Building Envelope Construction in the Lower Mainland

Current Issues and Initiatives

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Agenda

- Survey of Envelope Failures
- Principles of Wall Performance
- What are We Doing Now - Design & Construction
- What Isn't Known About Wall Behaviour ?
- Current Ideas and Initiatives ?
  - Current and Proposed Research - Stucco Wall Testing
  - BCHMC
  - CMHC - Best Practice Guide

Survey of Building Envelope Failures in the Coastal Climate of British Columbia

What the Survey Does do

- Objective assessment, takes problem out of realm of anecdotal
- Large group of buildings to establish trends and focus
- Answer key questions related to failures

What the Study Does Not do

- Provide specific solutions; just provides focal points for development of solutions
- Not exhaustive, there are issues where more data and more research would be beneficial
- Results can not be extrapolated to the general population of buildings

Buildings

TABLE 2.1

DISTRIBUTION OF BUILDING TYPES

Building Type		Initial Plan	Actual
Control	Market	Not Specified	5
	Non-market	Not Specified	4
	Total	12	9
Problem	Market	Not Specified	33
	Non-market	Not Specified	4
	Total	28	37

Wall Components

Component Distribution in Problem Walls

	STUCCO	WOOD	VINYL	OTHER	TOTAL
Building Paper & OSB	18	2	4	0	24
Building Paper & Plywood	8	1	0	0	9
Housewrap & OSB	3	0	1	0	4
Housewrap & Plywood	0	0	0	0	0
Other	0	0	0	0	0
Totals	29	3	5	0	37

TABLE 3.4

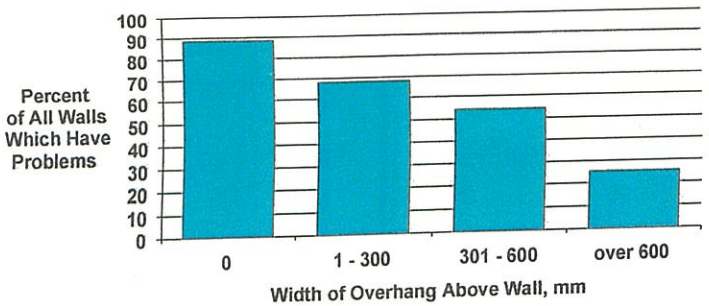
STATISTICS ON WALL DETAILS ON PROBLEM WALLS

Detail Type	% of Walls Having Detail	% of Details Flashed	% of Details Poor Design	% of Details Poor Material	% of Details Poor Installation
BUILDING FEATURES					
Flat Roof Parapet	63	94	31	3	31
Inverted Soffit	0	NA	NA	NA	NA
Roof/Wall Junction	37	58	26	5	16
Saddle (Guardrail, etc)	69	29	77	29	46
Decks	43	55	32	9	18
Balconies	57	41	48	14	38
Patios	49	24	24	8	8
Exterior Walkways	43	36	59	27	36
Exposed Columns	73	32	35	8	16
Material Transitions	47	25	33	4	13
Horizontal Movement Jts.	39	25	15	0	20
Door Sills	75	18	26	8	13
Door Heads	76	77	10	3	21
Window Sills	49	72	24	8	24
Window Heads	86	91	14	2	30
PENETRATIONS					
Dryer Vents	63	19	47	13	28
Other Vents and Intakes	49	16	24	12	20
Guardrail Attachments	71	8	67	14	28
Electrical Fixtures	59	10	40	3	10
Scuppers	51	46	35	31	42
Water, Power, Gas Lines	6	0	33	33	50
Other	4	50	100	50	100
EAVESTROUGHS	67	NA	26	6	32

Wall Details on Problem Buildings

Roof Overhangs

FIGURE 3.1
EFFECT OF OVERHANGS ON WALL PERFORMANCE



Responsibility for Problem

TABLE 3.9
OVERALL CAUSES OF PROBLEMS

Rating	Design		Construction		Maintenance		Operation	
	# of Ratings	# of Problems Contributed	# of Ratings	# of Problems Contributed	# of Ratings	# of Problems Contributed	# of Ratings	# of Problems Contributed
Acceptable	47	0	17	0	133	0	162	0
Poor	90	90	149	149	13	13	1	1
Not Designed	29	27	NA	NA	NA	NA	NA	NA
Not Maintainable	NA	NA	NA	NA	18	6	NA	NA
Not Rated	0	0	0	0	2	0	3	0
TOTALS	166	117	166	149	166	19	166	1

Control vs. Problem Buildings

- Wind exposure less on control buildings
- Roof overhangs larger
- Fewer details which cause problems
- Poor design and construction of details on both control and problem buildings
- What makes them successful ?

Conclusions

1. Exterior Water is the predominant moisture source, not construction moisture or interior sources.
2. Interface details are source of moisture ingress
   - not a field problem except that field of wall does not promote drying
   - stays long enough to rot
3. Windows and window perimeters - A440
4. Perimeters of decks, balconies and walkways are significant contributors

Conclusions

5. Saddle connections are significant contributors
6. Lack of details and poor details are contributors
7. Poor construction of details are contributors
8. All cladding types experience problems although number of problems and the cost of repairing damage is higher on stucco walls.

Conclusions

9. Buildings with overhangs perform better.
10. Insufficient evidence to establish differences between OSB and plywood.
11. Insufficient data to establish differences between housewrap and building paper.
12. Buildings with simple details or fewer problem details perform better.

Recommendations

1. Establish clarity in design strategies utilizing basic water management principles.
2. Improvement in details (show key details, larger scale, 3-D).
3. Guidance regarding good details for many of the problem details - Best Practice Guides.
4. Evolve generic details into product specific details, particularly with windows.

Recommendations

5. Logical sequencing and responsibilities for trades.
6. Mock-ups and testing on site to confirm details of construction and performance, help to communicate design intent.
7. Develop Quality Management Protocol
8. Training of trade personnel.

Further Investigation or Development

1. Guidance with respect to effective remedial work strategies.
2. Development work associated with the evolution towards rainscreen designs.
3. Research to establish the drying characteristics of these walls.

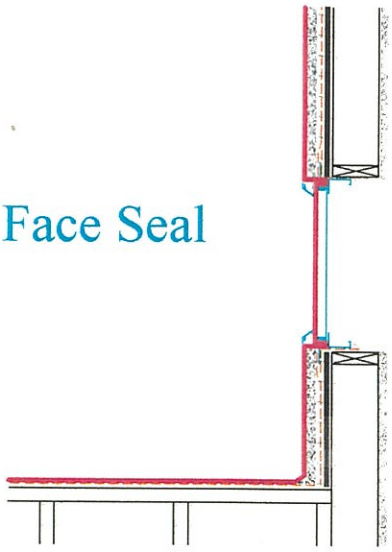
Further Investigation or Development

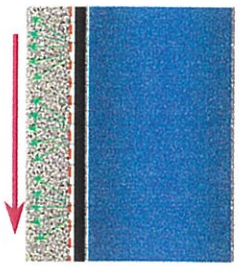
4. Enhancement of current standards or development of new standard which deals with the installed window assembly.
5. Development of a maintenance guideline for building owners.

Moisture Balance

- Wetting Mechanisms
  - from outside, inside, construction
- Drying Mechanisms
  - draining, diffusion and evaporation
- Tolerance to Moisture
  - storage, decay
- Climate and Exposure
  - wet, overhangs, protection from wind

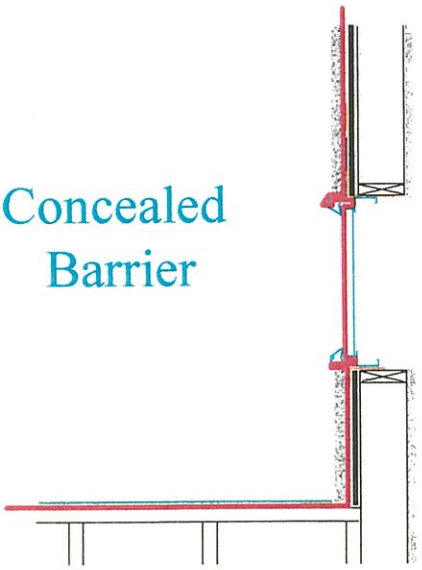
Face Seal

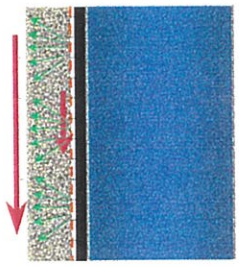




Drying Potential

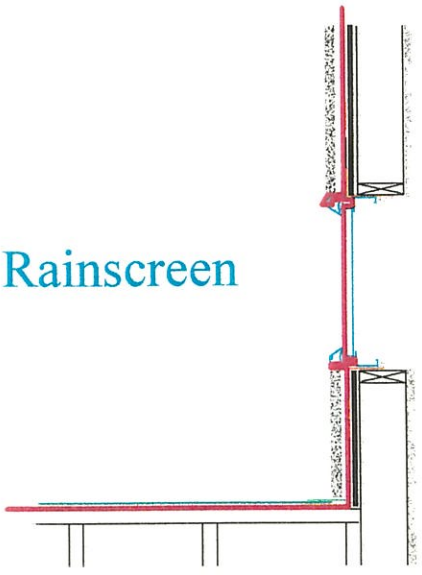
Concealed Barrier

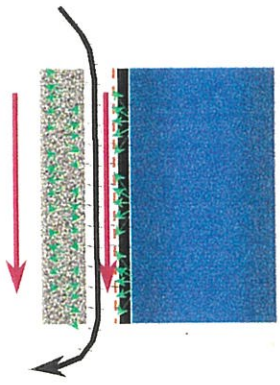




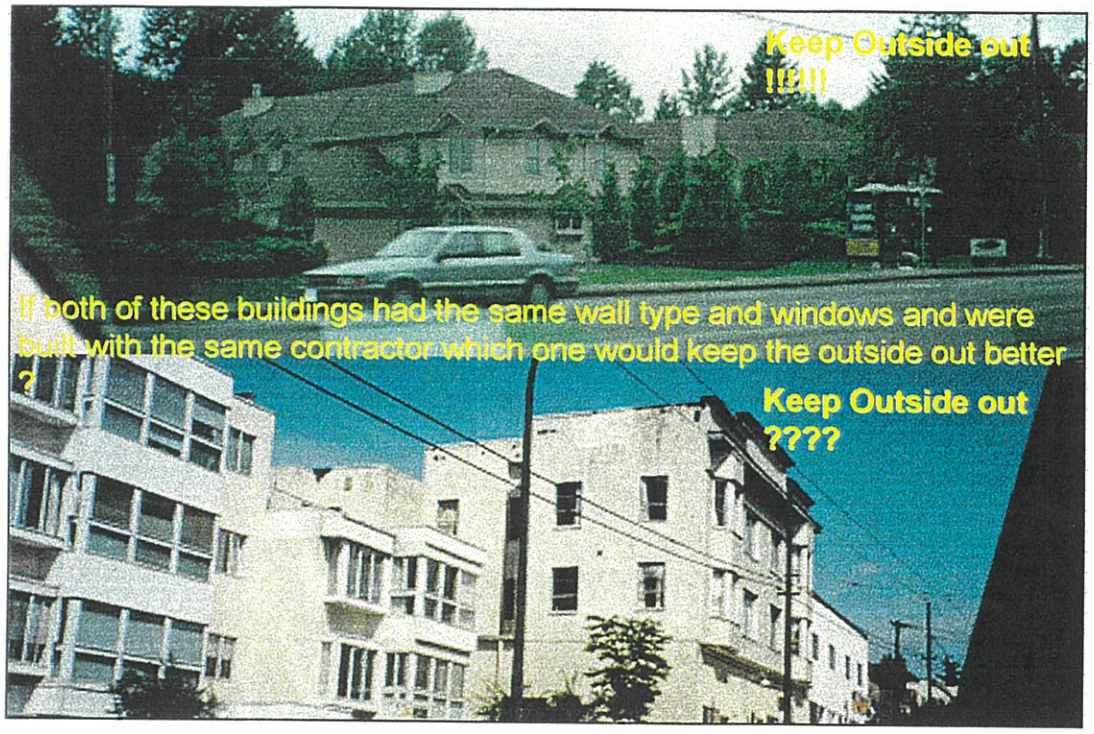
Drying Potential

Rainscreen





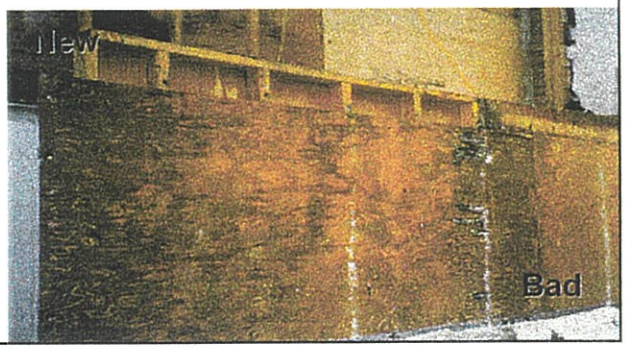
Drying Potential



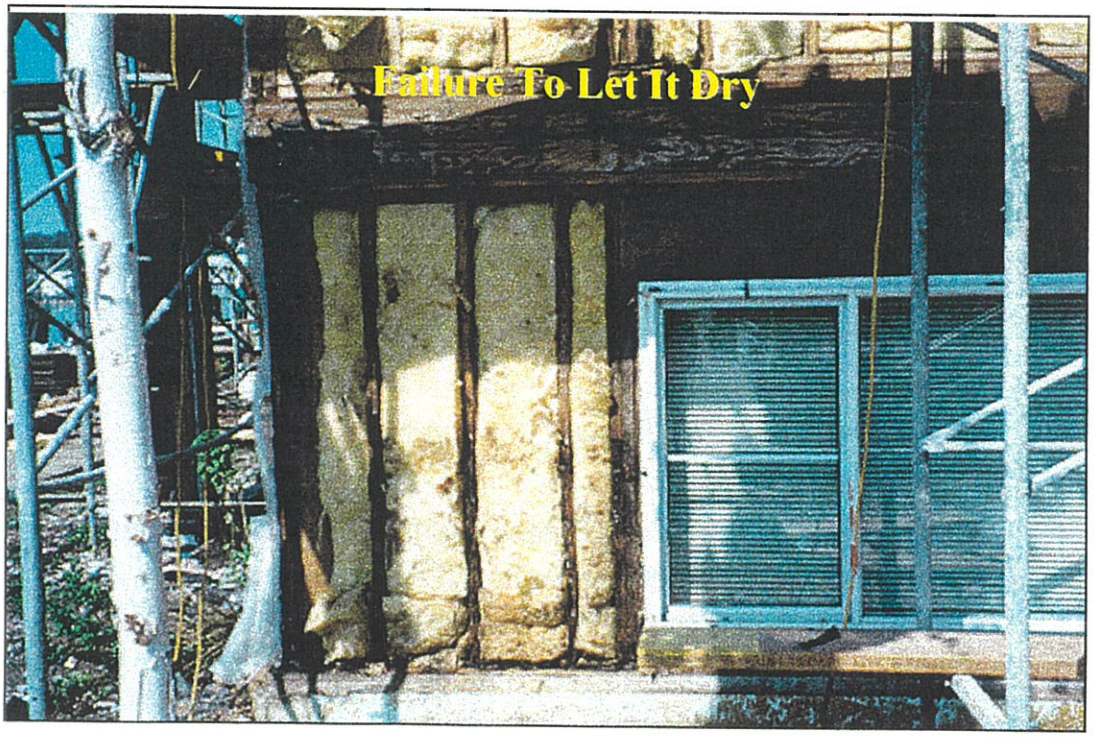
Can Face Seal or Concealed Barrier Systems Work?

- Very sensitive nature of wall assembly
- Perfection in details
- Attention to maintenance
- Low exposure conditions

Old Technology vs..
New Technology On
The Same Building




Failure to Keep Outside Out - Balcony

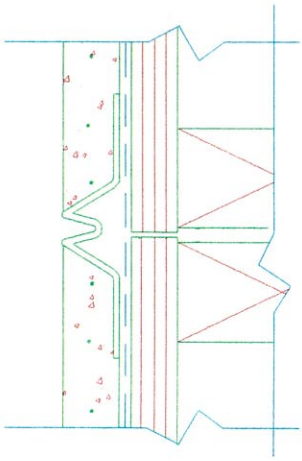

Failure To Let It Dry

What are we doing now? - Design

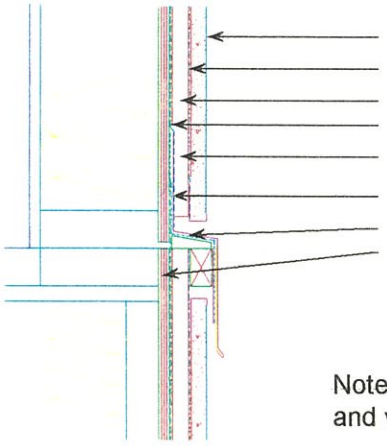
- Shotgun approach - improvement on many fronts:
  - adding drained cavities
  - adding venting
  - special attention to details
  - special treatment of windows
  - testing during construction
- As more information becomes available through current and future research we may find that some of the redundancy currently being incorporated in wall design can be economized.

Traditional Stucco Section

- stucco with 2" x 2 " metal lath
- building paper
- plywood or OSB sheathing
- framed wall



Current Design - Stucco Wall



- stucco
- paper backed lathe
- 3/4" strapped Cavity
- building paper
- metal wall flashing
- self adhesive membrane
- metal strip
- plywood sheathing

Note that cavity is drained at bottom and vented at top along full width

BCHMC Envelope Design and Construction Guideline

- Describes acceptable assemblies
- Limits where they can be used
  - Overhangs
  - No. of storeys
  - Exposure conditions
- Leaves design of details to design team
- Prescriptive

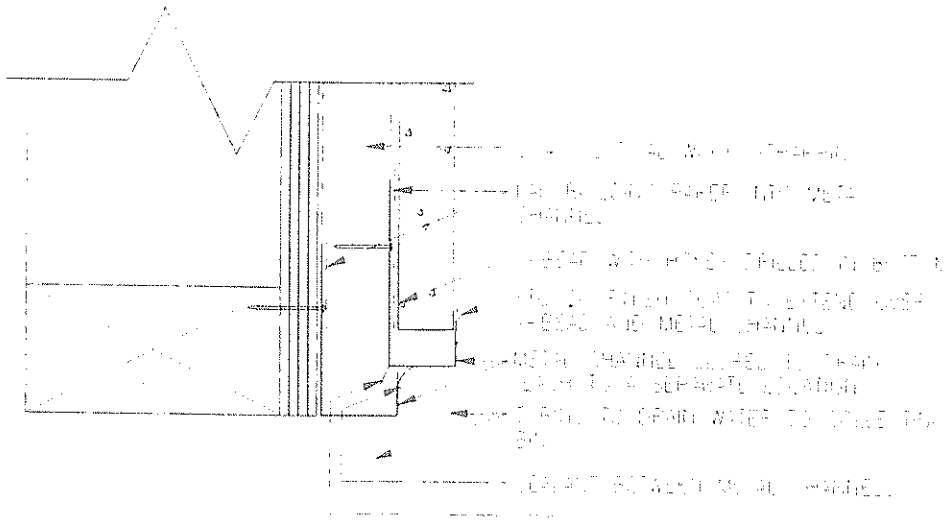
Unanswered Technical Questions

- How much perfection in details can we expect ?
- How sensitive are various wall assemblies to moisture?
- Is a cavity necessary for drainage? If so, how big?
- Does venting significantly improve drying?
- Is there a difference in performance with different types of sheathing paper?
- Is a (poly.) vapour barrier a positive or negative in Vancouver's climate?

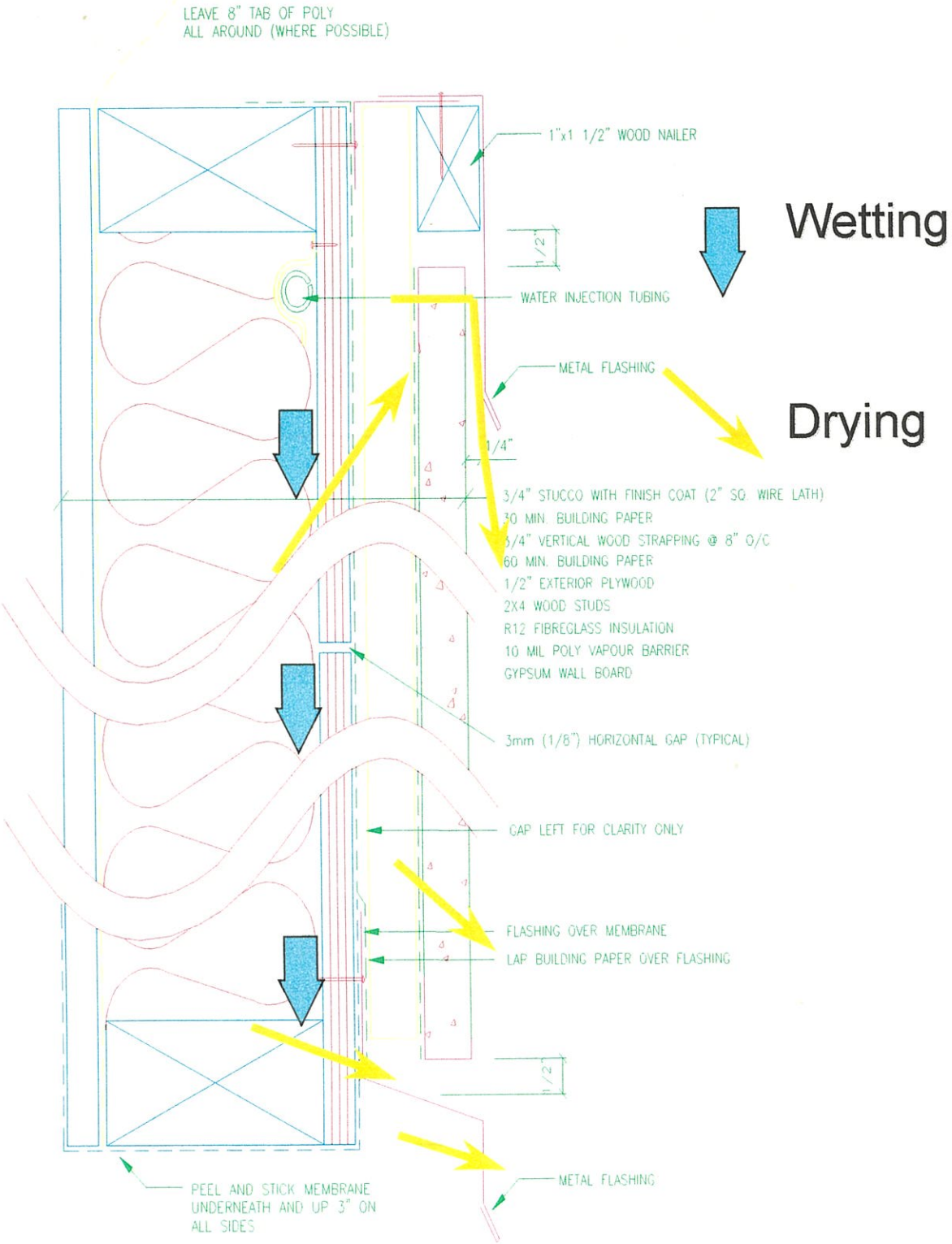
Research and Development Initiatives

- Stucco wall performance testing.
- Modeling long term performance
- Field monitoring of performance
- CMHC - Best Practice Guide for wood frame construction.

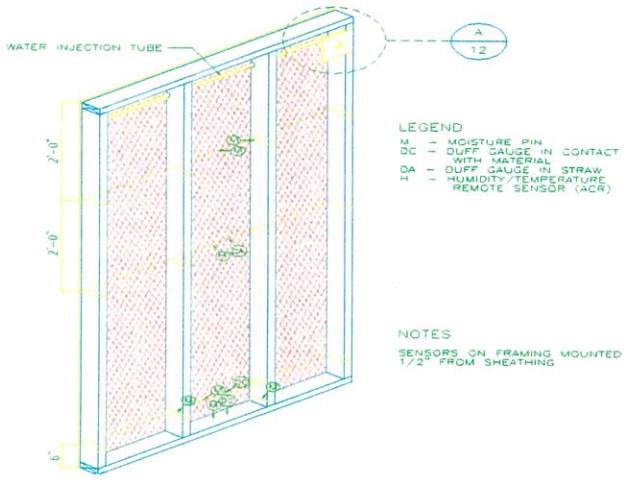
Stucco Testing - Drainage



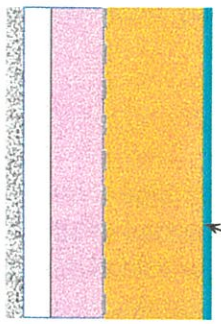
Stucco Testing - Drying



Stucco Testing - Drawing



The End



Why Not?

No insulation in stud space,
no polyethylene