Peter Baker, P.Eng.

Water Management Residential Podium Construction

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Overview

- Building Enclosure Commissioning
  - Setting project goals
  - Early design development to set basis of design
  - Design reviews (various stages)
  - Pre-construction assistance
  - Construction administration assistance
- Standards
  - ASTM E2813-12 Standard Practice for Building Enclosure Commissioning

Overview

- Systems
  - Below Grade Waterproofing
  - Walls
  - Roofs
  - Plaza Decks
  - Balconies
  - Windows and Doors
  - Commercial Glazing
- Standards and Testing

Below Grade Waterproofing

- Physics/Strategies
  - Gravity

That's it

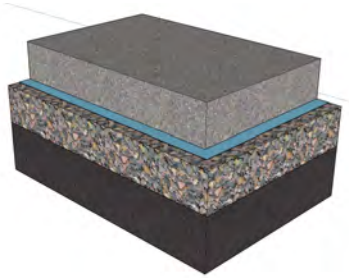
…oh, and sometimes pumps

Below Grade Waterproofing

- Physics/Strategies
  - Perimeter Drain (Boat out of the water)
    - Daylight
    - Sump
  - Waterproofing (Boat in water)
    - Waterproofing must be continuous
    - Waterproofing must be able to handle the loads applied
  - Both

Below Grade Waterproofing

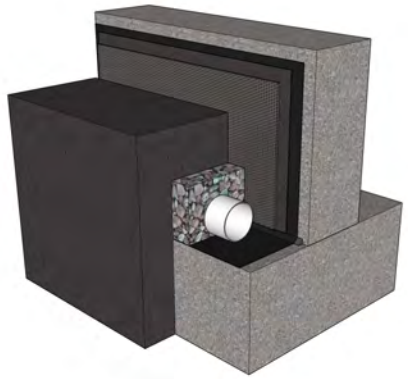
- Slabs
  - Slab above the footing drain – loose laid vapor barrier is sufficient
    - 15mil poly minimum for construction durability purposes
  - Below the footing drain – waterproofing system is recommended.
    - Blind side waterproofing is preferred.



Below Grade Waterproofing

- Walls
  - Waterproof membrane
  - Drainage mat/protection board
- Two-sided forms
  - Sheet membranes, liquid applied membranes
- One-sided forms
  - Blind side sheet membranes attached to sheet piles or wood lagging
  - For one sided forms, it is generally recommended to use braced forms instead of wire ties.

Below Grade Waterproofing



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Below Grade Waterproofing

- Products
  - Sheet membranes
    - Grace Bituthane 3000 (two-sided form)
    - Grace Prepruf 300/160 (blindside)
    - Henry WP200 (two-sided form)
    - Tremco Paraseal(two-sided or blindside)
  - Liquid membranes
    - Tremco 201/60, 250GC, 260
    - Henry CM100
  - Loose Laid Sheets
    - 15 mil (or greater) polyethylene (eg. StegoWrap)

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Below Grade Waterproofing

- Flood Events
  - Elevated ground water can result in high hydrostatic pressures on a foundation
    - Pressure relief ports
    - Flood vaults

Walls

- Physics/Strategies
  - Gravity

That's it

…no really.
That's it.

Walls

- Physics/Strategies
  - Water Control Layer
  - Drainage Space (Ventilation Space?)
    - Drainage will occur at gaps as small as 1/16"
    - Ventilation will occur at gaps as small as 3/8"
  - Flashings

Walls

- Water Control Layer
  - Mechanically attached sheets
    - DuPont Tyvek
    - Typar
  - Fluid Applied Membranes
    - Grace Perm-A-Barrier VP
    - Henry Air-Bloc 31MR, 33MR
    - Tremco ExoAir 220, 230
    - Carlisle Fire Resist Barritech VP


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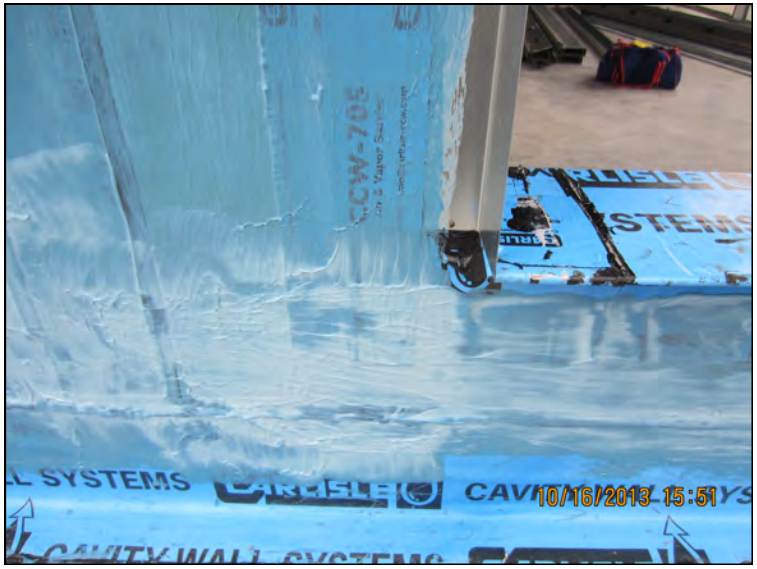
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Walls

- Water Control Layer
  - Fully adhered sheets (vapor impermeable)
    - Grace Perm-A-Barrier Wall Membrane
    - Henry Blueskin SA
    - Carlisle CCW 705
  - Fully adhered sheets (vapor permeable)
    - Grace Perm-A-Barrier VPS
    - Henry Blueskin VP 160

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Walls

- Drainage Space
  - Drainage will occur at gaps as small as 1/16”
  - Drainage is essential to the water management performance of the wall – removes liquid water from behind the cladding and reduces the potential for hydrostatic pressure to drive water in through small imperfections
- Ventilation Space
  - Ventilation will occur at gaps as small as 3/8”
  - Ventilation provides additional robustness to the system by increasing the outward drying

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Walls

- Recommended Cladding Drainage Space
  - Brick – 1” to 2” cavity space
  - Stucco – 3/8” drainage mesh
  - Adhered stone veneer – 3/8” drainage mesh
  - Panel cladding – 3/8” to 3/4” vertical furring strips
    - Furring/spacer strips do not need to be structural
  - Vertical siding – 3/8” drainage mesh
  - Horizontal lap siding – 3/8” to 3/4” vertical furring strips
    - Lap siding and vinyl siding are the lowest risk cladding systems and still provide reasonable performance without a drainage gap – though it is still recommended.

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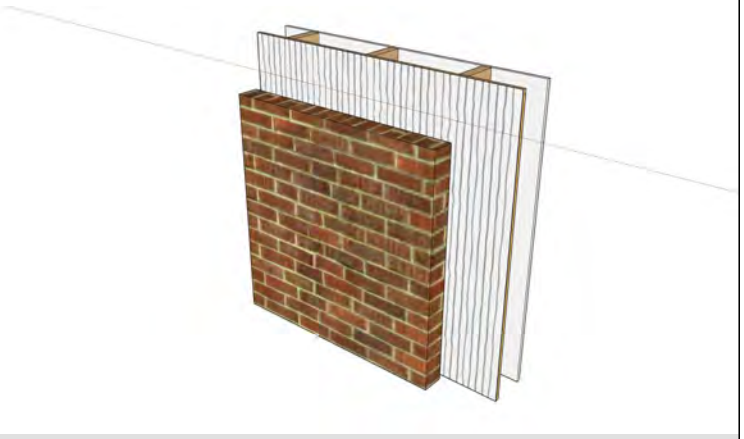
Walls



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Walls

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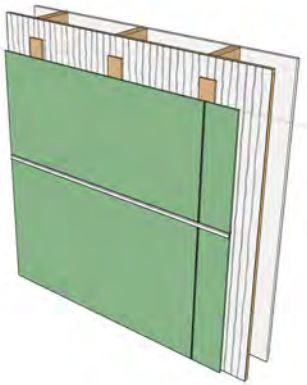

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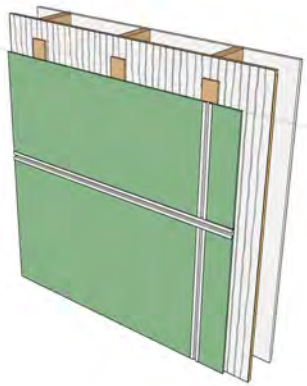

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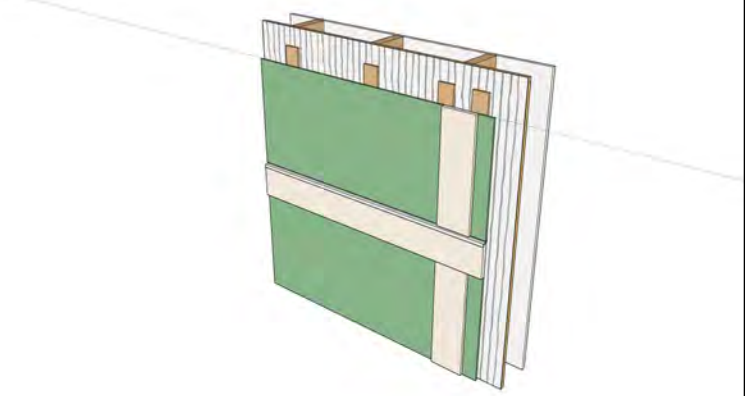

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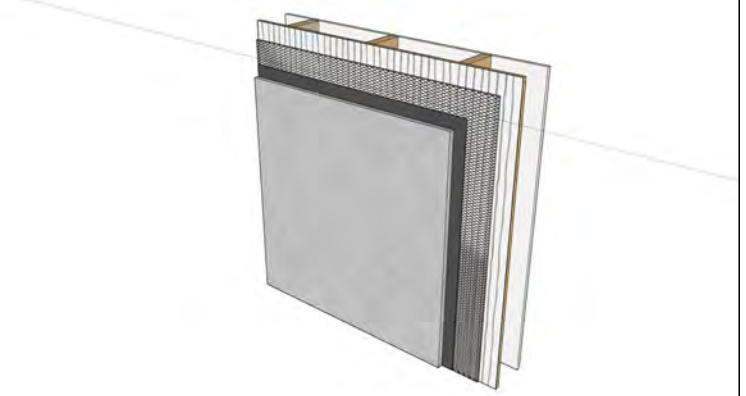

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Walls

- Flashing
  - Critical element to a drained wall assembly (and possibly the most underrated)
  - Three types
    - Waterproof
    - Through wall
    - Water shedding

…these are my definitions not industry standard so no arguing.

Walls

- Waterproof Flashings
  - Waterproof flashing are identified as flashings where a failure of the flashing will result in water entry into the building
  - These flashings are critical and require a robust design
  - Most common is a masonry through-wall flashing above a lower roof. Other common ones are flashings above commercial aluminum storefront systems.
  - Recommend a fully adhered waterproof membrane combined with a structural backing to create the flashing

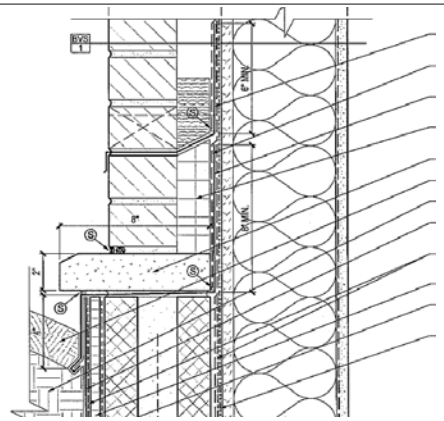
Walls

- Through Wall Flashings
  - Through wall flashing are identified as flashings that are installed to direct water that is in behind the cladding back out to the exterior and where a failure of the flashing will not result in water entry into the building
  - These flashings still serve a critical function however they do not need to be perfect all the time.
  - Examples
    - Flashing over masonry lintels directly over another masonry cavity
  - Needed to vertically separate large wall areas.
  - How many?... Every floor or two… or three?

Walls

- Water Shedding Flashings
  - Water shedding flashing are identified as flashings with the purpose of keeping water out of the cladding
  - These flashings still serve a critical function however they do not need to be perfect all the time.
  - Examples
    - Flashings at cladding transitions
    - Flashings at window head trim or other siding trim/horizontal joints
  - In essence a water shedding flashing maintains the shingle lapping of the exterior cladding elements

Walls



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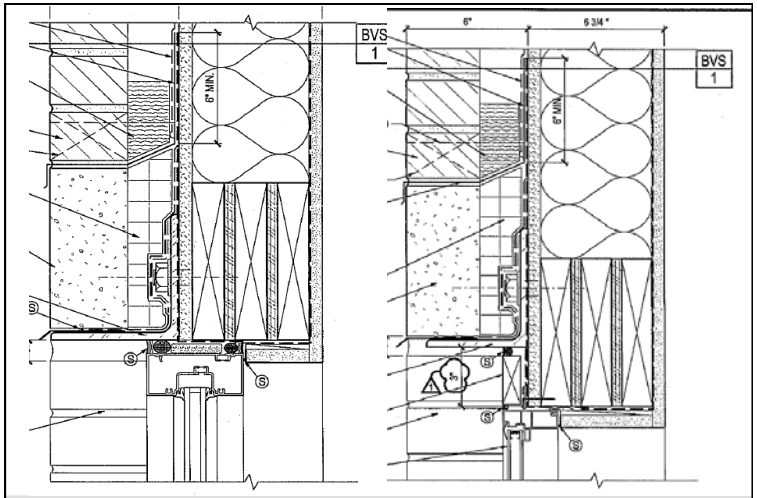

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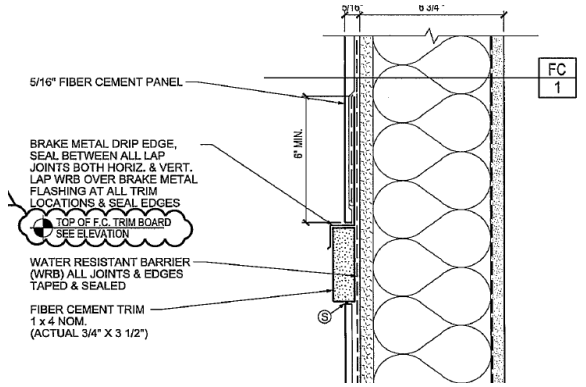

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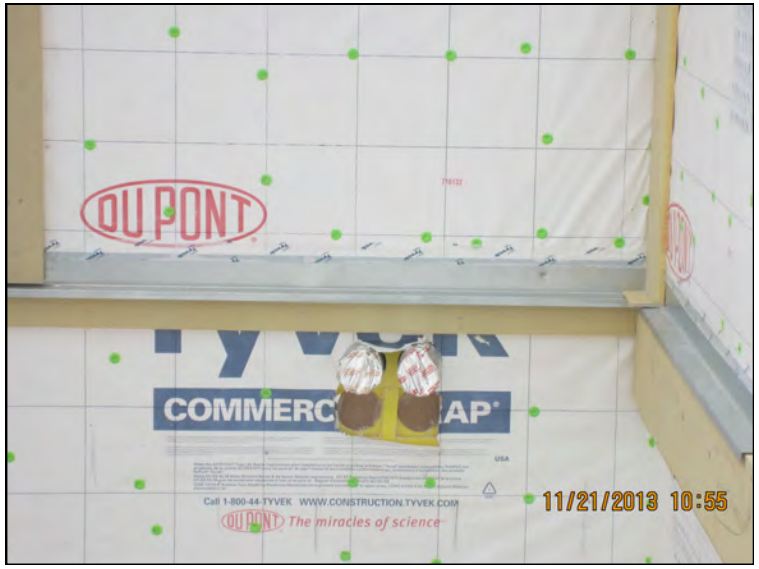

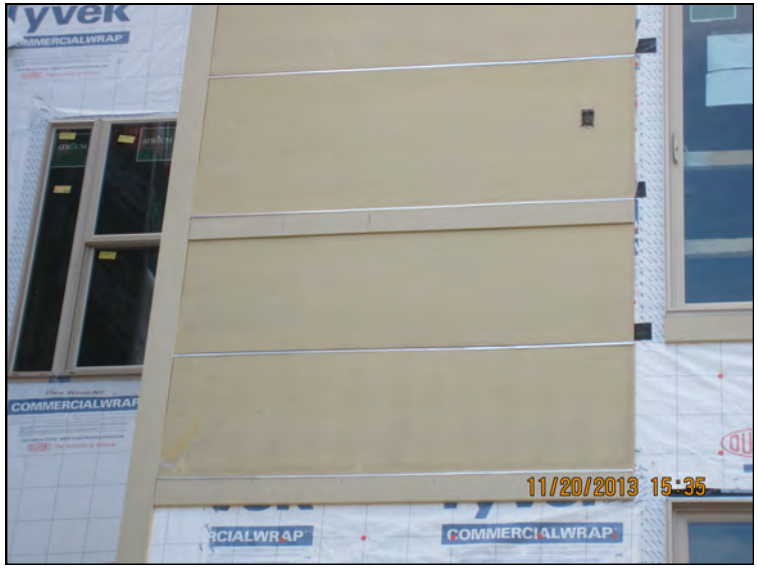

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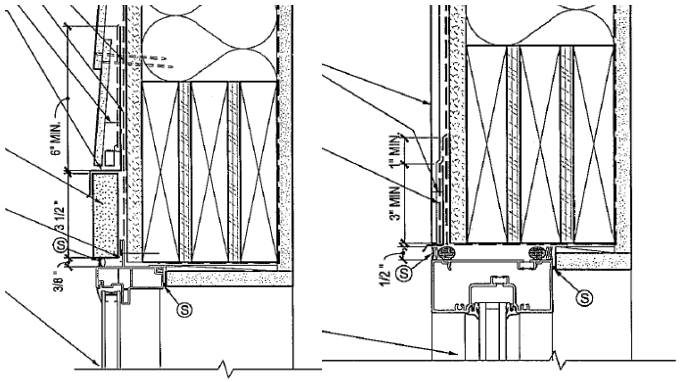

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Walls

- Other Details

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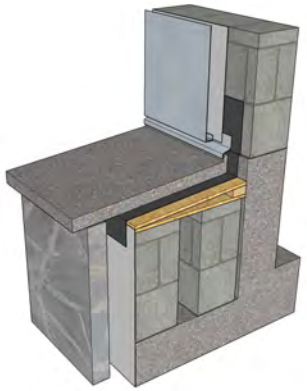
Walls



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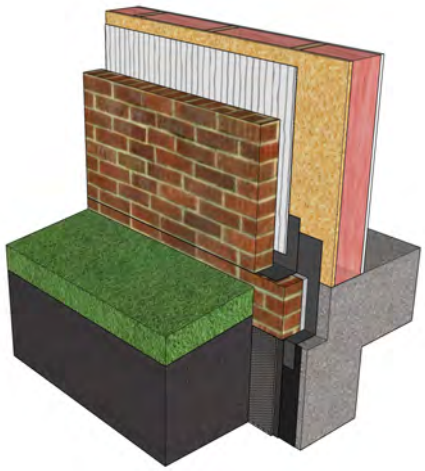

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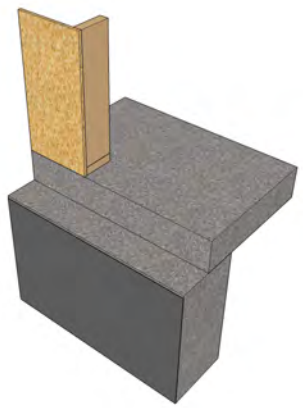

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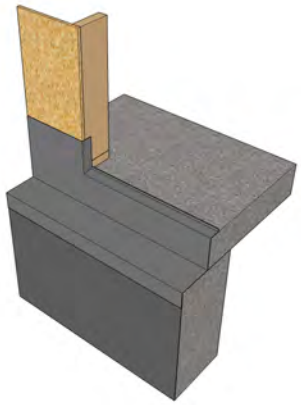

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Walls

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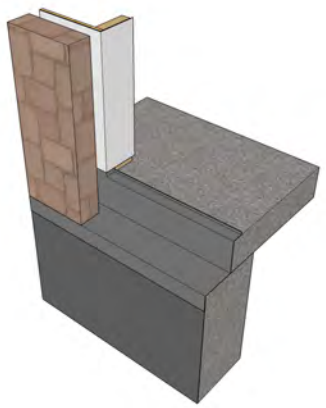

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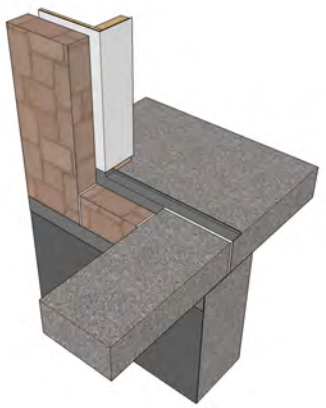

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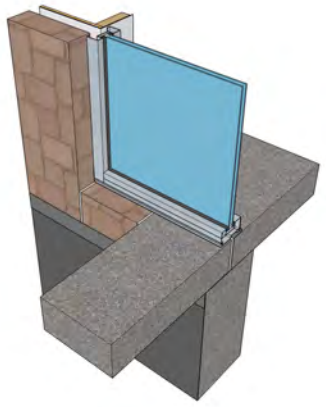

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Roofs

- Physics/Strategies
  - Gravity

That's it

…oh and continuity, durability, inspectability, serviceability replaceability…

Roofs

- Physics/Strategies
  - Near Flat Membrane Roofs
  - Clad Sloped Roofs

Roofs

- Near Flat Membrane Roofs
  - Systems
    - SBS (Styrene Butadiene Styrene Modified Bitumen Membrane)
      - Other names – MBM, Mod Bit.
    - PVC
    - TPO
    - EPDM
  - Which to use?
    - Any of them

Roofs

- What is important for long term performance?
  - Design
    - Proper slope to drain
      - Industry standard is ¼" in 12" minimum. Some clients request ½" in 12". More is better
    - Insulation cover board
      - Provides additional impact protection, and can also act as a hygric redistribution layer
    - Fully adhered system
      - Better stress transfer for wind uplift forces
    - Membrane thickness
      - Thicker membranes have more material, more material is harder to puncture.

Roofs

- What is important for long term performance?
  - Installation
    - Even insulation – avoids ridges
    - Tight corners – avoids tenting
    - Smooth seams – avoids fishmouths
  - Warranty
    - Many of the better manufacturers warranties are achieved from additional inspections by the manufacturer – more people looking at the roof installation = better
  - Testing?
    - Least beneficial for near flat (exposed membrane) roofs

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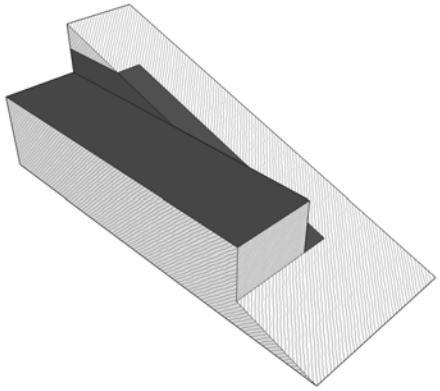

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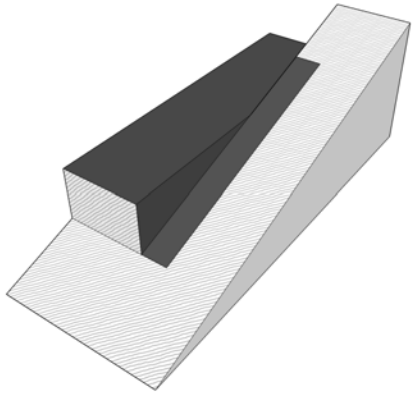


Roofs

- Dry-in (The race against the clock)
  - Critical for most construction schedules
  - Build-up…. Then down…
  - Earlier dry-in can save a lot of money
  - Temporary roofs can be effective and by extension cost effective
  - Types
    - Air barrier membrane underlayments
    - Taped structural sheathing
      - Huber ZIP Roof

Plaza Decks

- Physics/Strategies
  - Gravity
  - Drainage space/capillary beaks
  - Protection
  - Isolation

…oh and you better get it right.

Plaza Decks

- Physics/Strategies
  - Generally categorized as protected membrane roofs
  - Critical element that is not easily serviceable (they get covered by topping slabs, planters, landscaping, etc.) so a robust design and inspection protocol is essential
  - The plaza deck waterproofing should be isolated and protected from all other building and waterproofing components

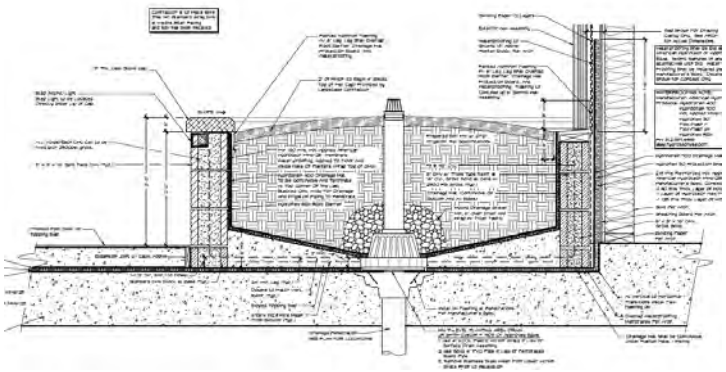
Plaza Decks

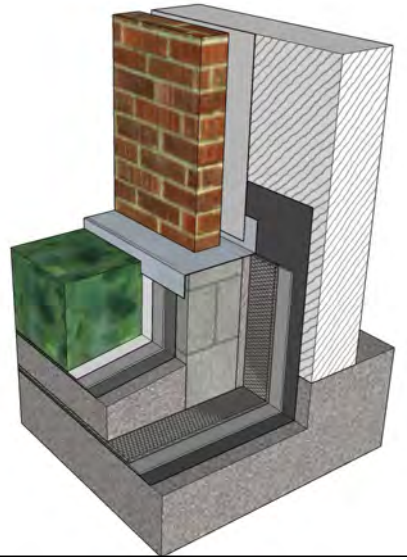
- Systems
  - Typically fluid applied
    - Hot applied membranes
      - Hydrotech 6125
      - Henry 790-11
    - Cold applied membranes
      - Tremco 250 GC
  - Which to use?
    - Hot applied over more critical areas (finished spaces)
    - Cold applied over less critical areas (parking structures)

Plaza Decks

- What is important for long term performance?
  - Design
    - Slope the structural deck
    - Slope the structural deck
    - Slope the structural deck
    - Provide a protection layer and drainage mat
    - Isolated the system from other building elements (such as planters, landscaping, pools, etc.)
    - If possible, provide easily removable systems from above the membrane (pedestal pavers, grid planters, etc.)
    - Provide curbs at penetrations

Plaza Decks





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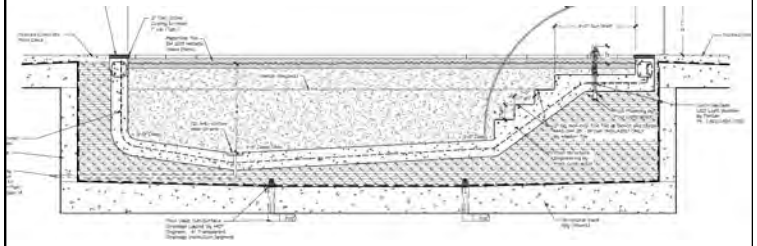

Plaza Decks

- What is important for long term performance?
  - Construction
    - Follow manufacturers installation instructions
      - Mil thickness application
      - Surface preparation
      - Crack/joint treatment
    - Provide sealant or additional liquid membrane cants at corners and transitions – reduces membrane stress and increases water shedding
    - Ensure when staging the application that sufficient membrane is provided for an effective tie-in in the future

Plaza Decks

- What is important for long term performance?
  - Inspection/Testing
    - Check Application Thickness
      - At minimum 1 test be conduct at every day of application regardless of area of coverage.
      - First test to be conducted during the initial 100ft2 of product installation
      - Subsequent tests to be conducted every 500ft2 after
    - Visually inspect membrane and note any deficiencies. If it is suspect, fix it.
    - Flood test areas prior to the installation of landscaping


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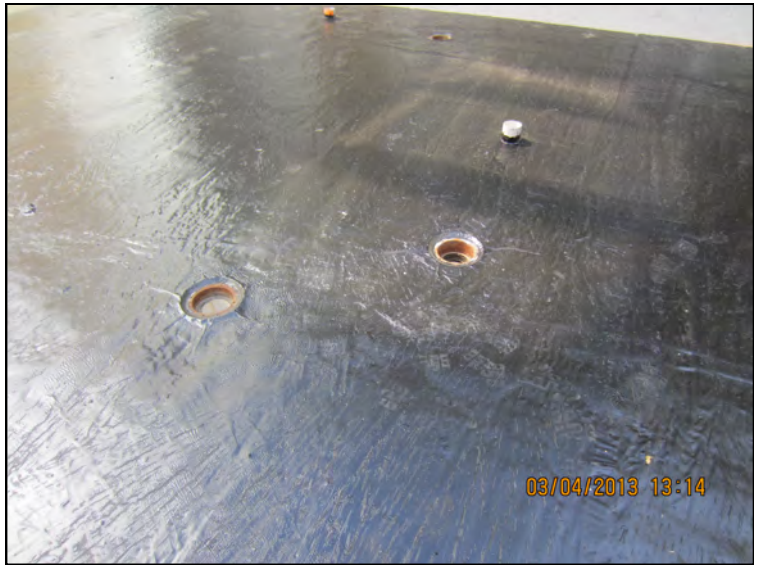
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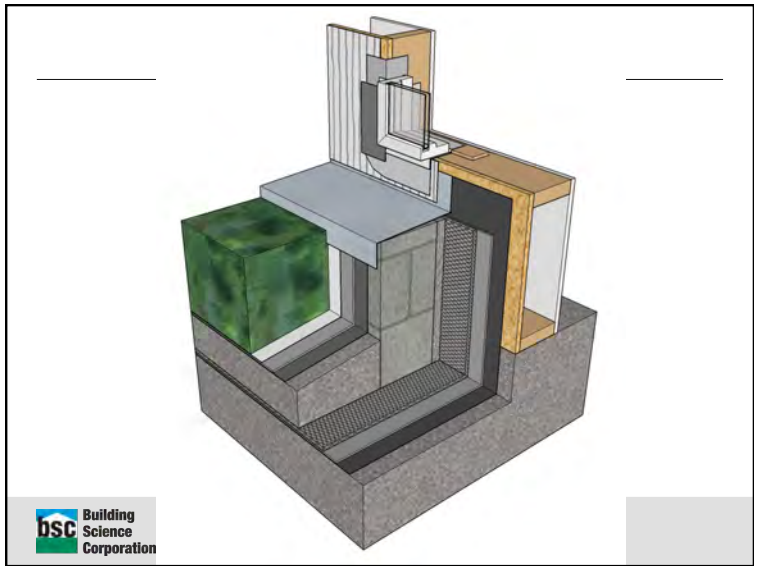


Balconies

- Physics/Strategies
  - Gravity
  - Drainage space/capillary beaks
  - Protection

Balconies

- Physics/Strategies
  - Generally categorized as protected membrane roofs
  - Critical element that is not easily serviceable (they get covered by topping slabs) so a robust design and inspection protocol is essential
  - Usually not over conditioned space, so less critical than plaza decks

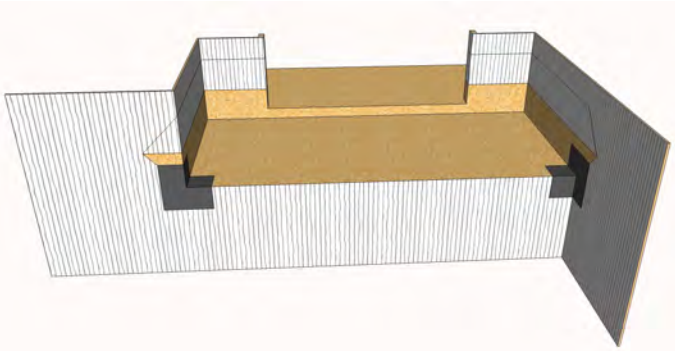
Balconies

- Systems
  - Sheet Membranes
    - Grace Bituthane 3000
  - Fluid Applied
    - Tremco 250 GC
  - Which to use?
    - Whichever you want

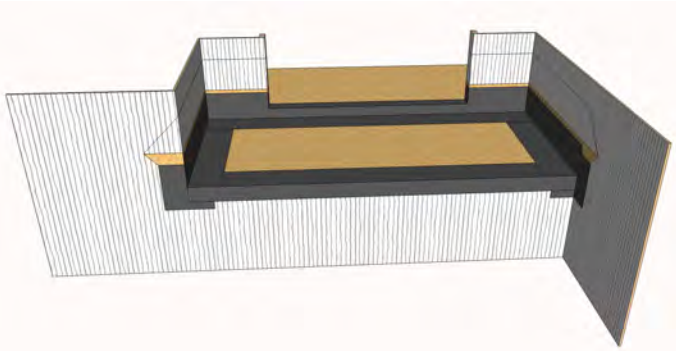
Balconies

- What is important for long term performance?
  - Design
    - Slope the structural deck
    - Provide a protection layer and drainage mat
    - Strip in an edge flashing that directs surface drainage out and over the cladding assembly below
    - If possible, provide easily removable systems from above the membrane (pedestal pavers, grid planters, etc.)
    - Provide curbs at penetrations

Balconies



Balconies



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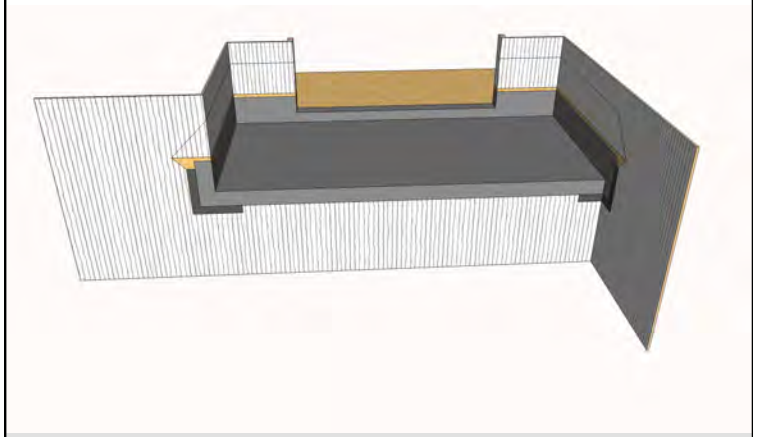

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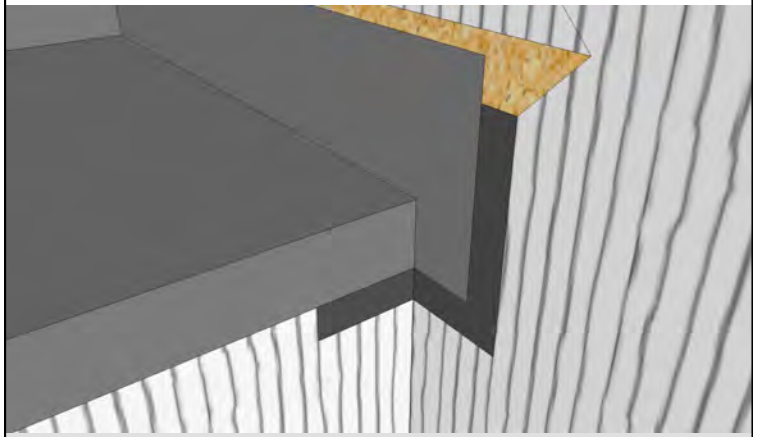
Balconies



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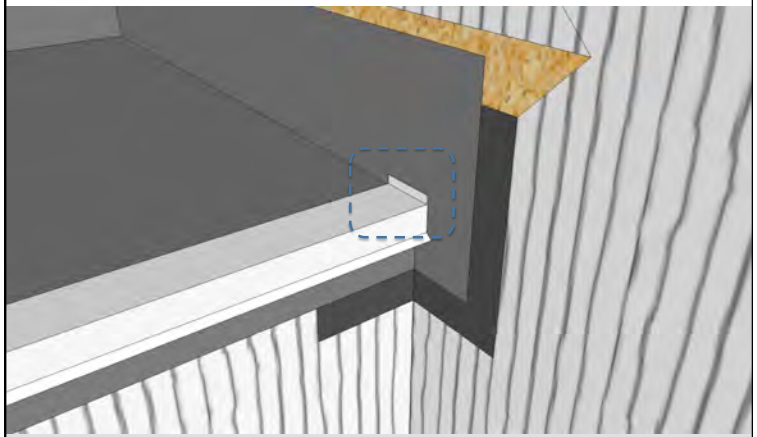
Balconies



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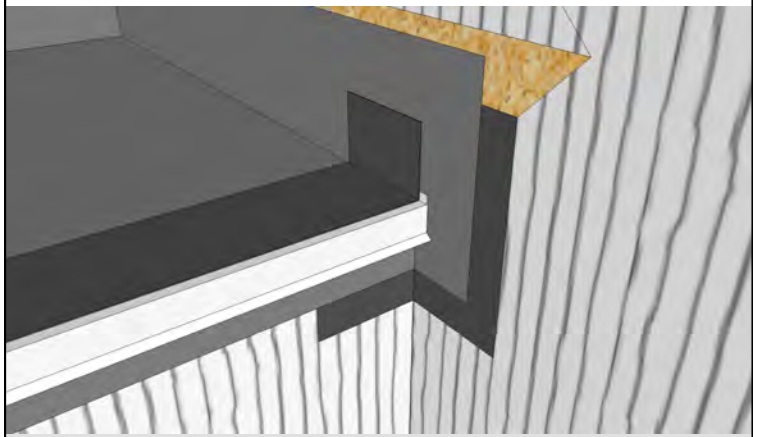
Balconies



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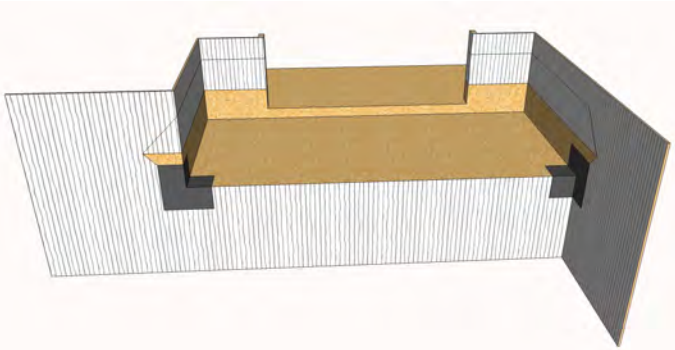

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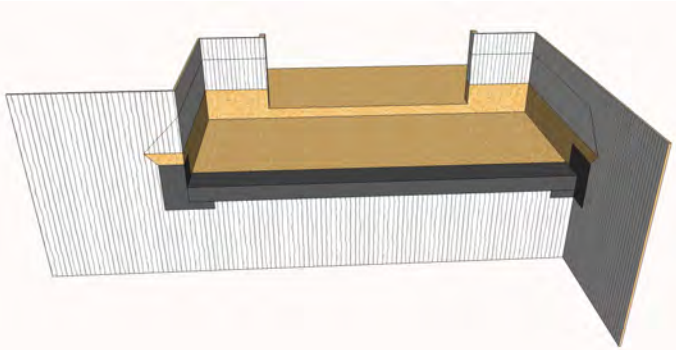

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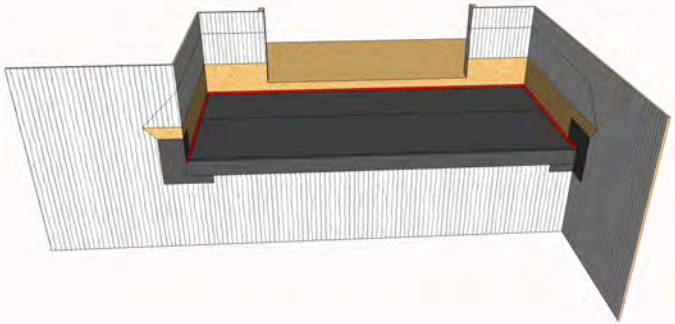

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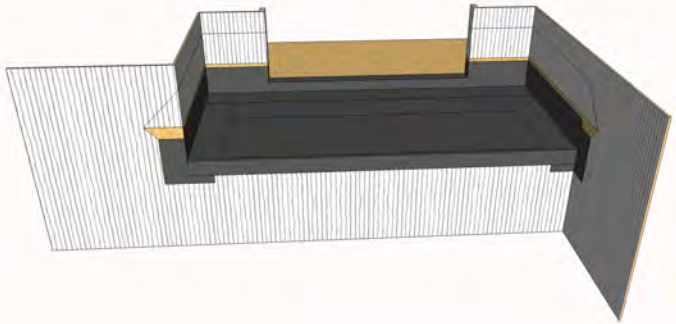

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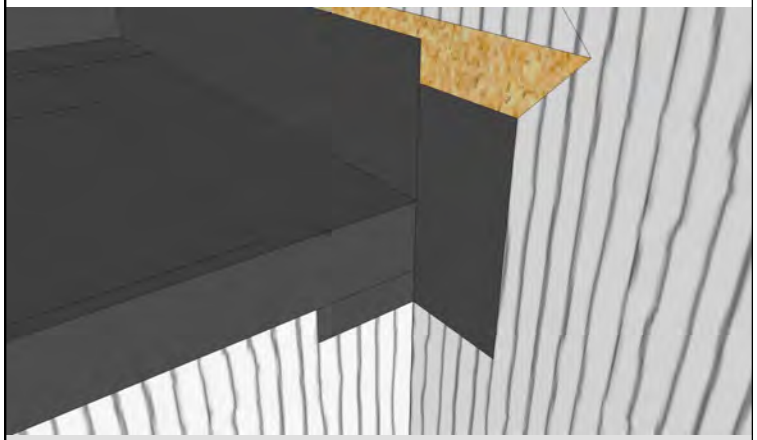

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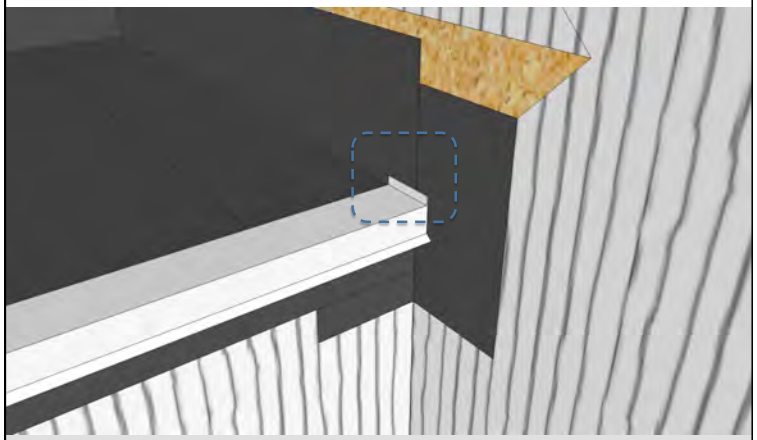

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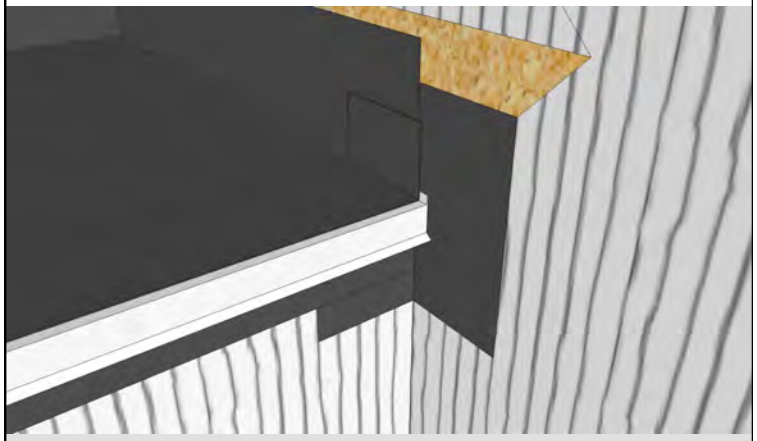

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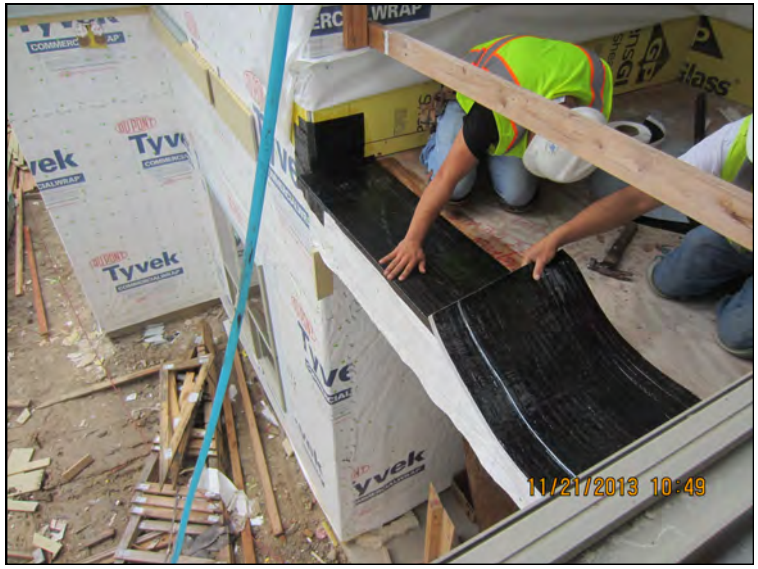
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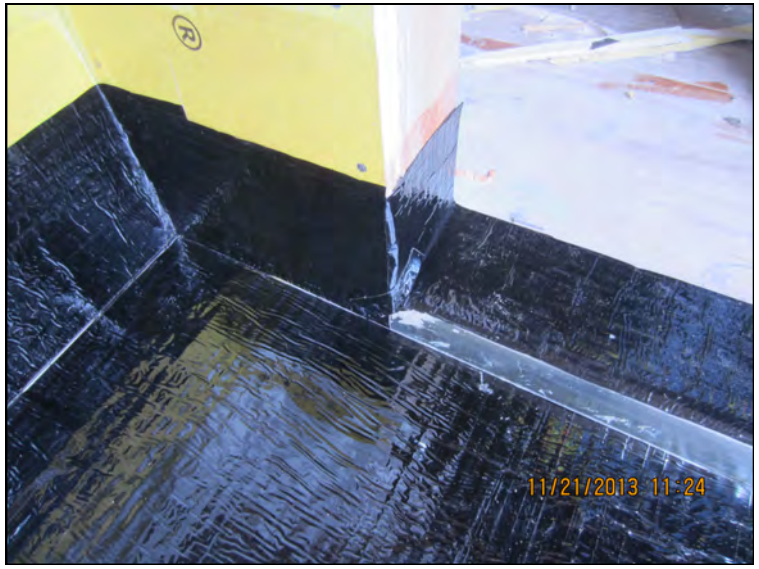
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Windows/Doors

- Physics/Strategies
  - Gravity
  - Pressure Moderation (Two-stage joints)
  - Three seals
    - Primary
    - Interior
    - Exterior
  - Pan flashed and drained openings
  - Dealing the window industry (they are a force unto themselves)

Windows/Doors

- Window Seals
  - Recommend Three Seal Locations
    - Primary – integrated with the wall water control layer
    - Interior – interior air seal for pressure moderation
    - Exterior – weather/aesthetic seal at the window to cladding interface

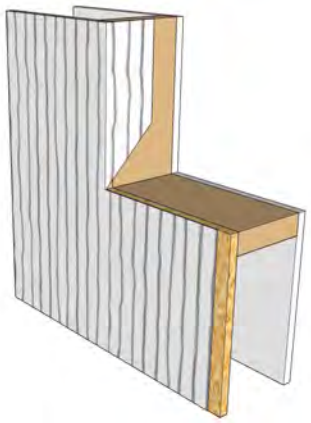
Windows/Doors

- Window Seals
  - For flanged windows the primary seal is made be taping the flanged to the wall WRB
  - For non-flanged windows, the primary seal will either be:
    - A backer rod and sealant joint
    - A membrane flange adhered directly to the window frame and WRB.
  - Interior Seal is typically a backer rod and sealant joint or a bead of low expansion foam
  - Exterior is typically a backer rod and sealant joint

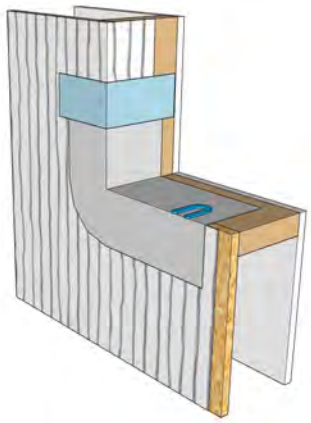
Windows/Doors

- Window Installation
  - Three general types
    - Flush with WRB
    - Recessed opening
    - Bucked out opening
  - Flush with WRB is easiest, lowest cost and least risky

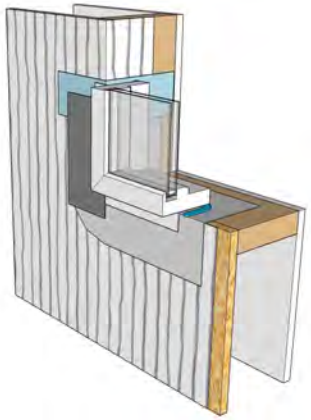
Windows/Doors



Windows/Doors



Windows/Doors



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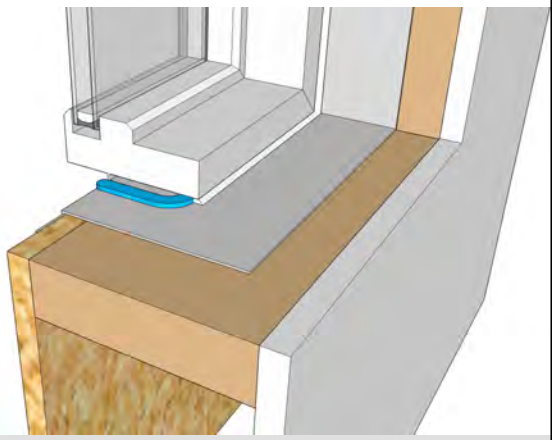
Windows/Doors



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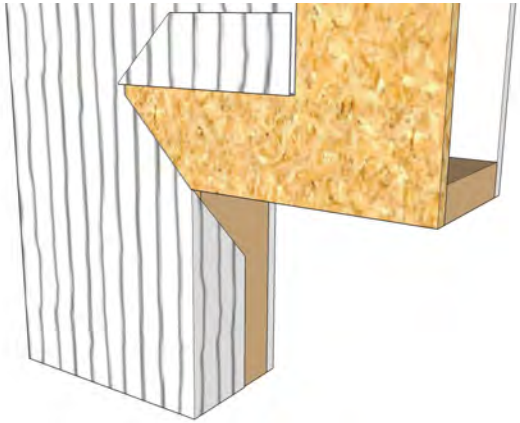

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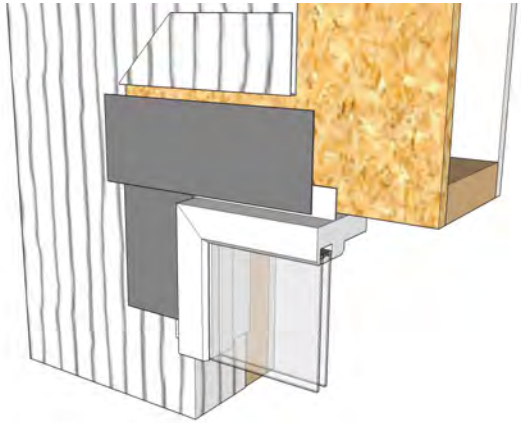

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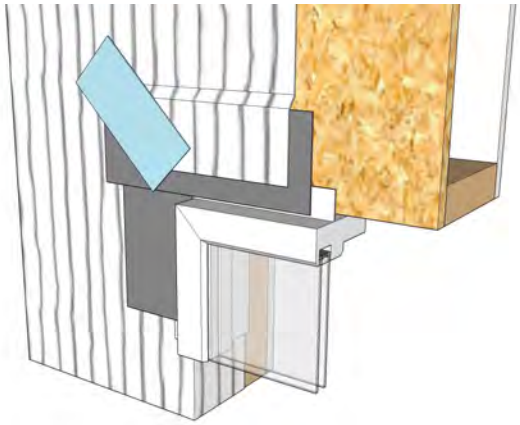

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Windows/Doors

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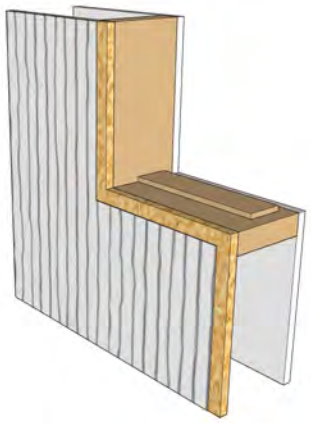

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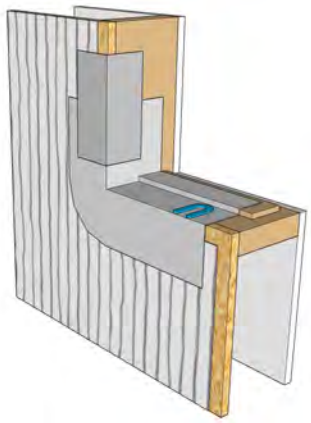

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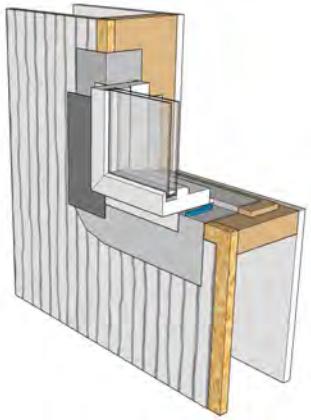
Windows/Doors



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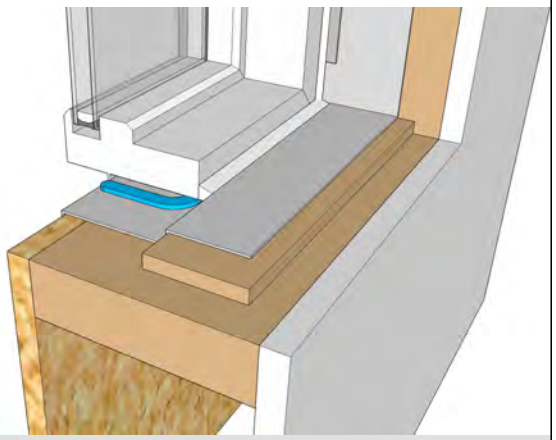
Windows/Doors



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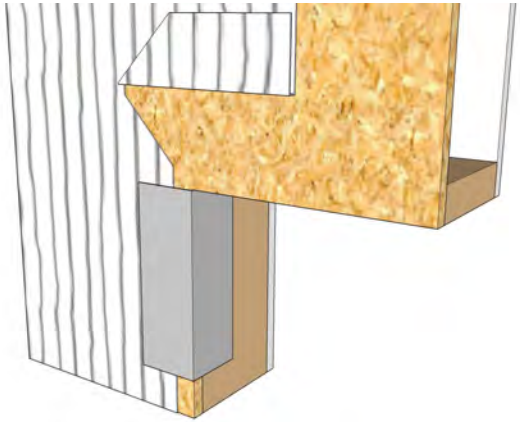
Windows/Doors



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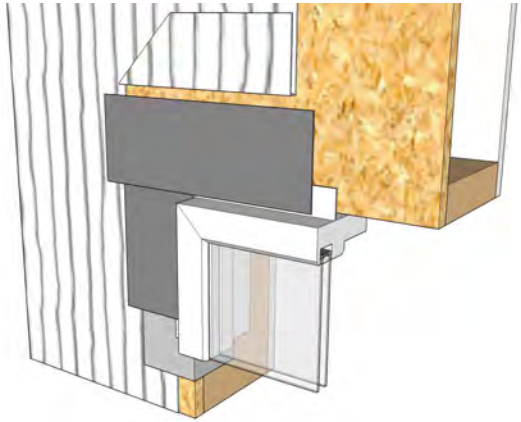

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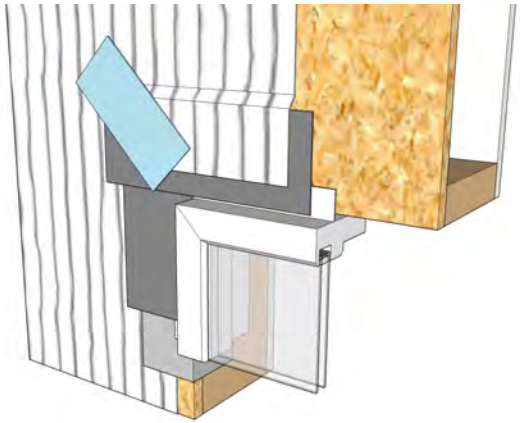
Windows/Doors



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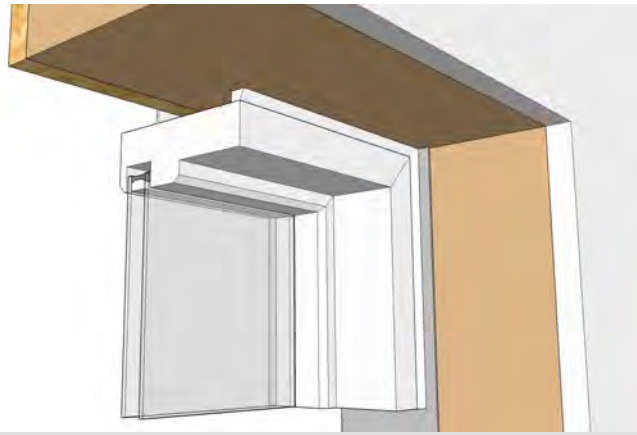

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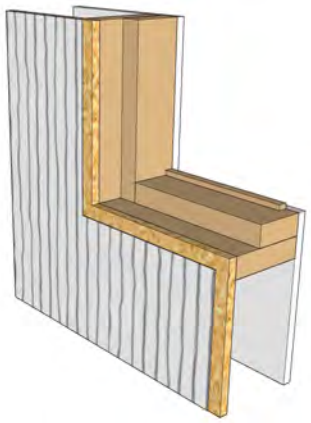

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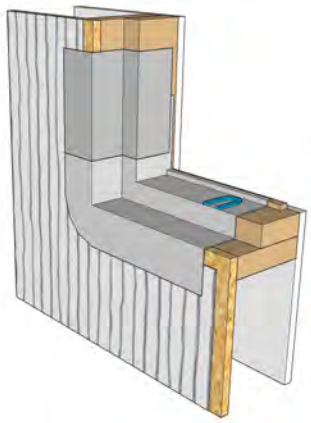

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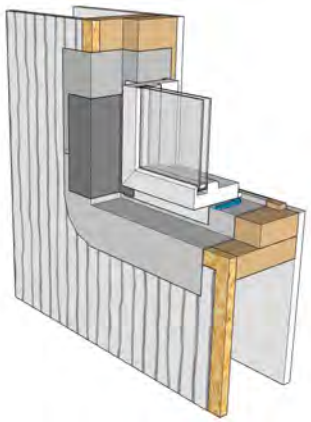

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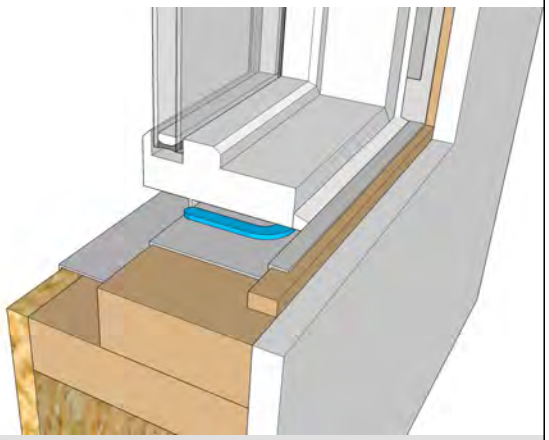

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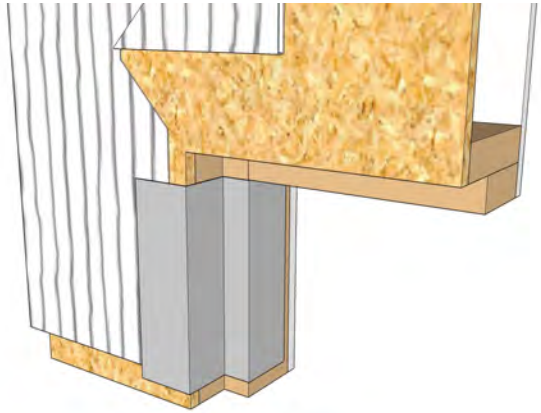

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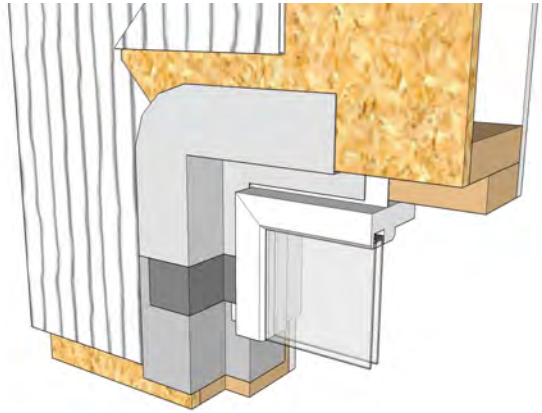

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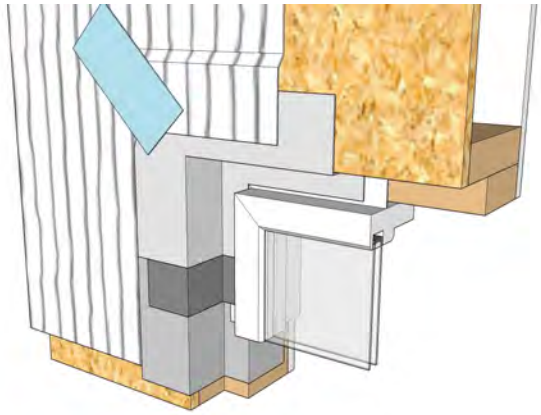

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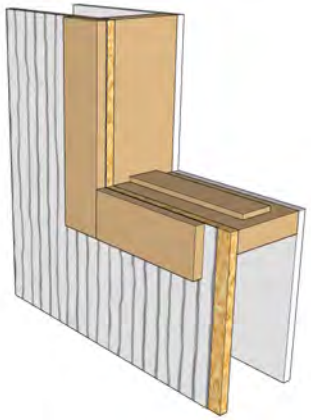

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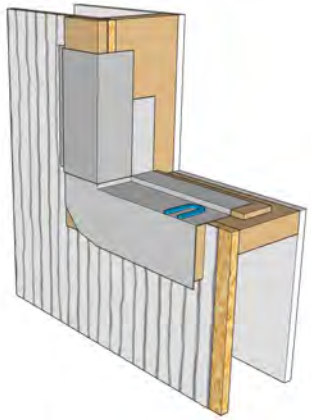

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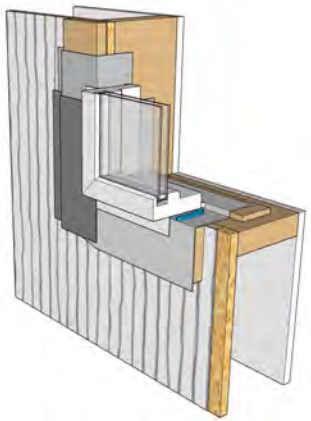

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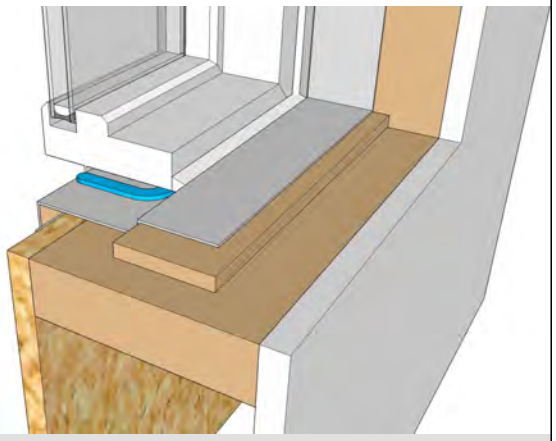

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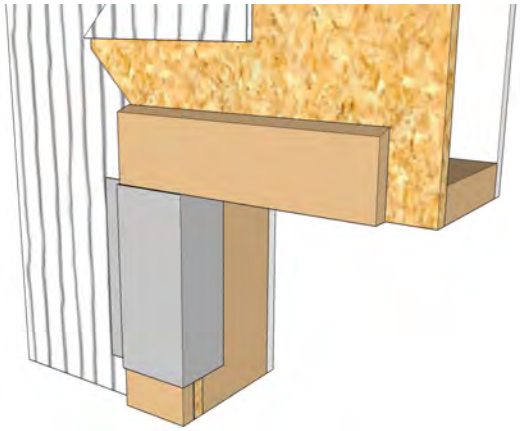

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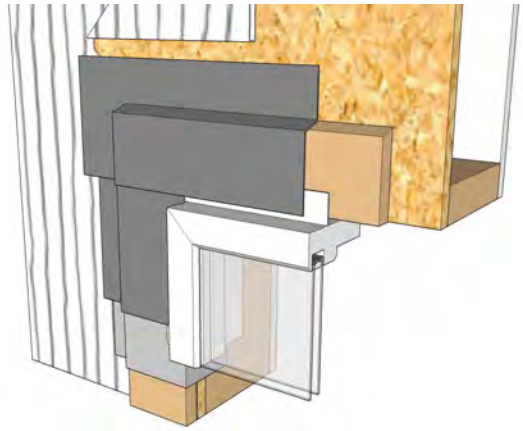

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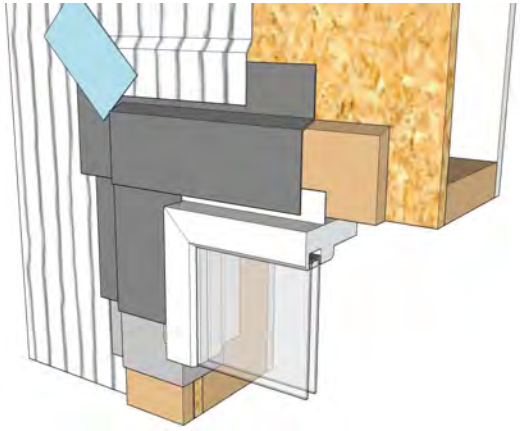

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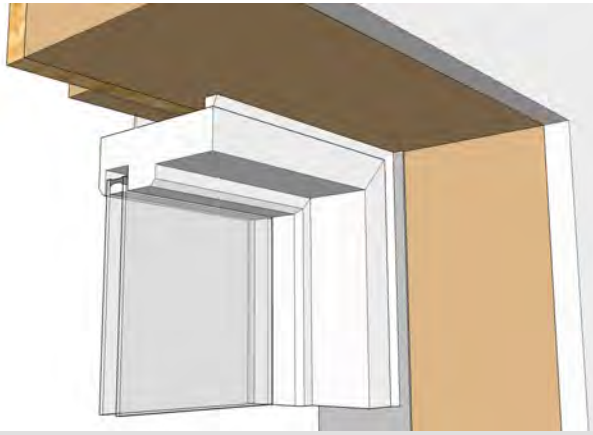

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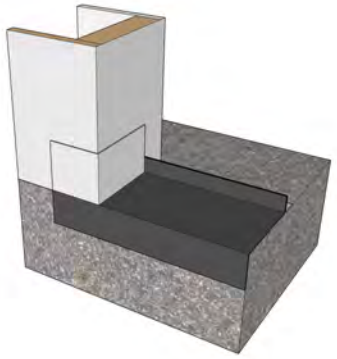
Commercial Glazing

- Physics/Strategies
  - Gravity
  - Pressure Moderation (Two-stage joints)
  - Three seals are ideal (usually only two is achievable)
    - Primary
    - Interior
    - Exterior
  - Pan flashed and drained openings

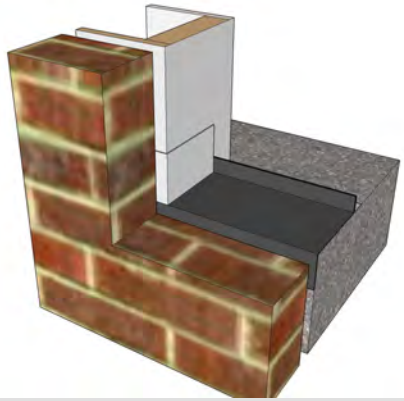
Commercial Glazing

- Systems
  - Aluminum Storefront
  - Curtain Wall

Commercial Glazing



Commercial Glazing



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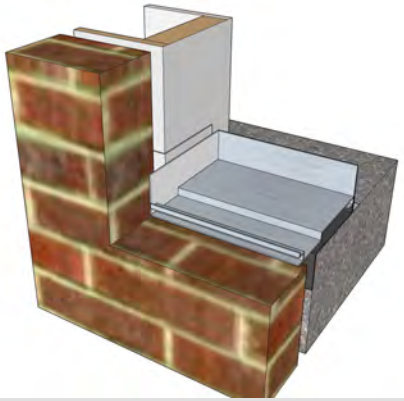
Commercial Glazing



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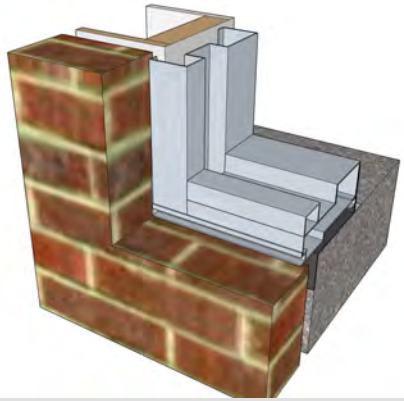
Commercial Glazing



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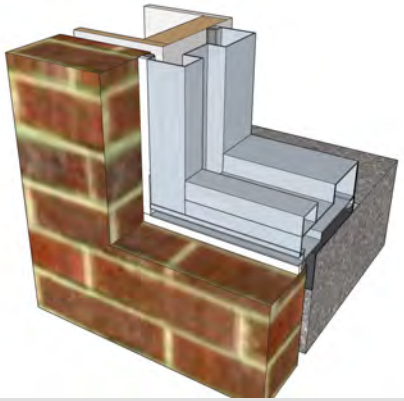
Commercial Glazing



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StraightFlash
Flex Wrap NF
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Flex Wrap NF
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12/09/2013 12:31


12/09/2013 12:32


DuPont
Flex
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Testing/Standards

- Window Standards
  - AAMA 101
    - This is the overall window and door standard that provides the basis for product certification
    - This is a manufacturers standard not a consumers standard
    - Within the standard are a series of product classifications as well as gateway requirements class
    - Within the standard are a series of laboratory tests used to evaluate the products for certification
      - ASTM E330 – Structural Performance
      - ASTM E331 – Water Leakage

Testing/Standards

DP Rating

Water resistance = 15% of DP Rating

Table 1
Gateway requirements
(See Clauses 0.2.1, 4.3, 4.4.2.3, 4.4.2.4, and 4.4.3.4.)

Product performance class	Minimum performance grade	Minimum design pressure, Pa (psf)	Minimum structural test pressure, Pa (psf)	Minimum water resistance test pressure, Pa (psf)
Windows and doors				
R	15	720 (15.0)	1080 (22.5)	140 (2.90)
LC	25	1200 (25.0)	1800 (37.5)	180 (3.75)
C	30	1440 (30.0)	2160 (45.0)	220 (4.50)
HC	40	1920 (40.0)	2880 (60.0)	290 (6.00)
AW	40	1920 (40.0)	2880 (60.0)	390 (8.00)

Testing/Standards

- Window Testing
  - *AAMA 502-11 Voluntary Specification for Field Testing of Newly Installed Fenestration Products*
    - *Recommends 10% of DP rating but not less than 1.9psf*
  - *AAMA 503-08 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems*
    - *Recommends 10% of DP rating but not less than 4.18psf*
  - These documents both reference *ASTM E1105 Standard Test Method for Field Determination of Water Penetration*

Testing/Standards

- Window Testing
  - *ASTM E1105 Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform or Cyclic Static Air Pressure Difference*
  - This is a test of the window system, and not the window to wall interface
  - We often use this test to evaluate both
  - Is this a reasonable test?

Testing/Standards

- Window Testing
  - *ASTM E1105*
    - 15 minute static test or 5 minute cyclical test (4 cycles)
    - 10% DP rating
    - Water delivery at 5.0 gal/ft2.hr
  - Let's look at this…

Testing/Standards

- Window Testing
  - Assume DP50 window
    - 50psf x 10% = 5.0psf or 0.96in of water
    - 5.0psf is roughly equivalent to 45mph wind
    - 5.0gal/ft2.hr is roughly equivalent to 8.0in of rainfall per hour
      - From E1105 the greatest recorded rainfall in the contiguous United States is 5.0in
    - These conditions are maintained for 15minutes or for four 5 minute cycles with a 1 minute break in between
  - This is a pretty aggressive test and not necessarily indicative of the in-field performance of the assemblies


Tyvek
10/16/2013 13:21


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10/29/2013 15:52


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Testing/Standards

- Passing the Test

Testing/Standards

- Test Specific Failures

Questions?

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