Building Construction and Water Intrusion

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Design considerations that can effect the construction characteristics, performance, and water shedding effectiveness of the building envelope.

- Building envelope choice
- Code issues specific to the building envelope
  - Secondary barrier requirements
  - Rated exterior envelopes
- Details often left to the trades; cost considerations during the construction documents phase.
Building envelope types

Drainage systems (traditionally more residential in scale):

• Wood panel, wood stock, hardboard, wood shingle, cement board materials, etc.

• Conventional three coat stucco; and increasingly common, one coat or other hybrid systems.

Barrier systems (traditionally low and high rise commercial):

• EIFS (Exterior Insulation Finish System).

• Curtain wall; glazed, pre-fabricated panels.

• Also, “water managed” barrier systems
Barrier vs. drainage system in the code

“1402.1 Weather Resistive Barriers. All weather-exposed surfaces shall have a weather-resistive barrier to protect the interior wall covering…… equal to that provided for in UBC Standard 14-1…

A weather-resistive barrier may be omitted in the following cases:

1. (of 6 exceptions): When exterior covering is of approved weatherproof panels.”

“1402.2 Flashing and Counterflashing. Exterior openings exposed to the weather shall be flashed in such a manner as to make them weatherproof.”
Barrier system typical problems

- Field panel cracking/delamination (EIFS)
- Sealant issues/failures
  - Poor sealant specification, poor joint configuration, backer rod issues, poor mixing of multi-part sealants.
  - Cohesive failure, adhesive failure, improper curing.
- Window (product) failures
- Incorrect/failure of flashing systems. Poor integration of drainage systems at unique locations.
- Other miscellaneous penetrations
Hotel: Originally designed as an EIFS envelope, changed to stucco with building paper during construction.
Issue 1: Poor configuration of sealant joint/backer rod, poor joint preparation, multiple failures.

Above: Thin sealant, cohesive failure.

Side: Backer rod improper location/joint depth.
Issue 2: Poor/no integration of building papers in a drainage system; weather-lapping and material selection improper.
Secondary barrier requirements

The minimum requirement for Grade ‘D’ building paper is to be water *resistant* for 1/6 hour or 10 minutes.

Building paper is not waterproof.

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Generic wall assembly

No sheathing.
Drainage good
between studs

Structural sheathing
Drainage impaired
continuous contact

Fire & Structural sheathing
Drainage impaired continuous
contact absorbent material
Generic Wall Assembly, gypsum sheet absorption

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- Hardiplank, 2” at 7 days
- Gypsum Board, 39” at 7 days
- Hardboard, 3/4” at 7 days
- Gypsum Sheathing, 23” at 7 days
Typical conditions left to the trades (not detailed):

• Roof to wall connection at diverter location
• Elevated deck/walking surface
• Rail cap/parapets
• Concrete slab to framed wall
• Windows
• Civil issues/crawlspace
Example: building type 1

Example: building type 2

Built 1960’s

• Large buildings with additional structural and fire resistive requirements.

Built 1990’s

• ‘Humanizing’ the scale of the building with many different and complex envelope details.
Roof to wall

Z-BAR

DIVERTER
Roof to wall

WALL SYSTEM

90° Z-BAR FLASHING

METAL STEP FLASHING

ROOF SHEATHING
Elevated Walkway to Wall - Schematic

NOT DETAILED

TYP DETAIL

TYP DETAIL
Walkway to wall detail - Problem
WHAT GETS BUILT

- Exterior Wall Finish
- Wall Exposed to Concrete (Multiple Trade Integration)
- Area of Big Leak
- Area of Small Leak
- Open Edge Flashing Abutted to Siding
- Walking Surface
- Wall Flashing
- Membrane
- Plywood Decking
Walkway to wall detail
WHAT GETS BUILT
Walkway to wall - Damage
Highest moisture content is confined to the border of the gypsum sheet affected.
Walkway to wall – Influence of gypsum board

Elevated moisture levels and subsequent damage in siding material (and studs beneath) reflected by the outline of the gypsum sheathing beneath that remains at a consistently high moisture content.

The only method for the gypsum sheathing to dry is by evaporation.
Rail Caps
Rail Caps

3/8" GAP AT SHEET METAL
CAP END TO SIDING
(BUTT JOINT CONNECTION)
FRAMING VISIBLE WITHOUT
DESTRUCTIVE TESTING

3/8" GAP CCAP TO TRIM

SEALANT CRACKING
Slab to framed wall
Slab to framed wall – As built example 1

TOTAL RELIANCE ON WATERPROOFING “SYSTEM” AND ACCURACY OF THE POUR

OUTSIDE

THIN ALUM. SHT. (flimsy)
VERTICAL ONLY

PROTECTION BOARD (turn up to bottom of weep)

TOPPING SLAB

INSIDE

CONCRETE SLAB

MEMBRANE turns up onto aluminum, (paint film thickness)

1/4” OFFSET
Slab to framed wall – As built example 1

- Stucco/paper removed
- OSB decay
- Aluminum
- Membrane turn up
- Topping slab removed
Slab to framed wall – Example 2; original detail

WALL SYSTEM WITH GYPSUM SHEATHING

OUTSIDE

WATER UNDER

CONCRETE SLAB

INSIDE

GALV. SHT. MTL. FLASHING

3,000 LINEAR FEET

1/2"
Slab to frame wall – Example 2
Architect revised detail

DESIGN CHANGE 1

DESIGN CHANGE 2

3,000 LINEAR FEET
Slab to frame wall – Example 2
As-built. 3,000 linear feet

Inside units at building perimeter.

Tried original detail with peel and stick.
Gypsum board, under the siding, in contact with concrete, absorbs water and keeps the wall system damp well after the water event has terminated.
Window

Primary barrier at window has failed and not been maintained by homeowner.
Building paper deteriorated, gypsum board absorbed water beyond water intrusion point. (window also reverse flashed)
Window

Damage to framing stops just above sill at right jamb where water intrusion is more limited and there is a gypsum board joint.
Grade Considerations
Grade considerations

Exterior grade and slab edge conditions suspect.
Crawlspace – No ventilation
Crawlspace – Vapor barrier
Maintenance

Typical maintenance (owner) issues that effect the long term performance of the building.

• Understanding of useful life

• Landscape issues
  • Poor maintenance
  • Owner hardscape/landscape additions
  • Sprinklers

• Improper maintenance, poor understanding of original system design.

• Building movement issues.
Maintenance; plumbing leak

Water heater leak (8-12 yrs old). Only leaking a few months. In closet opposite side of wall.

Note: owner had report this as a roof leak.
Paint/Sealants
Paint/Sealants
Landscape management
Owner additions – Landscape/Hardscape

Owner installed patio over stucco weeps. Some of remaining foundation vent visible in rear of photo. Owner landscape issues.
Landscape control

Tree root growing under slab has buckled wall. Out of plane approximately 6” at base of wall. Source of water intrusion.
Sprinklers – Landscape control
Silicone at laps.
Trim rot.
Gap and missing sealant at window frame to trim.
Silicone at laps.
Poor/Improper Maintenance
Poor/Improper Maintenance
Poor/Improper Maintenance
Poor/Improper Maintenance – Example 2
Building movement - Examples