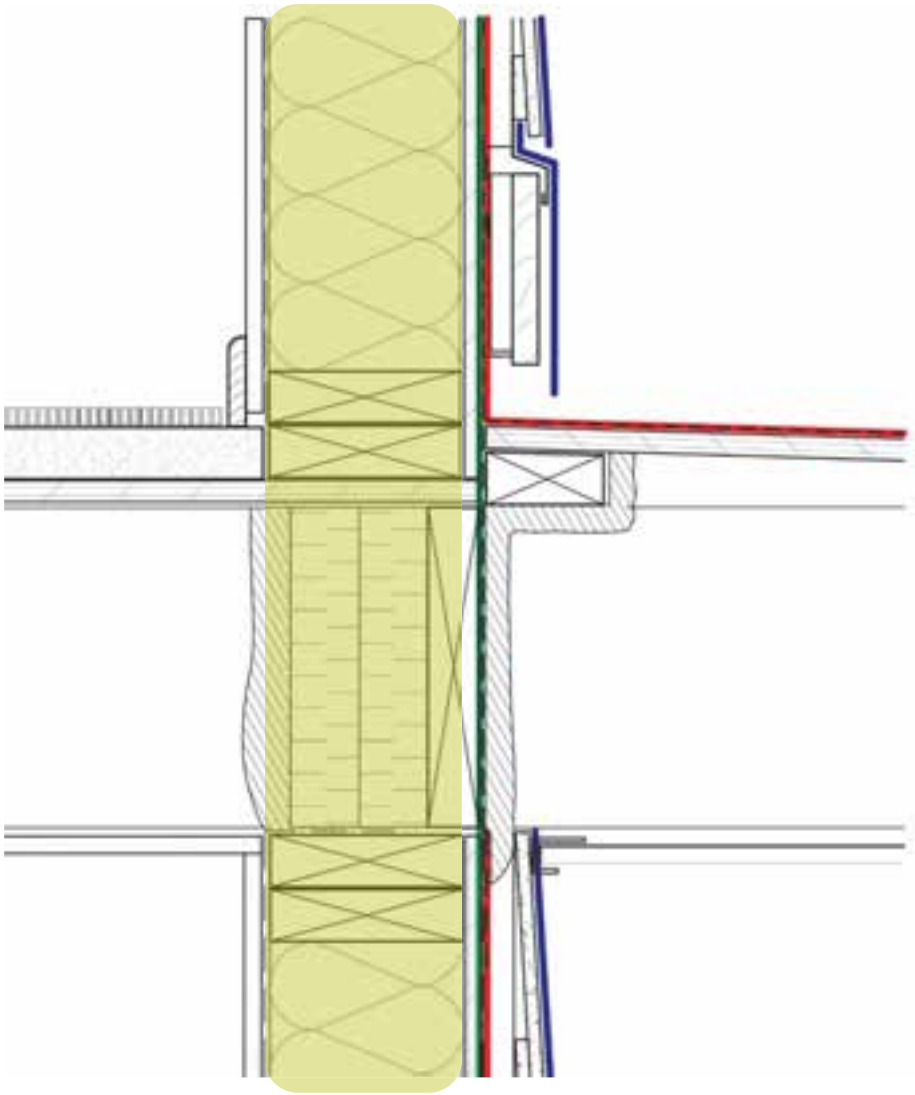
→ All of these apply to balconies too!



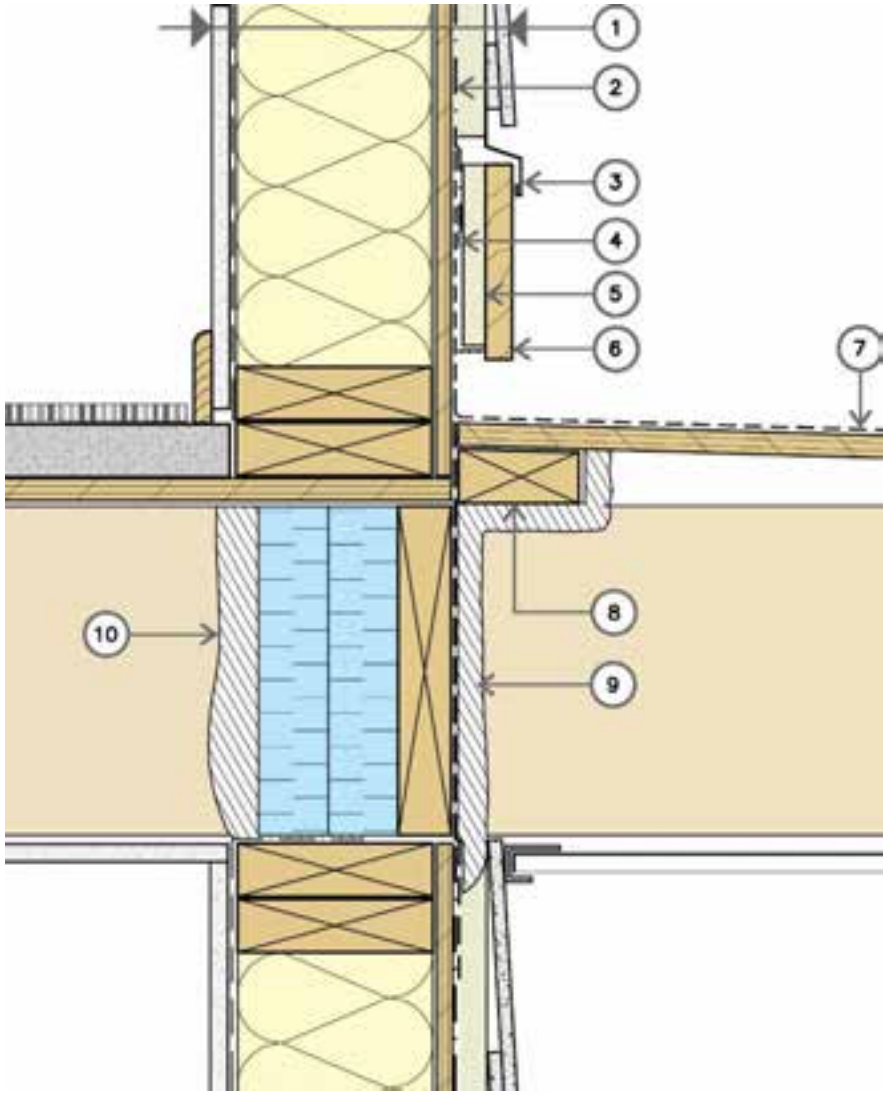
Continuity of Control Layers

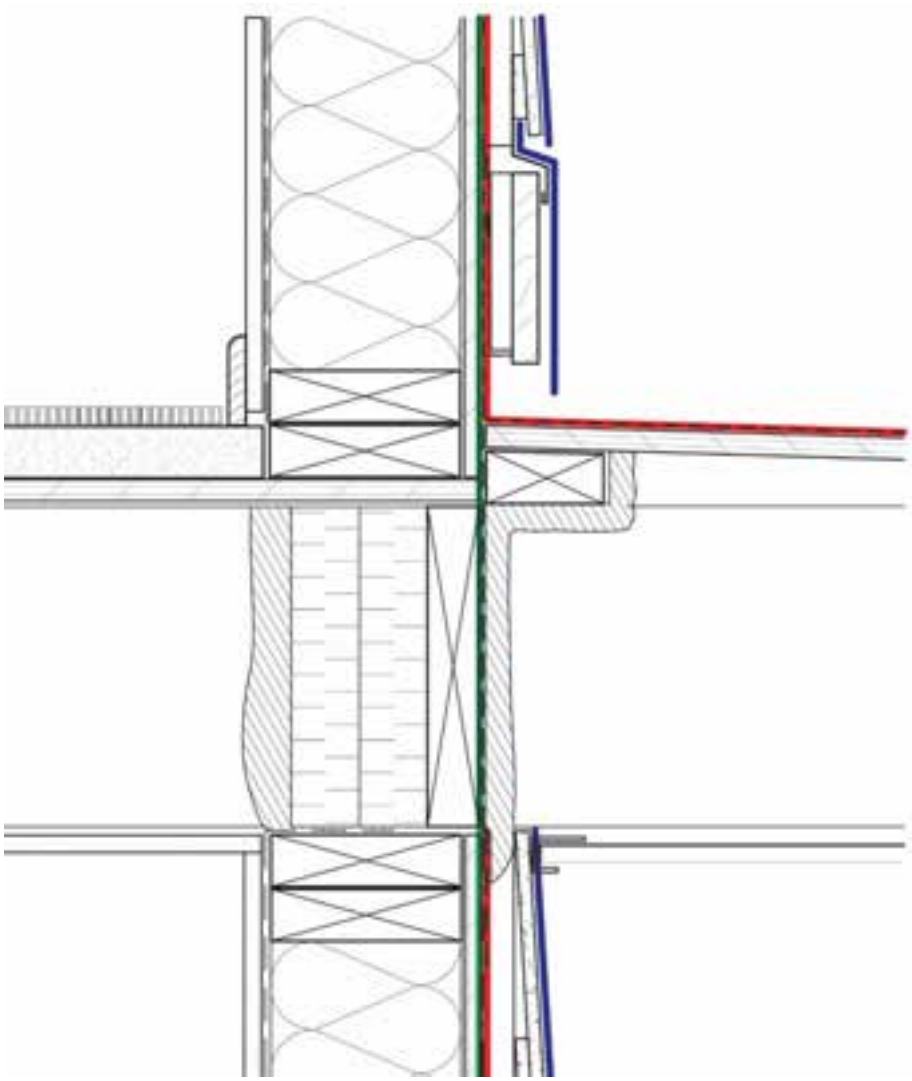
→ How to design a detail:

- → Identify the 4 control layers within each assembly
- → Connect each of the layers across the detail
- → Do not lift your pencil off the page
- → Select appropriate materials to make the necessary transitions
  - › There isn't a 'right' way here



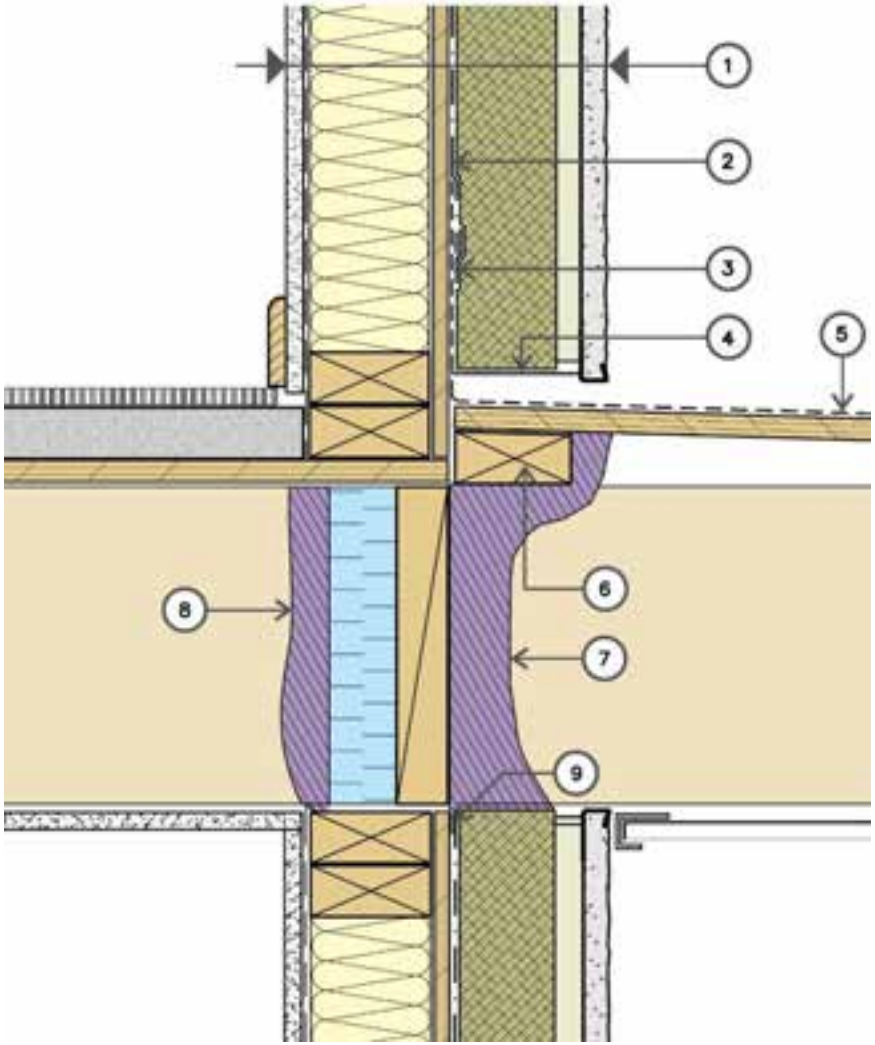
Cantilevered Balcony – Control Layers





Continuity of Air / Thermal Control Layers

- → Lots of thought given to water control layer and rightfully so
- → Air barrier and thermal barrier continuity often overlooked
- → Difficult to reliably detail sheet membrane around penetrating joists
- → Spray foam often used for air and thermal control



Continuity of Air / Thermal Control Layers

Cantilevered Balcony - Saddles

→ 3-dimensional integration of assemblies, needs 3-dimensional detail

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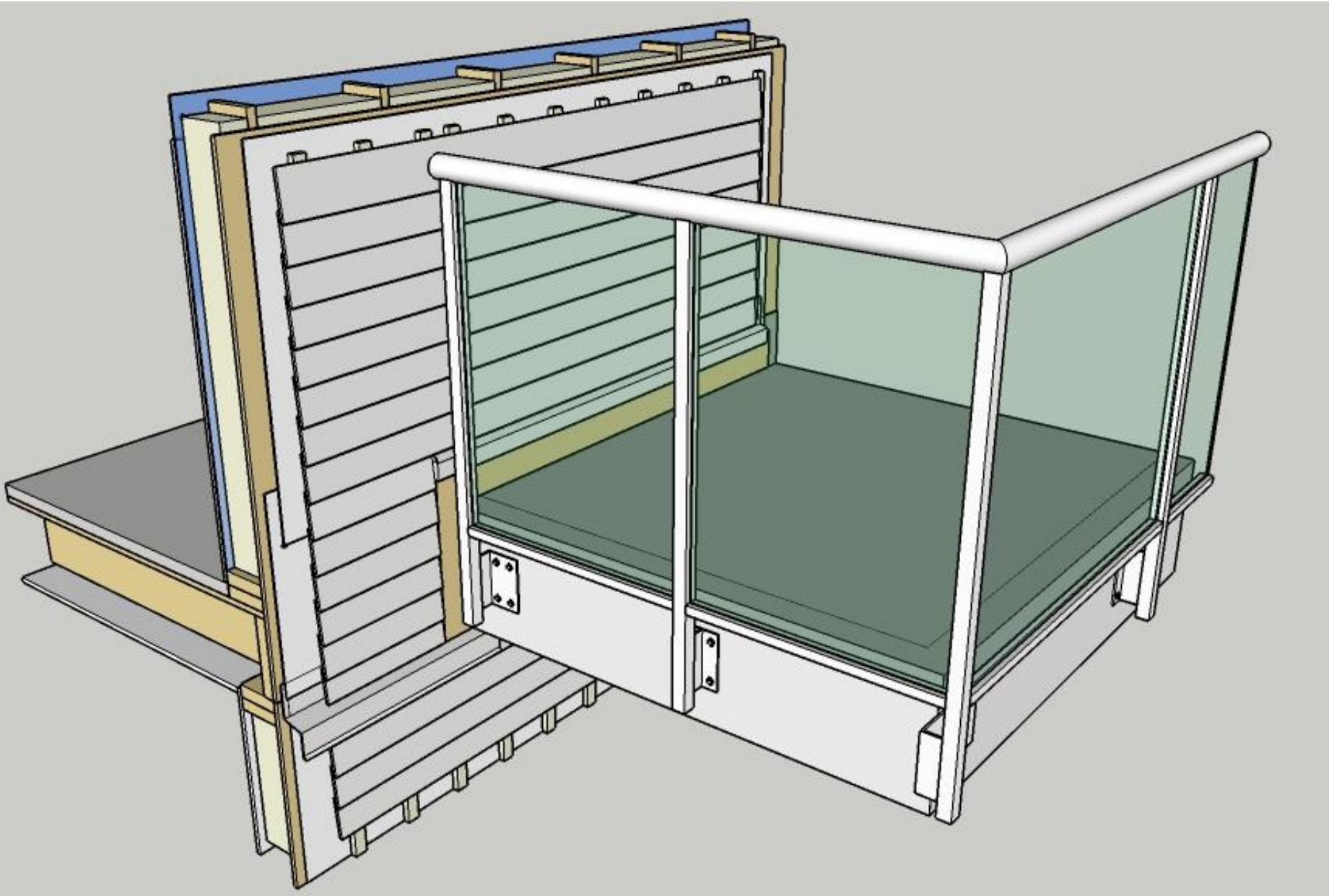
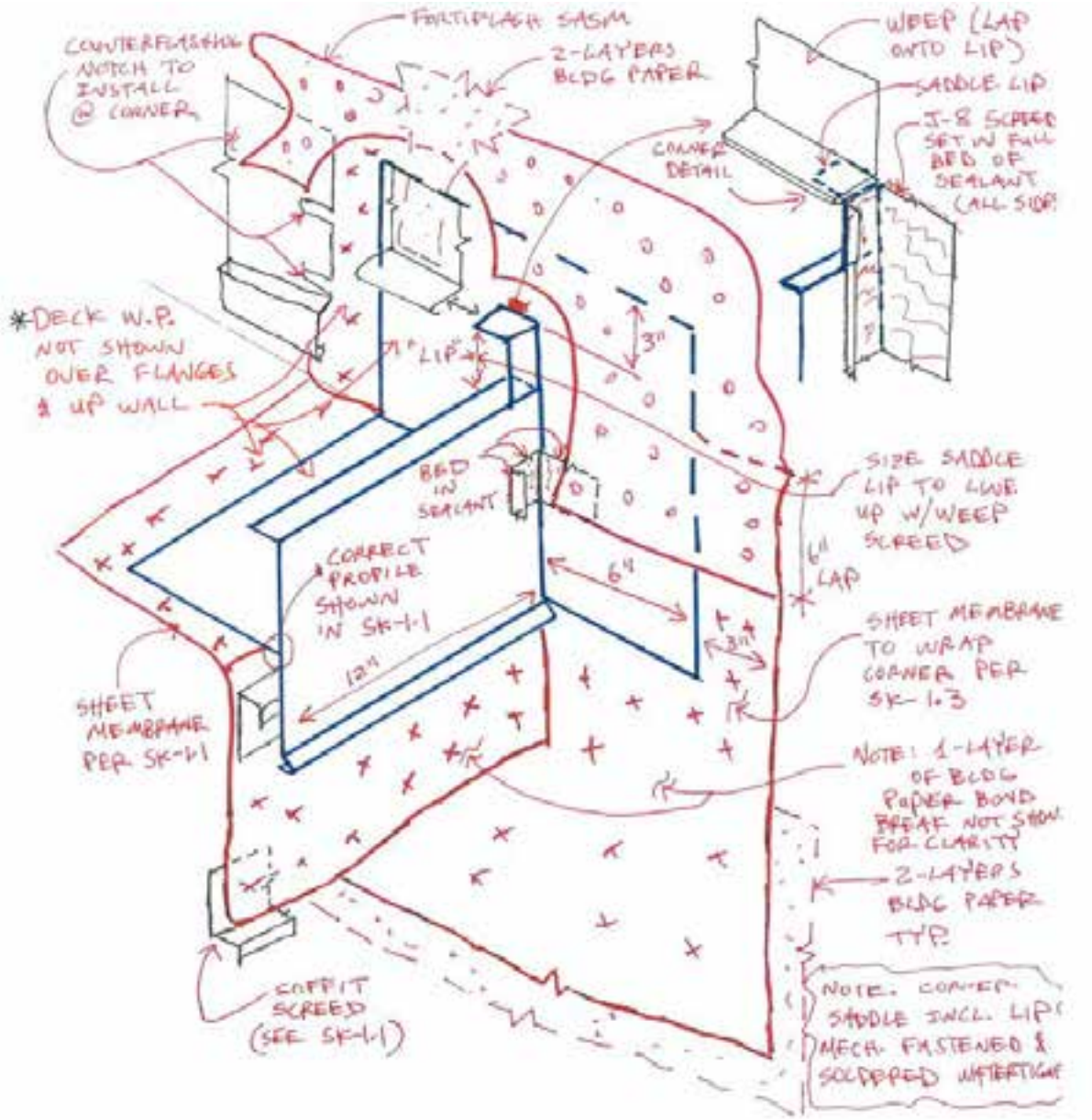
Cantilevered of Water Control Layer



Balcony Corner – Wood Frame

Balcony Corner Saddle Flashing



Balcony Corner Saddle Flashing

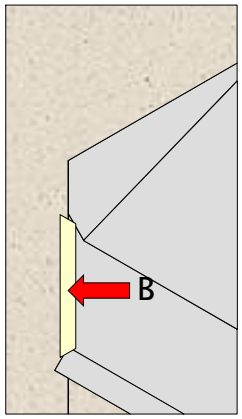
Balcony Corner Saddle Flashing

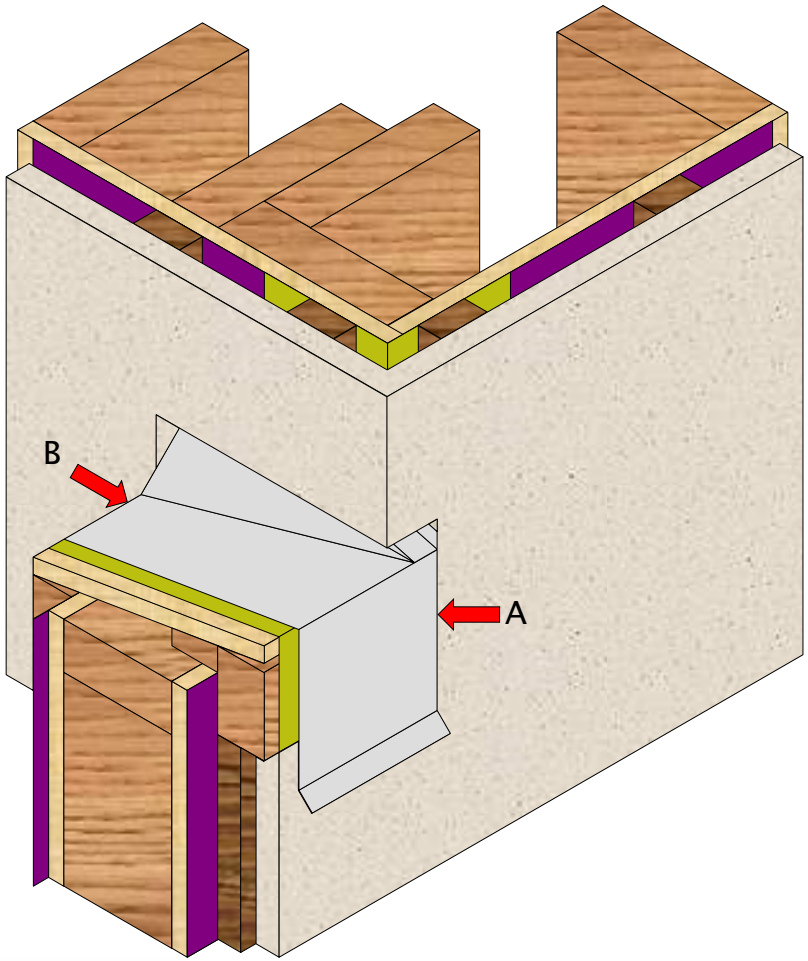
Balcony Corner Saddle Flashing

Balcony/Deck Edge – Concrete Frame

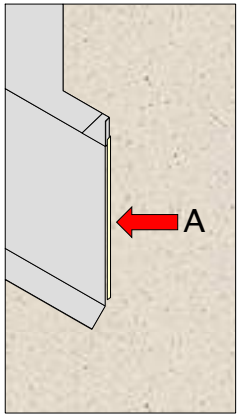
DIFFERENT MATERIALS AND SYSTEMS

SAME DETAILS





Framing
Wall Sheathing
Sheathing Paper
P.T. Wood Sloped Blocking
Sloped Blocking Membrane Flashing
Wall Membrane Flashing
Sheathing Paper
Corner Membrane Flashing
P.T. Wood Strapping
Metal Parapet Flashing
Stucco Cladding
Exterior Caulking



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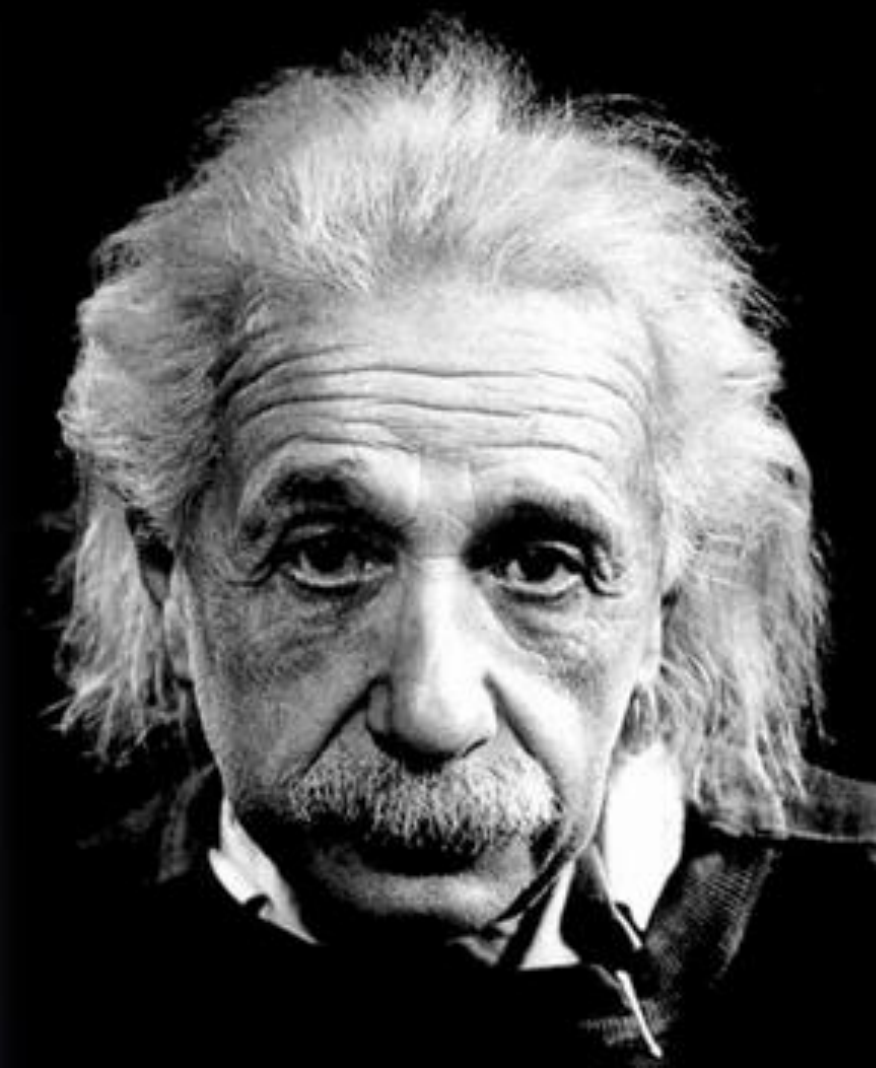
Parapet to Wall Flashing

A Better Way?

→ Avoid the hard details altogether

“Everything should be made as simple as possible, but not simpler.”

Albert Einstein



Pre-Finished Balcony

→ Balcony is a 'bolt-on' architectural component, but not part of building enclosure

→ Air, water, and thermal control layers continuous behind pre-finished balcony

→ Simplifies detailing – no saddles

→ Continuous water, air, thermal layers

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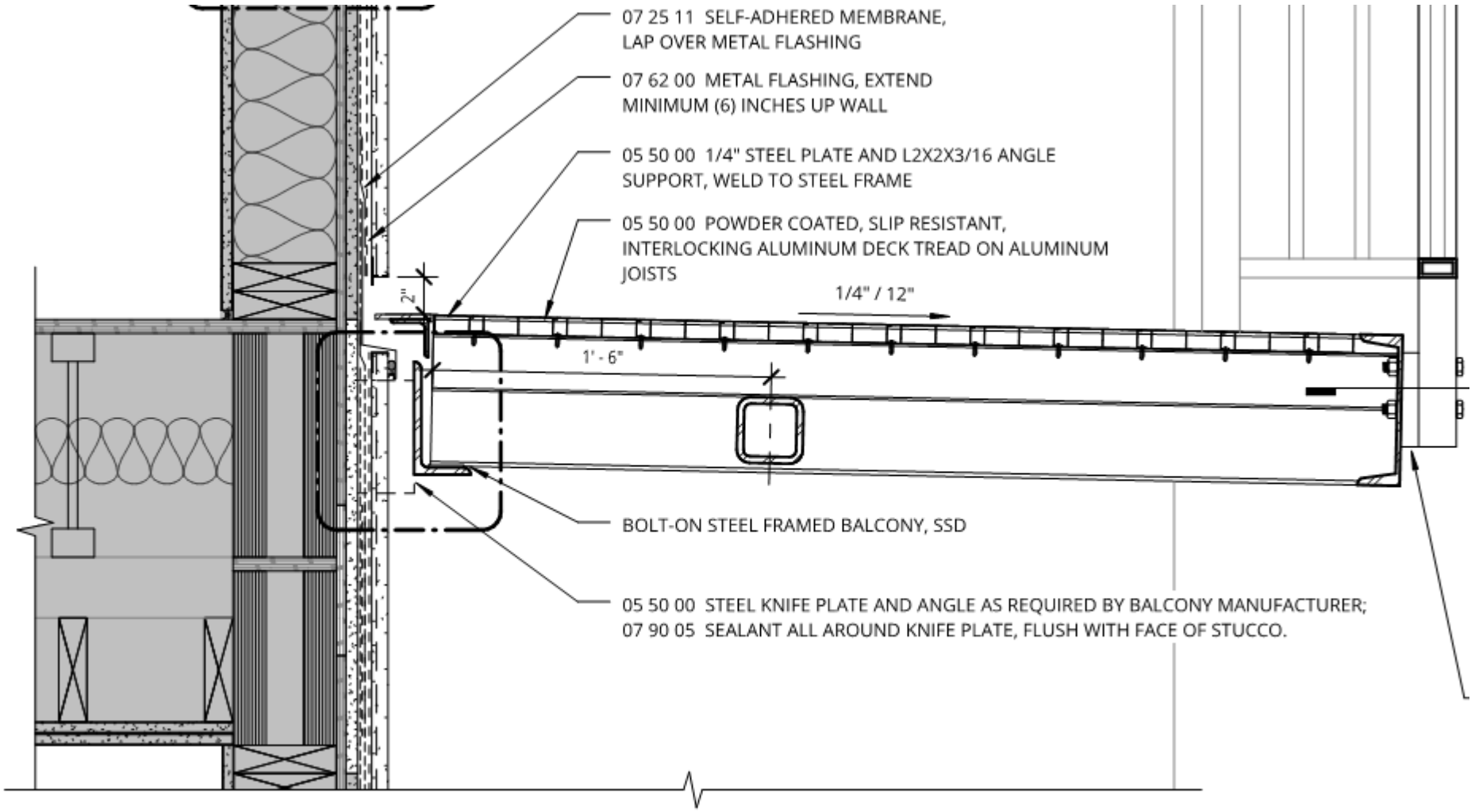
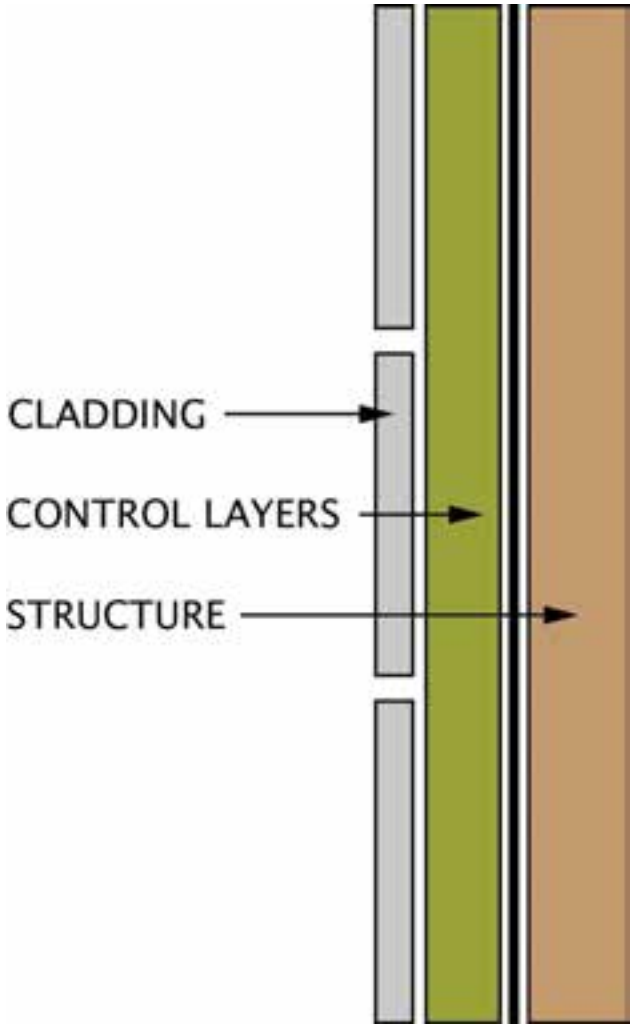

07 25 11 SELF-ADHERED MEMBRANE, LAP OVER METAL FLASHING
07 62 00 METAL FLASHING, EXTEND MINIMUM (6) INCHES UP WALL
05 50 00 1/4" STEEL PLATE AND L2X2X3/16 ANGLE SUPPORT, WELD TO STEEL FRAME
05 50 00 POWDER COATED, SLIP RESISTANT, INTERLOCKING ALUMINUM DECK TREAD ON ALUMINUM JOISTS
2"
1/4" / 12"
1' - 6"
BOLT-ON STEEL FRAMED BALCONY, SSD
05 50 00 STEEL KNIFE PLATE AND ANGLE AS REQUIRED BY BALCONY MANUFACTURER;
07 90 05 SEALANT ALL AROUND KNIFE PLATE, FLUSH WITH FACE OF STUCCO.

Summary

- → Control moisture, air, and heat
- → Best practices:
  - → Rainscreen cladding
  - → Keep structure warm and dry: control layers on exterior
- → Think about the details!
  - → Provide continuity of control layers within and between assemblies and details
  - → Easier said than done: modern large buildings often architecturally complicated
- → Walls, roofs, balconies, and…?



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