Better Walls:
Wall Strategies for Wood Frame Construction Durability

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Modern Walls

Modern architectural design and building codes concerned with better performance (energy, fire, etc.) are forcing us to find different methods of cladding walls to ensure building durability

Walls now must often perform both interior and exterior moisture management to a much higher standard than historically required

The Issue

- bulk moisture from the interior or exterior environment must not be allowed to reach and remain in the building structure in quantities sufficient to adversely affect the structural components
- moisture (wetting and drying) must be managed so that levels within the wall structure never exceed the ability of the wall structure and components to tolerate it

The Discussion

- This document focuses on strategies for managing or controlling the larger moisture control problem in this climate: exterior moisture

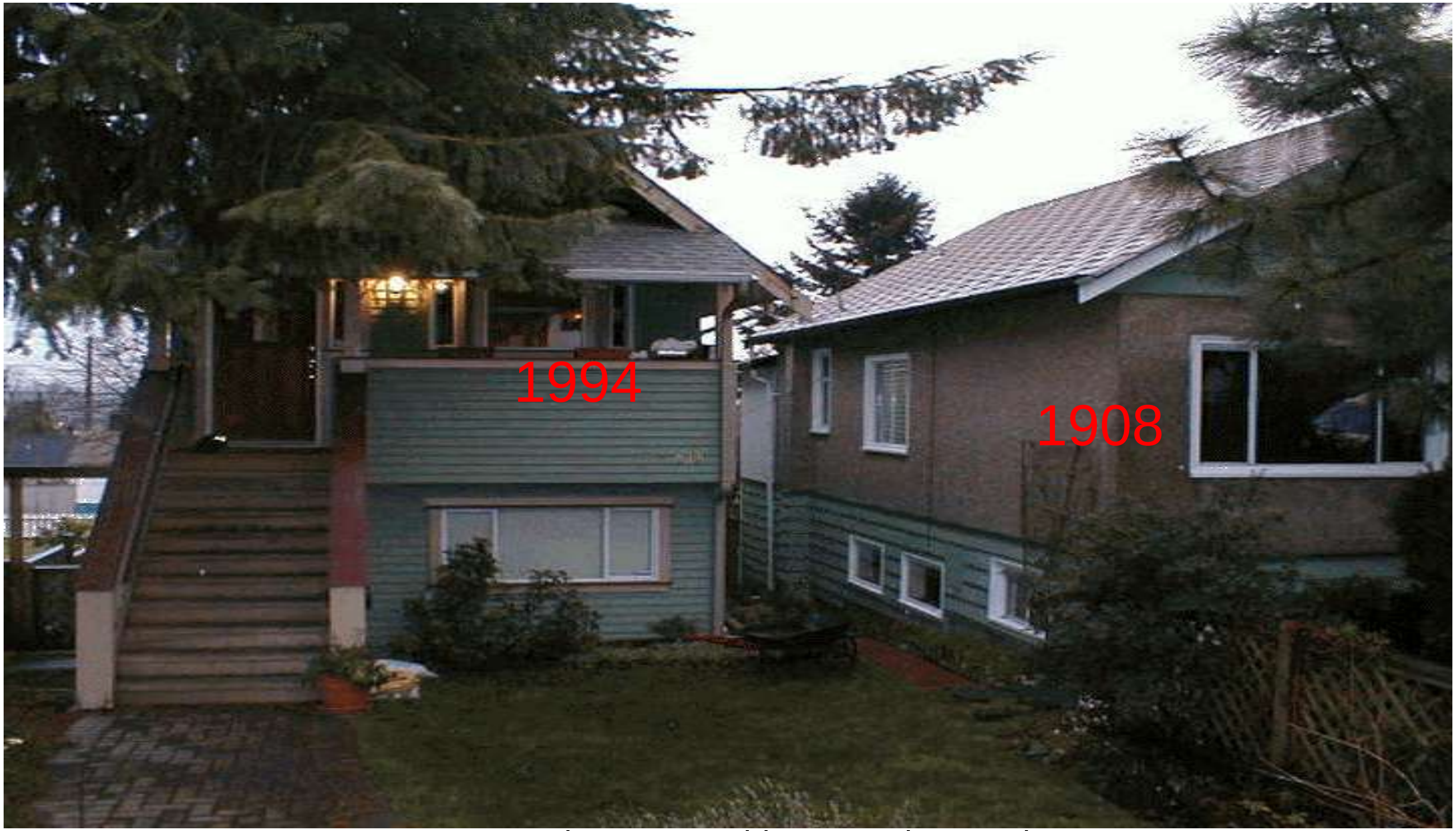
Today's Situation

- research into modern distressed walls has caused the evolution of new strategies for "best practices" of wall construction
- these "best practices" and our ability to implement them are becoming the benchmarks by which we are judged as designers or builders

How Did We Get Here?

- The Lower Mainland and Coastal Areas have very unique climates in terms of moderate temperatures and relatively constant humidity and wetting
- Traditional housing styles have not generally suffered moisture related wall failures
- Traditional housing styles are not necessarily what the consumer wants

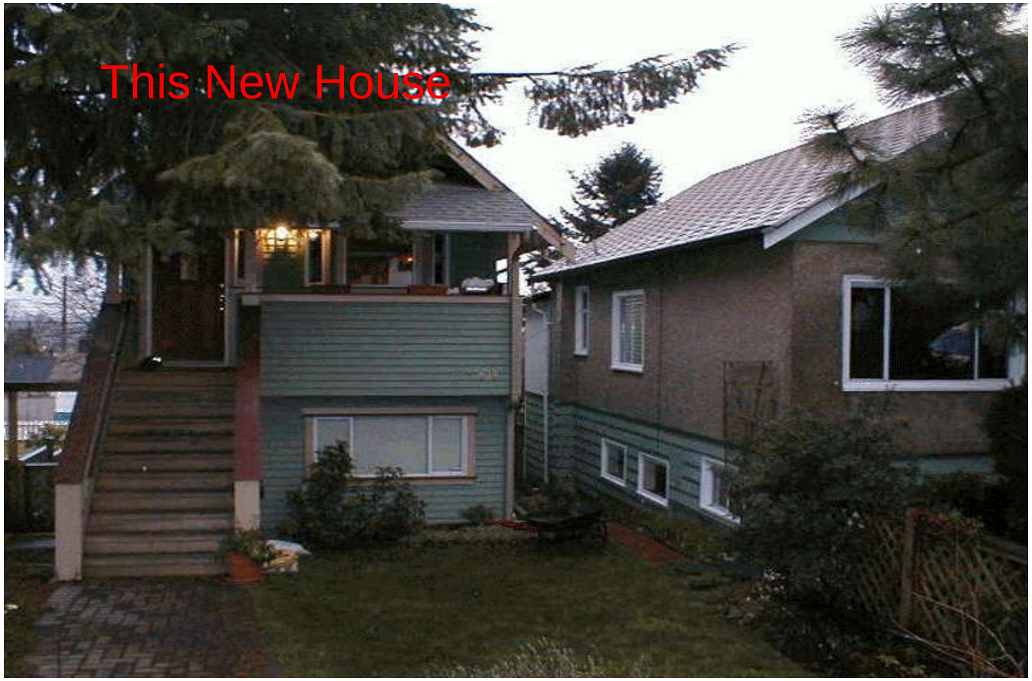
This Old House (and This New House)



This Old House

- circa 1908 (??? code)
- vapour barrier (interior oil paint), stick frame (cedar 2x4), insulation (wood chip R5?), concealed barrier cladding c/w moisture/air barrier (roofing felt), 1x10 cedar siding (backprimed) & rock dash stucco, overhangs
- drafty, cold, noisy
- has just passed the 100 yr. durability mark

This New House



- circa 1994 (1992 code)
- vapour barrier (poly), stick frame hem/fir (2x6), insulation (R20), concealed barrier cladding c/w air/moisture barrier (tyvek), 1x6 cedar siding (backprimed), overhangs
- comfortable, quiet
- Just passed 15 yr. durability, should eventually pass 50 yr. ??, 100yr?

Are All New Houses Equal ?

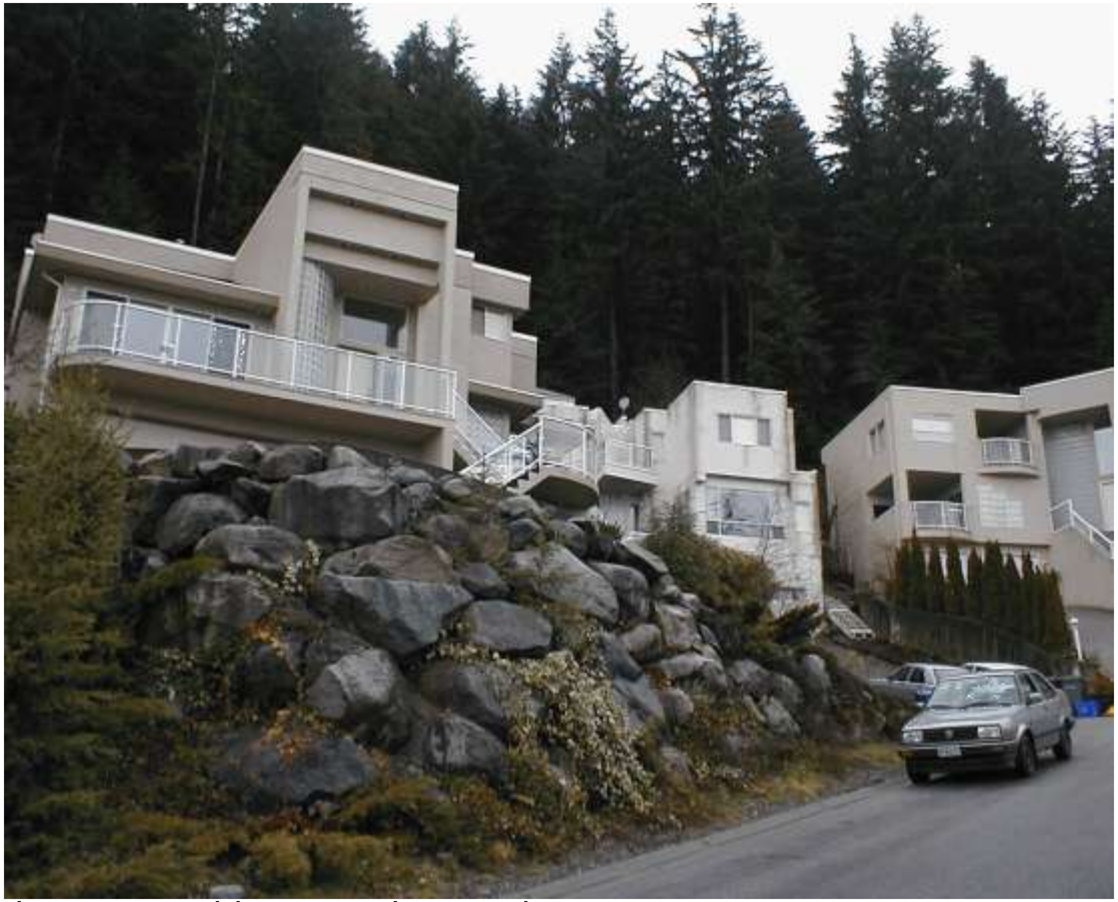
- We apply the same prescriptive “minimum standard” building code to all Part 9 housing
- this standard may be perfectly acceptable for many walls, however
- It is now accepted that <u>all walls are not equal</u> and that each wall should be appraised, designed, and constructed considering ***exposure risk***

Exposure Risk

- ***Low Risk*** = the "traditional house" in a "protected location"
  - Add architectural complexity to floor plans
  - Add decks, balconies, bay windows, walkways
  - Add height and reduce overhangs or protective features
  - Add more complex and larger windows and skylights
  - Add mixture of claddings with interfaces between each
  - Add purely architectural detail features and complexity
  - Add exposed location, remove trees, etc.
- = ***High Risk***

This Other New House

- Circa 1995
- 5 yr.problem free ????
- 50 yr ???
- To be durable wall assembly may have to be very different from the “traditional house”



Risk Summary

- Every building will fall somewhere on the ***risk*** scale
- the more complex the architectural design and the more exposed the wall facades the higher the ***risk***

The Traditional Wall
(Air/Vapour Barrier/Insulation/Structure)

- in residential home building we are used to traditional stick framing with some value of insulation within the wall
- recently the components of this wall were altered to make habitats more comfortable
  - increasing performance of vapour barriers
  - increasing insulation
  - increasing air tightness
- this equals more comfortable interiors but also colder walls with less drying potential

The Cladding Assembly

- for the traditional wall to work and be durable moisture reaching the structure and moving through the structure must be managed within the range of the ability of the structural components to withstand it
- The air barrier and the wall cladding design and materials must perform this function

The Air Barrier

- ☒First we must try to ensure that an ***air barrier*** is present and functional in any wall assembly
- ☒if air cannot move through the assembly then neither can water
- ☒the air barrier must be complete and durable
- ☒the air barrier can be polyethylene, airtight drywall, a house-wrap, or a sheet/liquid membrane (if appropriately placed)

The Cladding

- Second, we must ensure that the exterior cladding assembly can manage moisture reaching the wall

The 4 d’s

- the wall cladding 4 d’s to ensure a durable structure
  - deflection:
    - water is kept out
  - drainage:
    - water can drain out over shingled components
  - drying:
    - remaining water can dry or vent out
  - durability:
    - if likely to be occasionally wet, the components are durably moisture tolerant

4 Wall Cladding Strategies

- face seal
- concealed barrier
- cavity wall rain-screen
- exterior insulated cavity wall rain screen
  - how do they stand up to the 4-d's ?

The Exposed Surface

- Some wall strategies, especially prevalent in the 1980’s, had assumed that 100% of the moisture hitting the wall can be managed at the outside skin of the building
  - these were the “face sealed” wall assemblies

Face Seal

- the ***face seal*** assumes moisture can be controlled by the outside visible skin of the building acting as the primary (and only) barrier resisting all water penetration **(*deflection*** strategy)
- the inability to control the ***face seal*** integrity of large areas of cladding, sealant for penetrations and dissimilar materials, and structural movement and cracking influence the success of this strategy
- exposure to climatic stress and lack of breathability ***if moisture penetrates the assembly*** also influence the strategy
- the ***face seal*** approach may be appropriate if the wall is ***low risk*** (i.e. it is a protected/sheltered wall)

Add Redundancy

- assume that the outside skin can handle most of the moisture hitting the wall
- ***BUT*** also assume that some small percentage of moisture will penetrate the outside skin
  - the reality in the Greater Vancouver Climate
- should any percentage of moisture penetrate the outside skin add the extra “back-up” strategy to manage moisture
- this back-up is ***redundancy***

Concealed Barrier

- for generations we have had what is termed as the ***concealed barrier*** approach that assumes some moisture will penetrate the exterior cladding
- the ***concealed barrier*** approach intends that a moisture barrier and some shedding ability will help prevent moisture from damaging the structure thus providing a small redundancy to the integrity of the cladding
  - ***deflection*** with a moderate ***drainage*** strategy
- the strategy is very dependent on the moisture barrier (sheathing paper) not becoming damaged or contaminated
- the strategy is very dependent on design and quality of workmanship of details (moisture barrier and flashing installation)
- for generations the ***concealed barrier*** has generally worked in this climate in ***low*** to ***moderate risk*** exposures

Cavity Rain Screen

- the evolution to the ***cavity rain-screen*** approach assumes that the primary water shedding surface can fail (***deflection*** strategy) and should have a secondary and separated line of defense
- the ***cavity rain-screen*** approach introduces true redundancy allowing a two stage water defense strategy plus a drying plane and compartmentalized drainage (***drainage*** and ***drying*** strategy***)***
- the materials used in the cavity should all be moisture tolerant ***(durability*** strategy***)***
- this strategy improves on the concealed barrier and is more appropriate for ***moderate*** risk buildings

Exterior Air Barrier/Exterior Insulation/Cavity Rain Screen

- the ***exterior air barrier/exterior insulation/cavity rain screen*** approach assumes that the structure should be completely separated from the air/vapour barrier, insulation, and cladding (***deflection*** strategy)
- the cavity is thick providing a greater mass for water to travel across, has an airspace between the cladding and the insulation (***drying*** strategy), and the cavity is compartmentalized for drainage (***drainage*** strategy)
- all components (air/vapour barrier, insulation, strapping, and cladding) are in the exterior environment and must be moisture tolerant (***durability*** strategy)
- for ***high risk*** or uncertain exposures or interior conditions

Details

- 90 % or more of the water penetration failures occur due to the failure of a penetration detail
- a simple “low risk” building may have a few details in a few dozen locations, a complex “high risk” building may have dozens of details in hundreds of locations
- ***each detail is a quality control issue!***

Detail Construction

- when constructing details:
  - windows, vent penetrations, railings, parapets, saddles, gutters, columns/posts, etc.
- always assemble materials to fit the 4d approach,
  - does the detail:
    - deflect ?
    - drain ?
    - dry ?
    - is it made of durable materials ?

Details and Walls

- the more robust the wall strategy the more tolerant of detail failure
  - On the one extreme ***face seal strategies*** cannot withstand ***ANY*** detail failure on the exposed cladding
  - On the other extreme ***exterior air barrier/exterior insulation*** can withstand failure on the exposed cladding as it would require the moisture penetration to cross a cavity (drainage/drying plane) and then penetrate a waterproofing and air/vapour barrier membrane
- remember it is highly unlikely that the every detail on every wall will be executed and perform perfectly (variables: design, materials, workmanship)
- The more redundancy in the wall strategy the more insurance against detail failures

Summary: What are the Options ?

- we can make a wall more resistant to air movement
  - if air cannot move neither can water
- We can keep water from the wall
  - increase overhangs, use wind/rain deflection strategies
- We can make a wall shed water better
  - add membrane and sheet metal flashing to improve shedding at detailing

Summary: What are the Options (cont.)?

- we can introduce a cavity
  - we allow the wall to drain and dry easier
- we can make a wall thicker or use materials that are able to retain and release water without damaging the components
  - we can use more durable materials
- we can design better details to incorporate penetrations into our cladding
  - we can use two stage details

Recommendations

- We must become very sensitive to the exposure and detail intensity of the structure you are constructing - appraise the ***risk***
- We must draw on reference materials and basic principals (4p's) to form a wall design strategy commensurate with the ***risk***
- We must build your walls applying a strategy drawing on your resources and understanding of water movement and shedding principals, materials, and workmanship to ensure your wall assemblies will protect a building structure for many decades