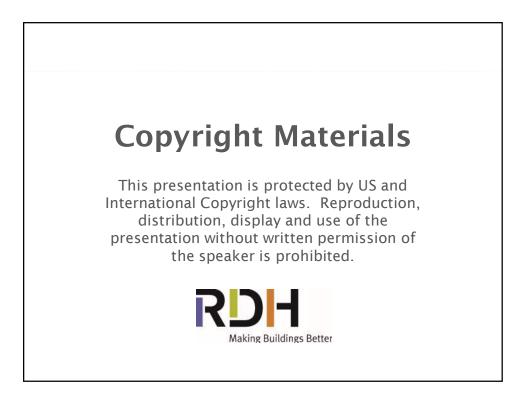




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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



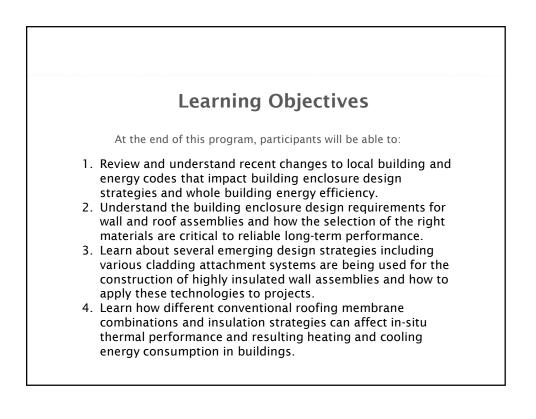
## **Course Outline**

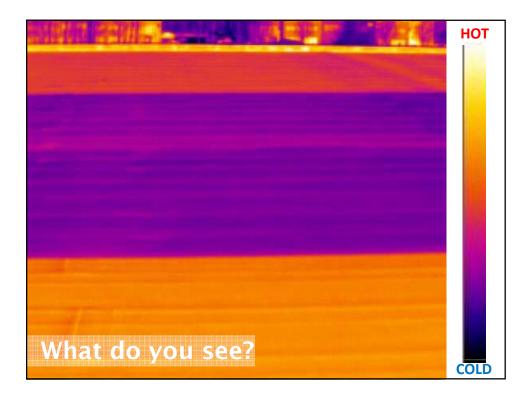
# Building Enclosures for the Future – Building Tomorrow's Buildings Today (3 AIA/CES HSW CREDIT)

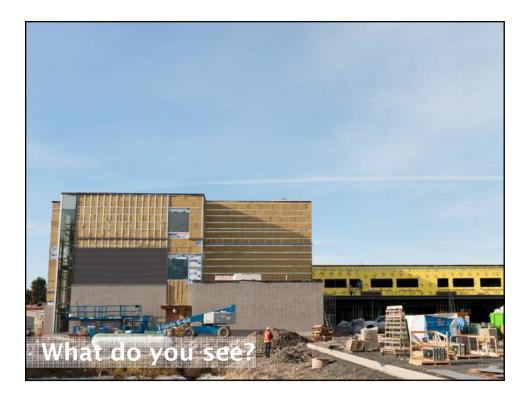
This half-day educational session will cover the latest in building enclosure technology for energy efficient buildings. Presented by one of North America's leading building science research engineers, Graham Finch of RDH Building Sciences will provide an in-depth discussion of emerging wall and roof assemblies that provide durable, cost effective and thermally efficient performance.

Recent building and energy code changes will be reviewed including an opportunity to discuss solutions to meet these more stringent requirements. Current building science research and field monitoring information will be presented, demonstrating how insulation materials perform under different climatic conditions and how Rvalues change with time and season. Strategies to construct highly insulated wall and roof assemblies and avoid thermal bridging will be presented, along with several case studies to illustrate how these emerging technologies have been utilized in new and existing buildings.

The seminar will cover all building types and construction materials, with a few highlights and lessons learned from the construction of building enclosures for new 5&6 storey wood-frame buildings.



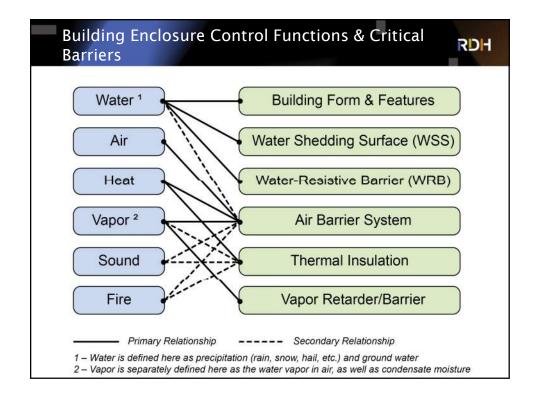












#### Industry Trends in Building Enclosure Designs

- → Trend towards more efficiently insulated building enclosures due to higher energy code targets and uptake of passive design strategies
  - → At a point where traditional wall/roof designs are being replaced with new ones
  - → Seeing many new building materials, enclosure assemblies and construction techniques
  - → Greater attention paid to reducing thermal bridging & use of effective R-values instead of nominal insulation R-values
  - → Optimization of cladding attachments for both structural and thermal performance
  - → More & more insulation is being used



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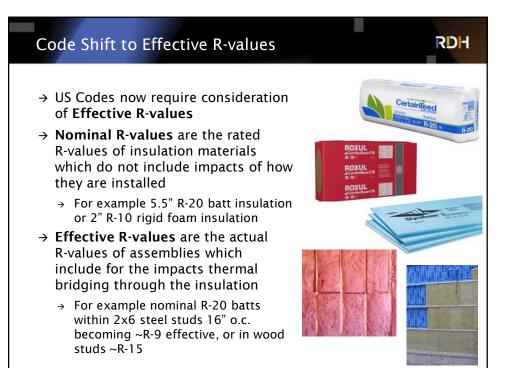


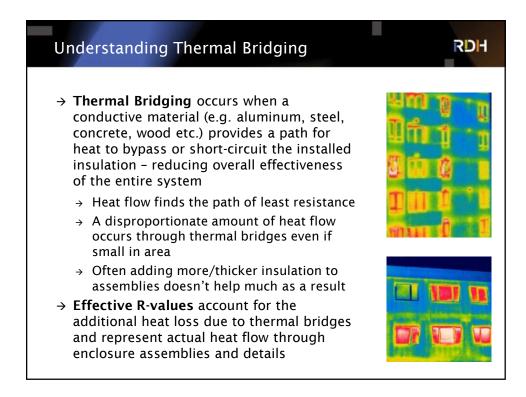
#### Highly Insulated Building Enclosure Considerations RDH

- → Highly insulated building enclosures require more careful design and detailing to ensure durability
  - More insulation = less heat flow to dry out incidental moisture
  - → Amount, type & placement of insulation materials matter for air, vapour and moisture control
  - → Art of balancing material, cost, and detailing considerations
- → Well insulated buildings require balancing thermal performance of all components & airtightness
  - → No point super-insulating walls or roofs if you have large thermal bridges - address the weakest links first



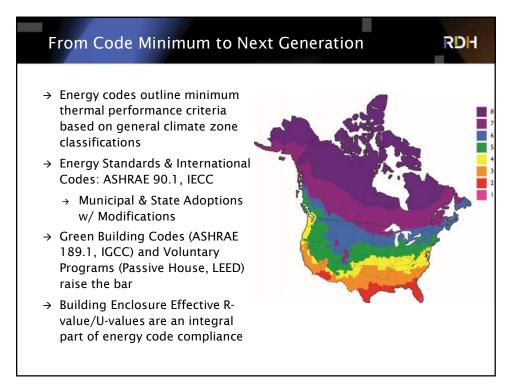


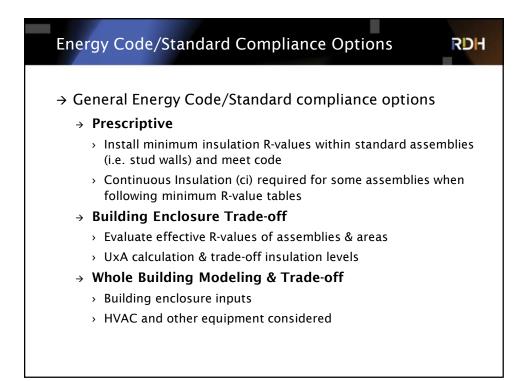


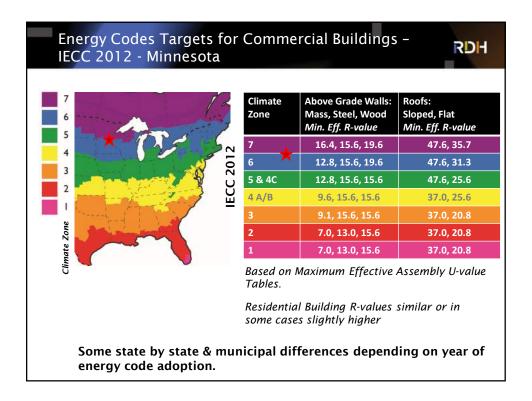


Understanding <sup>-</sup>	Thermal Bridging	RDH
	<ul> <li>→ Examples of Thermal Bridges in Buildin</li> <li>→ Wood framing or steel framing (studs, p in insulated wall</li> <li>→ Conductive cladding attachments throug insulation (metal girts, clips, anchors, so etc.)</li> <li>→ Concrete slab edge (balcony, exposed sleedge) through a wall</li> </ul>	lates) gh crews
	<ul> <li>→ Windows &amp; installation details through insulated walls</li> <li>→ Energy code compliance has historically focused on assembly R-values - howeve more importance is now being placed of details and interfaces &amp; included therm bridges</li> <li>→ Comfort implications</li> </ul>	er on

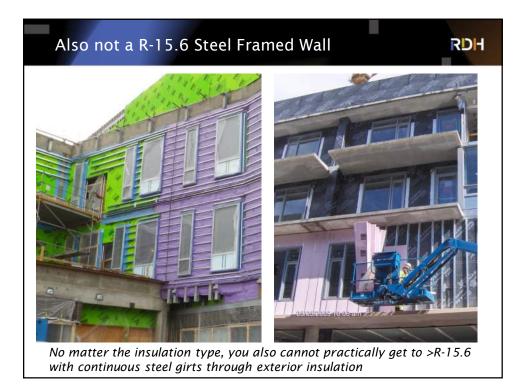


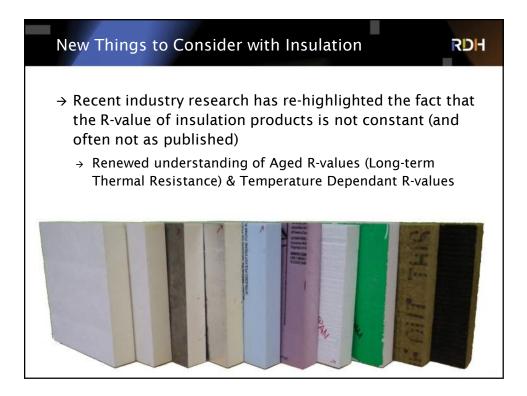


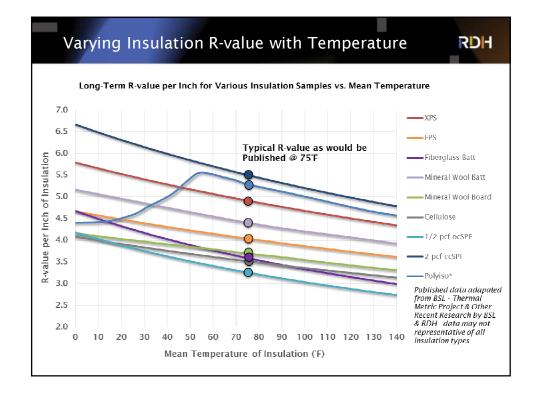


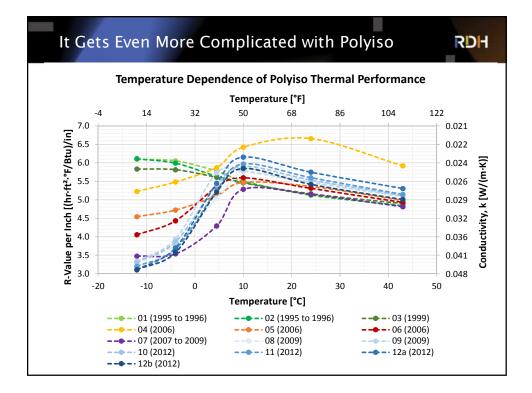












### Other Considerations - NFPA 285

RDH

- → Full-scale fire test developed initially by foam plastic insulation industry in late 1970s in response to non-combustible construction requirements within the IBC
- → Intent is to prevent fire propagation up the outside of a tall building
- → EIFS, combustible claddings and WRBS added to test requirements in addition to foam plastic insulation requirements between 2000 and 2012



## NFPA 285 Triggers & Industry Response

→ Foam Plastics in the wall assembly all buildings (any height)

- → Combustible claddings in buildings over 40 feet
  - → High Pressure Laminates
  - → Fiber Reinforced Polymers
  - → Metal Composite Materials
  - $\rightarrow$  EIFS
- → Combustible WRBs in buildings over 40 feet
- → Industry Response = NFPA 285 Tested Assemblies or Non-Combustible Insulation, Claddings & WRBs



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Passing test with mineral wool & fiberglass clips



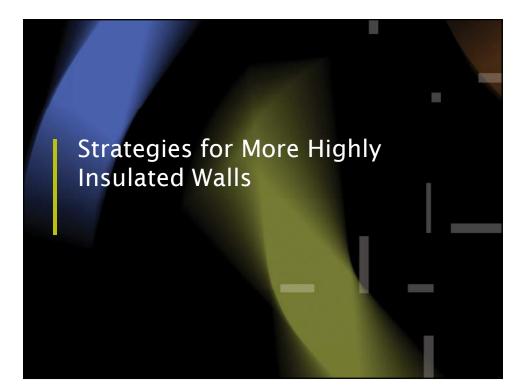
#### New Performance Targets & Project Expectations RDH

- → In US Climate Zones 4-7 minimum effective R-value design targets are in range of:
  - $\rightarrow$  R-15 to R-30 effective for walls
  - $\rightarrow$  R-25 to R-50 effective for roofs
- → Green or more energy efficient building programs including Passive House, R-value targets in range of:
  - $\rightarrow$  R-25 to R-50+ effective for walls
  - $\rightarrow\,$  R-40 to R-80+ effective for roofs
- → Plus other drivers air-tight, thermal comfort, passive design, mold-free

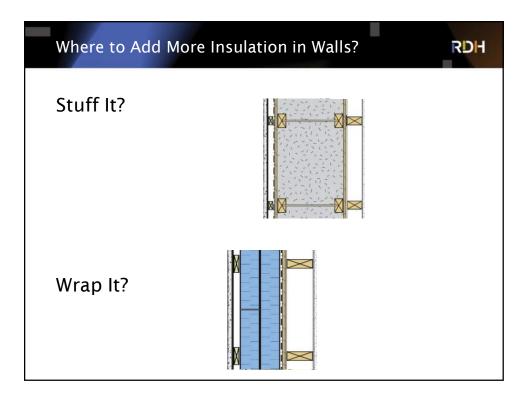


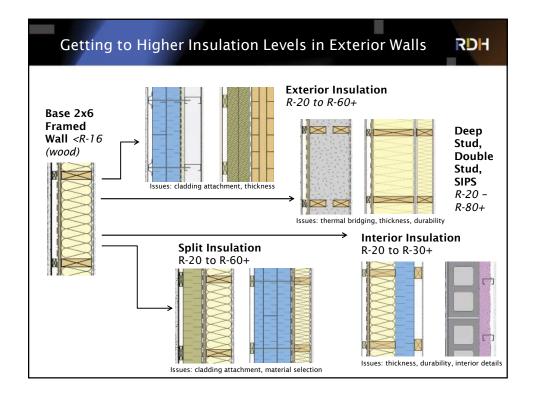


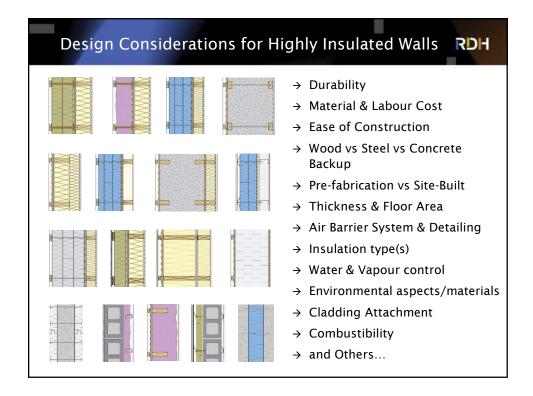




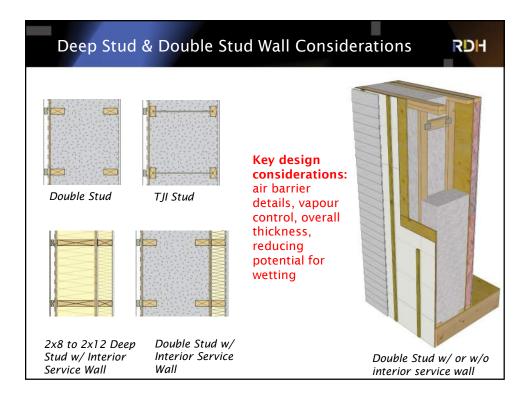


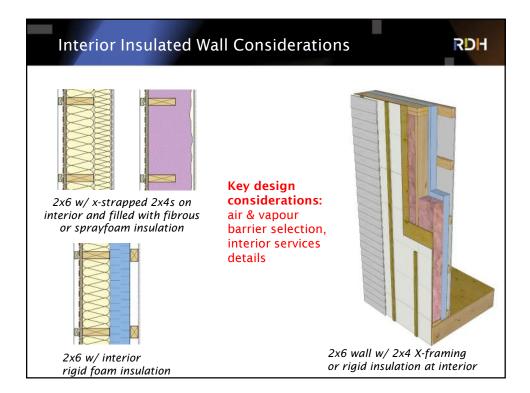


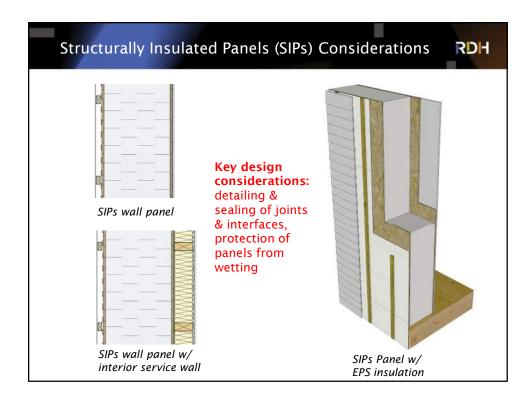


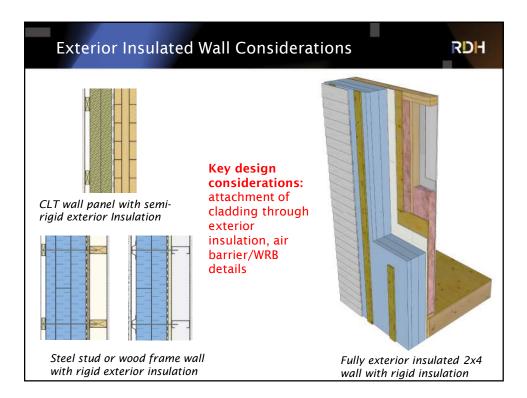


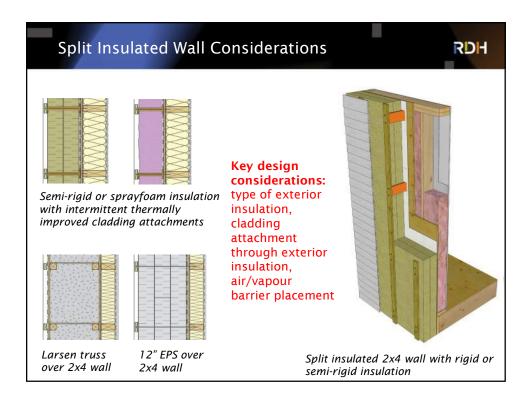


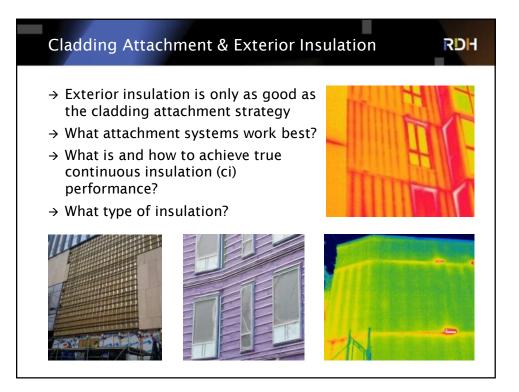


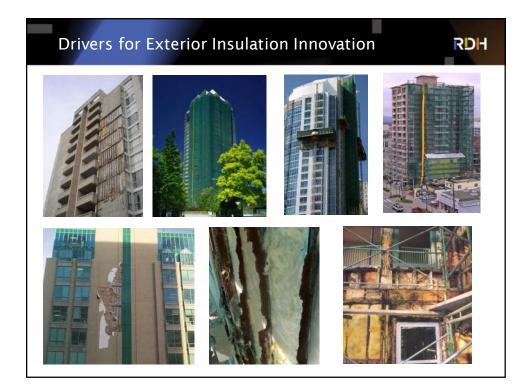




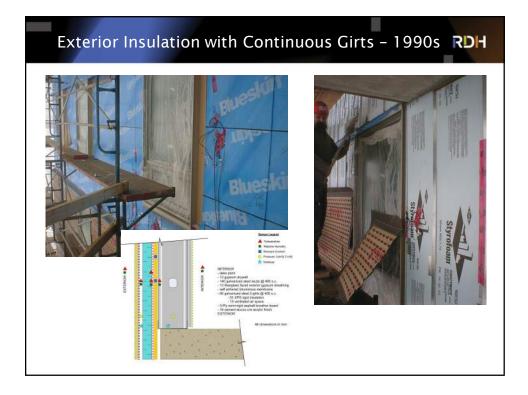


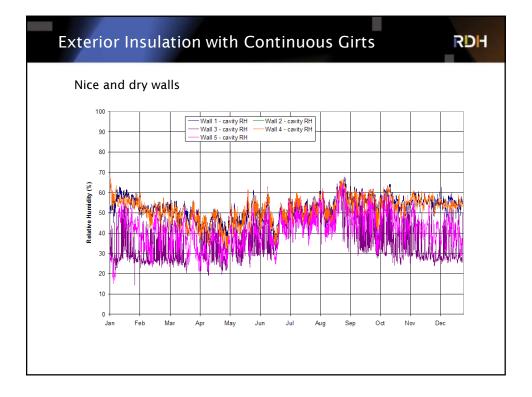




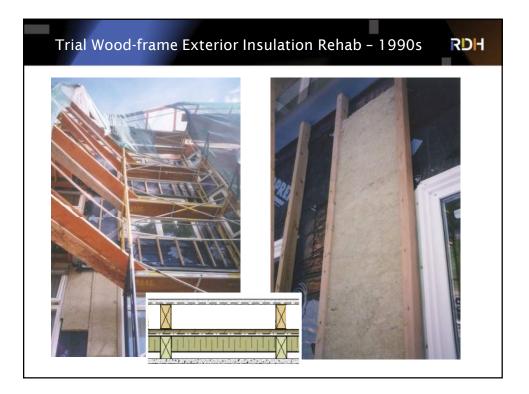


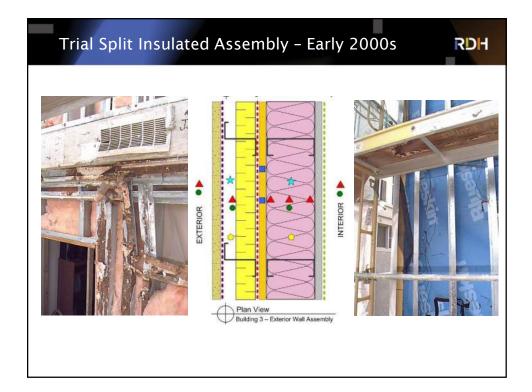


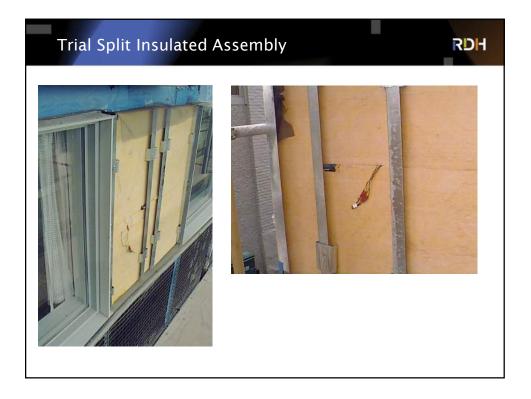


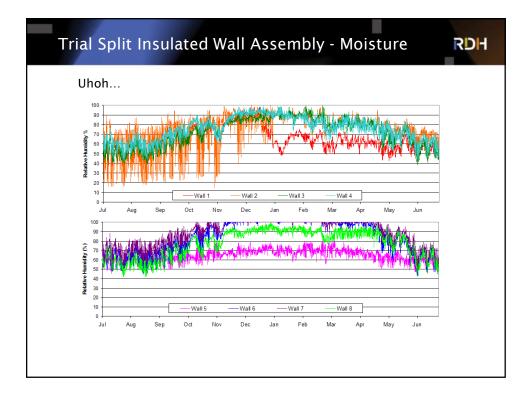


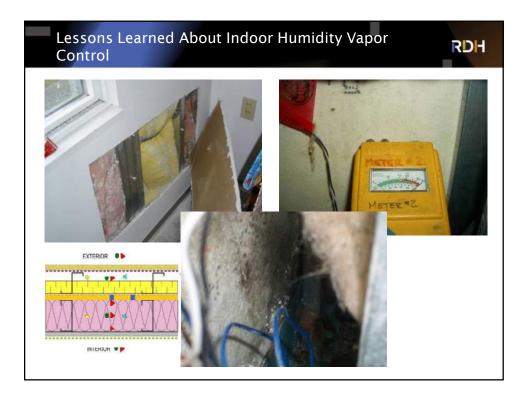




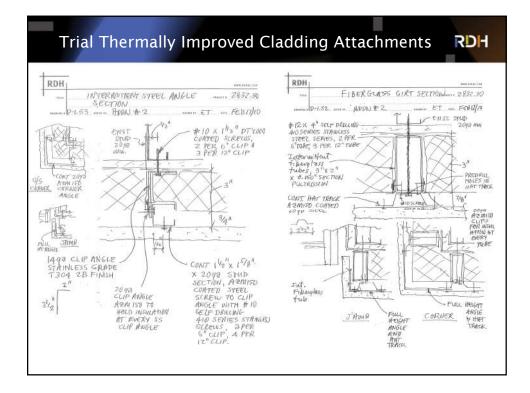




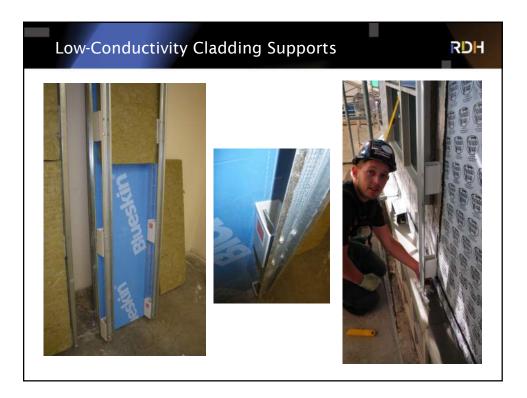


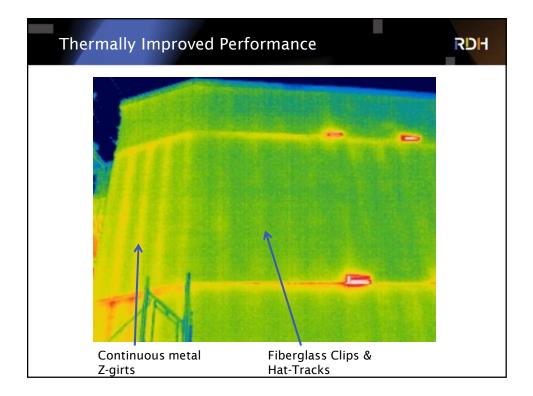




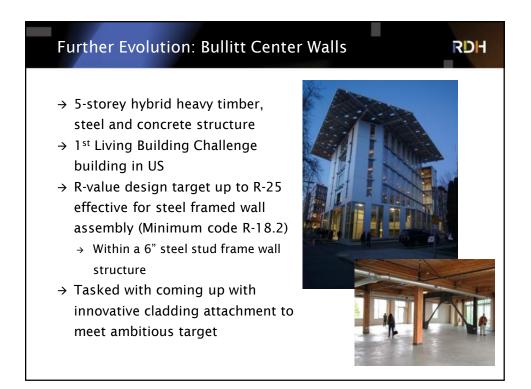


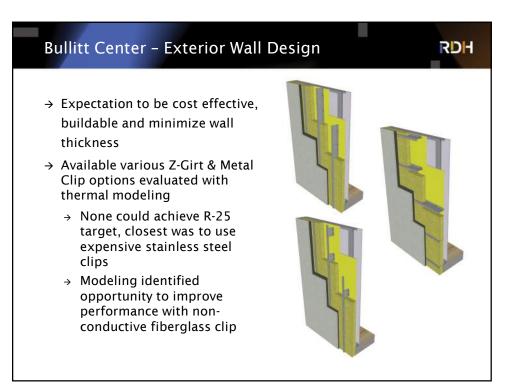


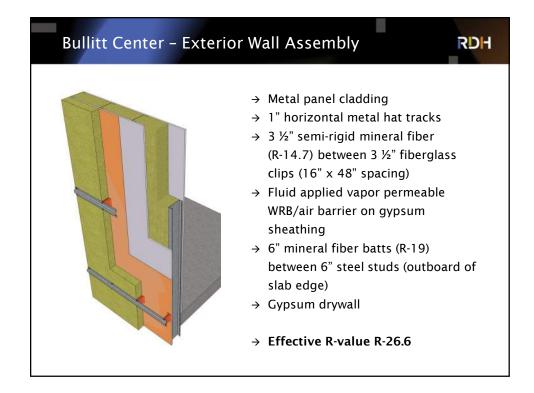






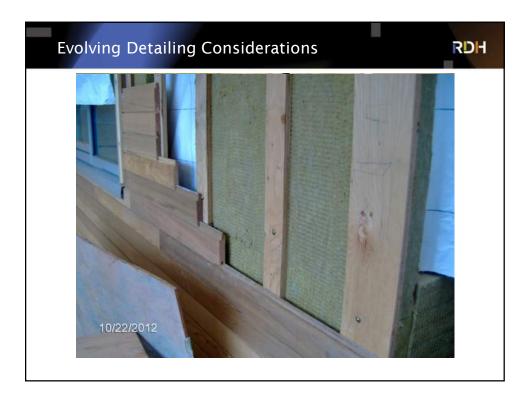


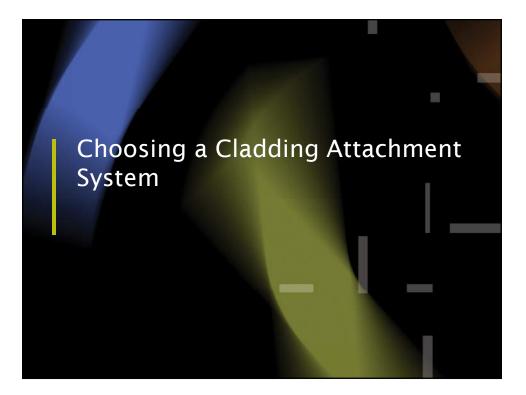


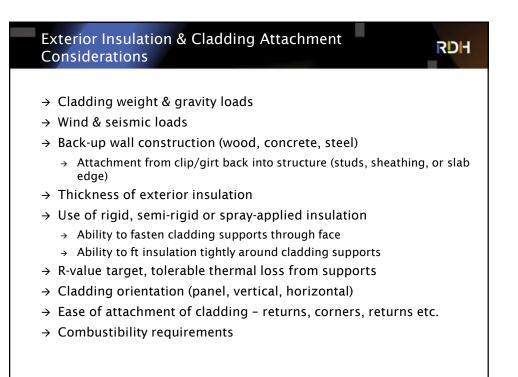


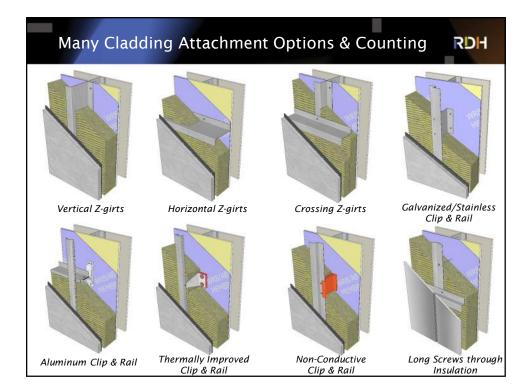


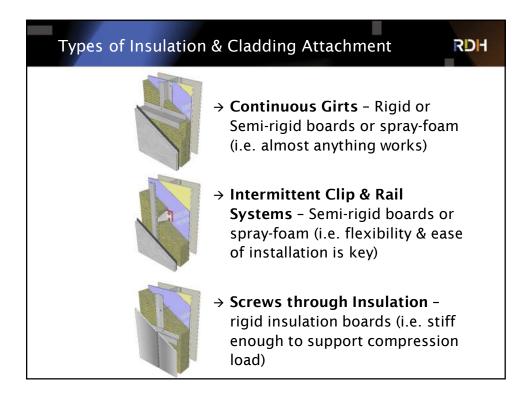








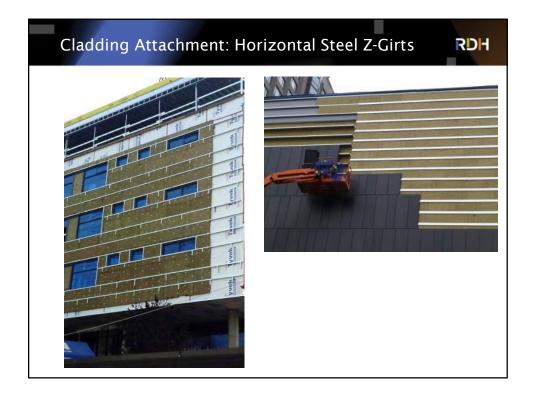




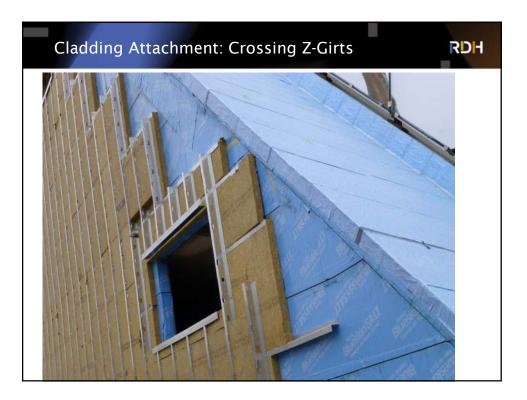


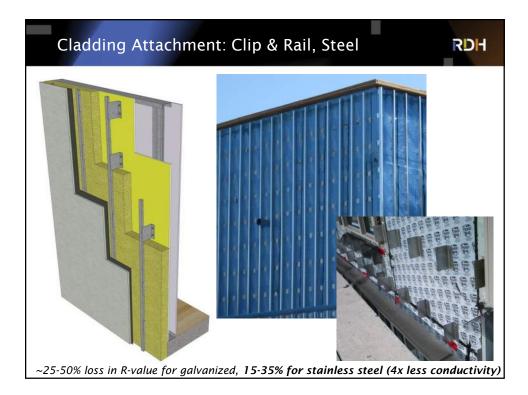


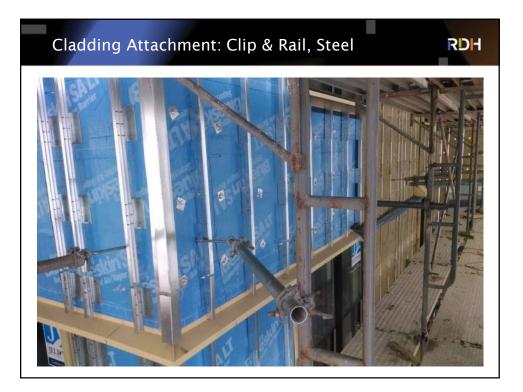


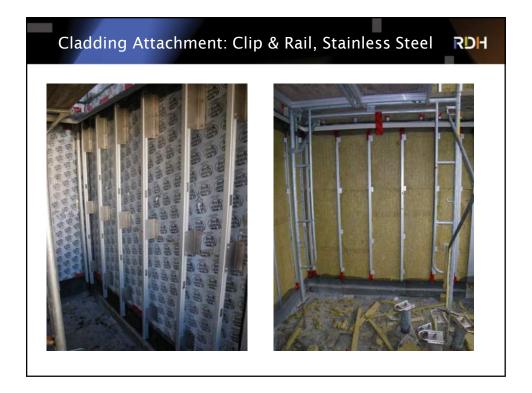










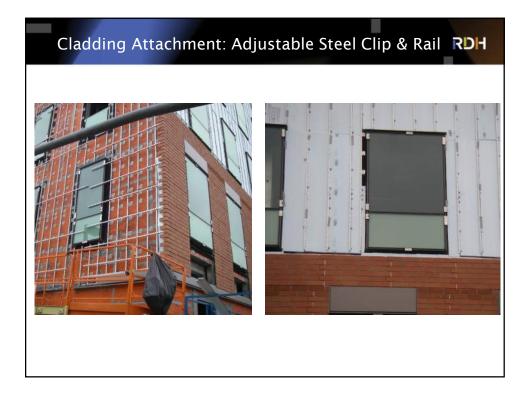






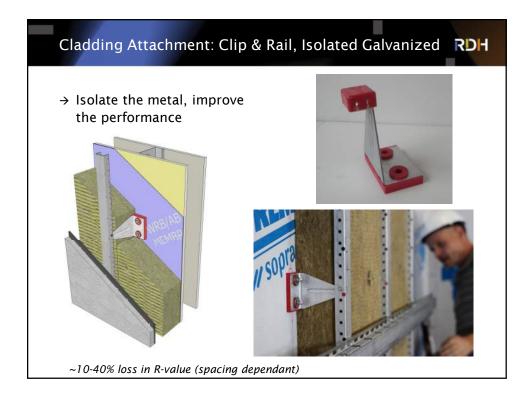




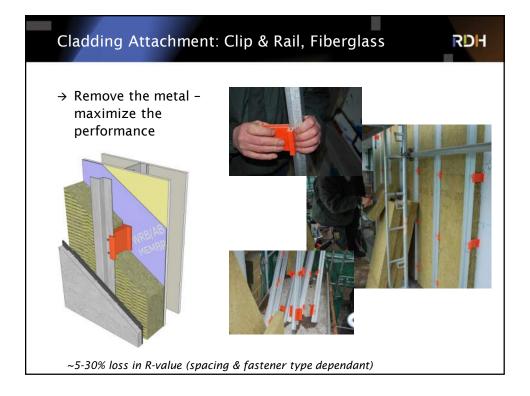






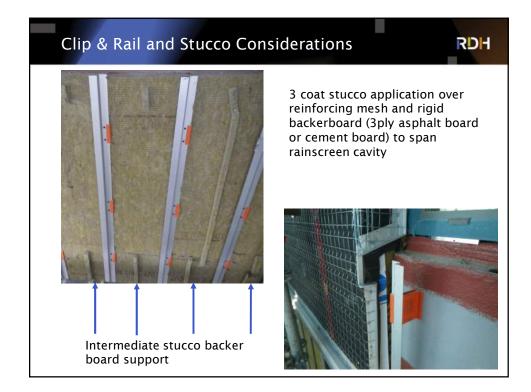


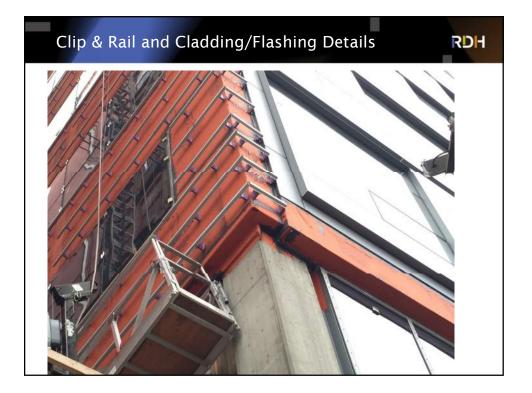




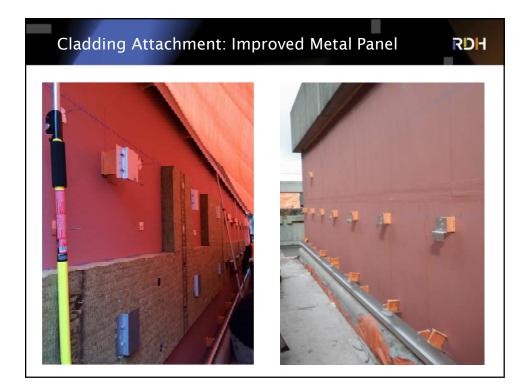




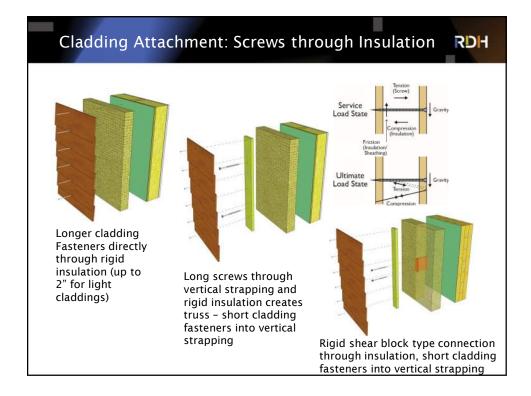


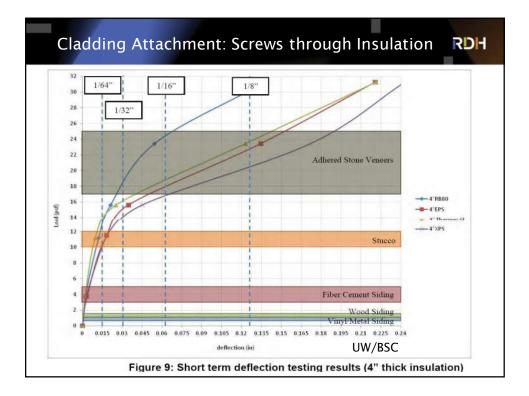








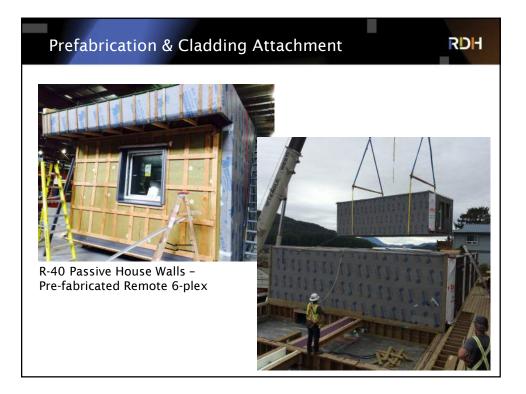


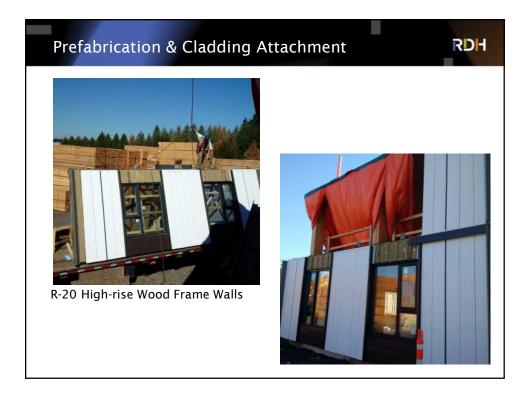




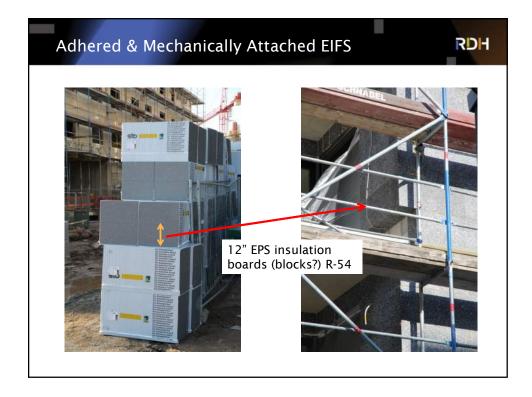


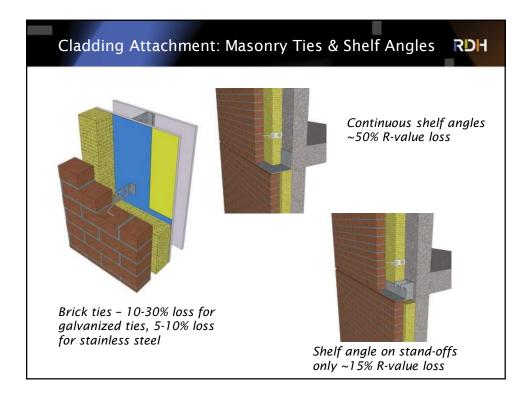


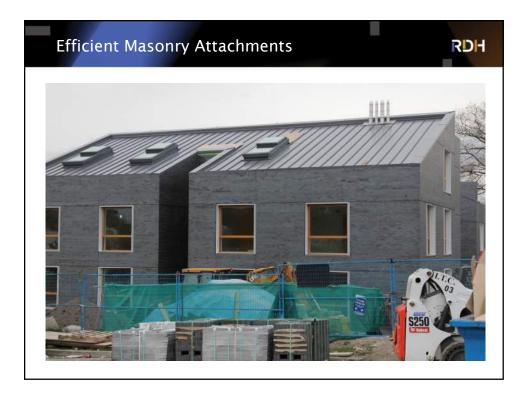






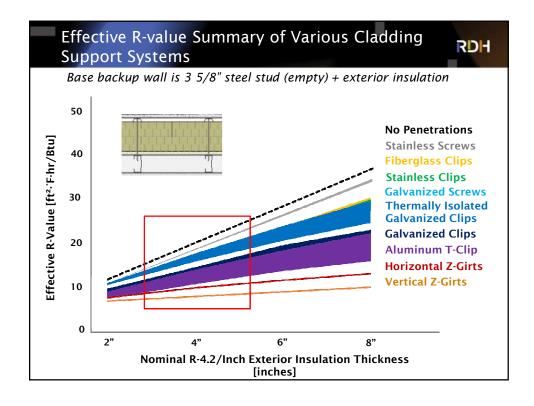


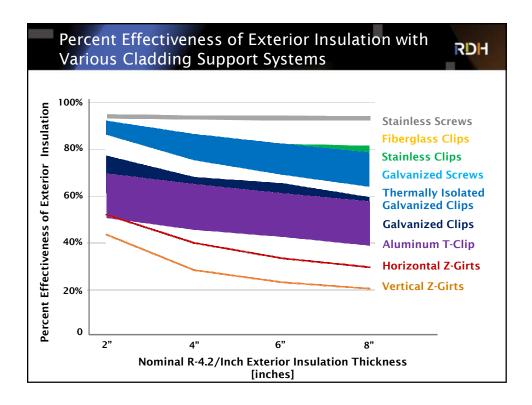


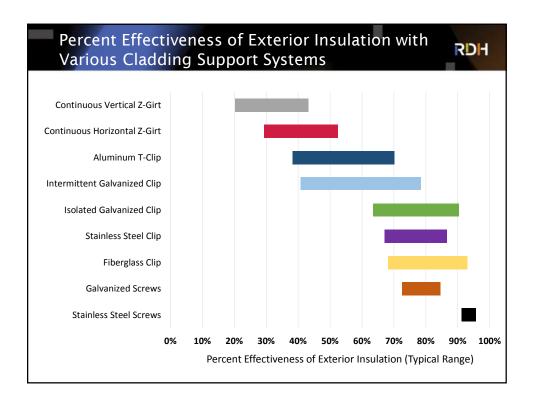


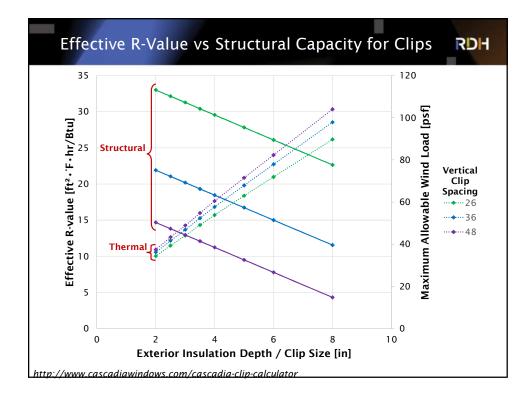




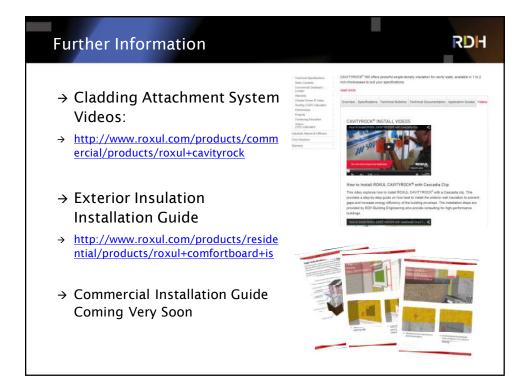


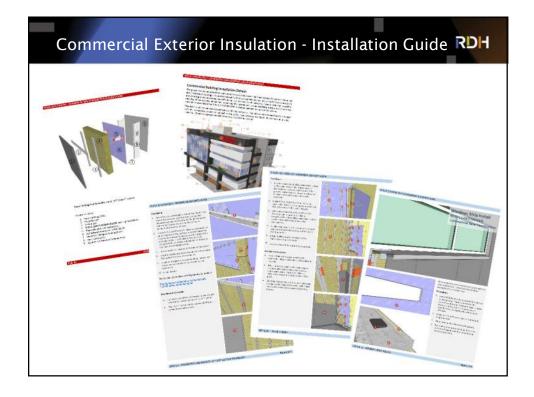




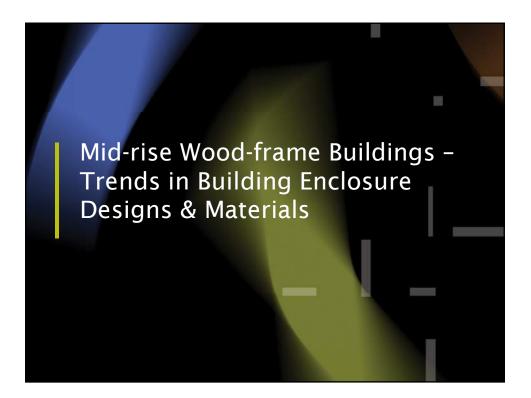


Cladding Attachment Recommendations			RDH
Substrate Cladding Type	Wood Backup (OSB/Plywood)	Steel Stud Backup	Concrete or Concrete Block Backup
Light weight (up to fiber cement panels, <10psf)	Clip & Rail good Screws good	Clip & Rail good Screws okay, but difficult to hit stud	Clip & Rail good Screws can be difficult to install
Medium weight (stucco, cultured stone, 10-30 psf)	Clip & Rail good Screws with shear block or engineered	Clip & Rail good Screws with shear block or engineered	Clip & Rail good Screws can be difficult to install
Heavy weight (Masonry, Stone Panels, >30 psf)	Gravity supports, anchors & engineered connections only	Gravity supports, anchors & engineered connections only	Gravity supports, anchors & engineered connections only

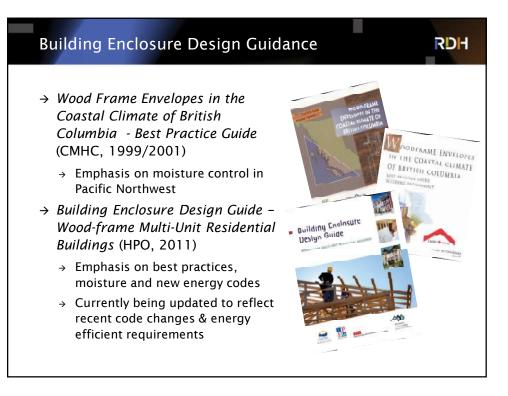


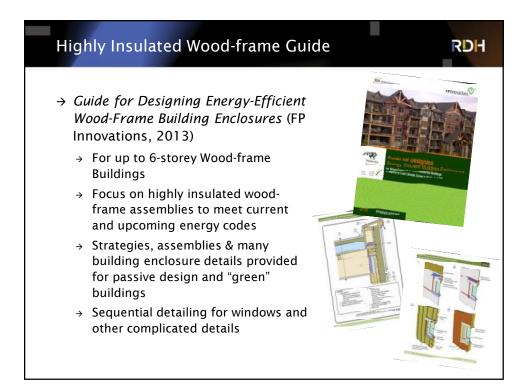






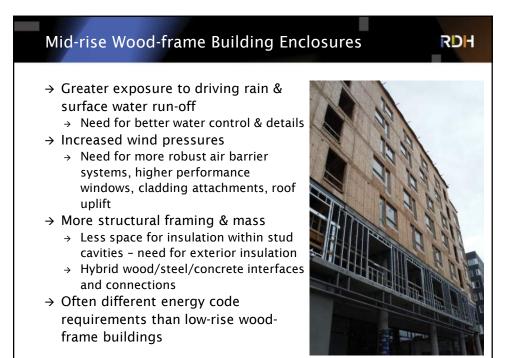


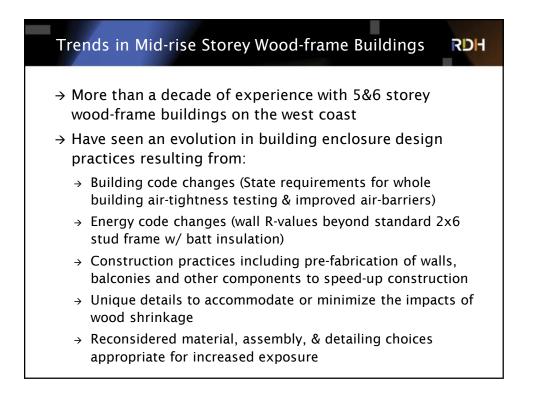




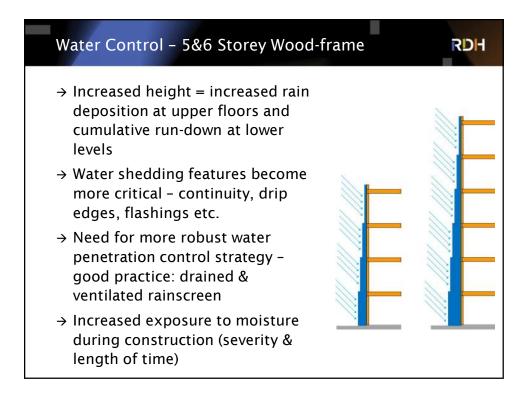






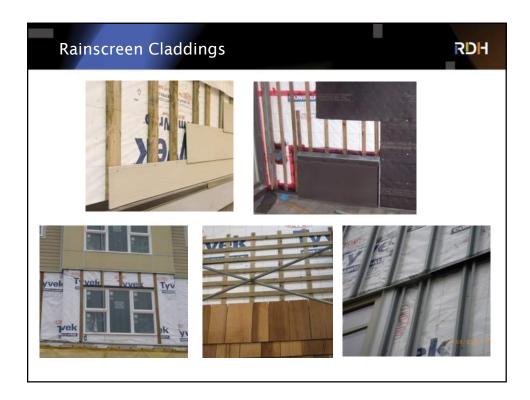














## Water Resistive Barriers for Mid-rise Wood-frame RDH

- → Water Resistive Barrier, WRB (aka sheathing membrane)
- → Secondary plane of moisture protection & innermost plane that can safely manage moisture and drain & dry it back out
- → Many different products available (mechanically fastened, self-adhered, & liquid applied)
- → Many products can also be taped/sealed/applied as air barrier - discussed later
- → Both vapour permeable & impermeable products available
   - choice depends on insulation placement & wall design

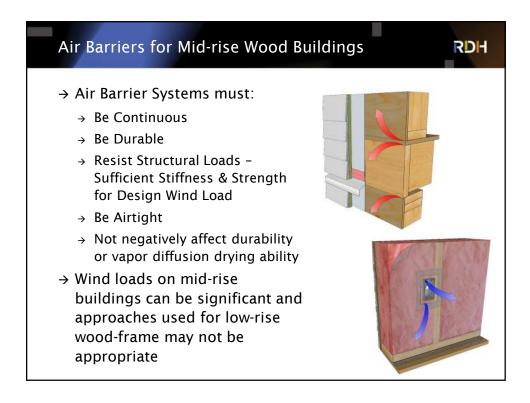


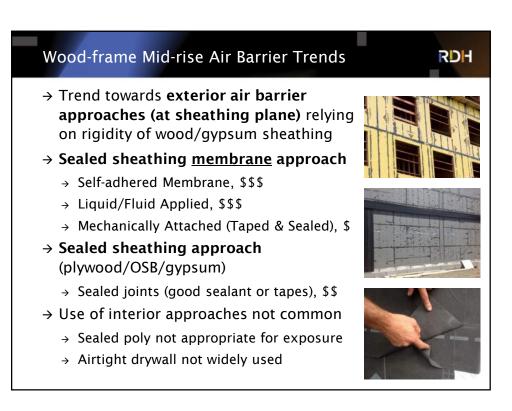


## Vapour Control with Wood-frame Exterior Walls RDH

- → Use of polyethyelene, polyamide "smart vapour retarder" or vapour retarder paint most common for standard framed walls
  - $\rightarrow$  Canada tends to be Poly
  - → US tends to be VR paint or smart vapour retarder
- → Vapour control strategies are re-assessed in walls with exterior or split insulation



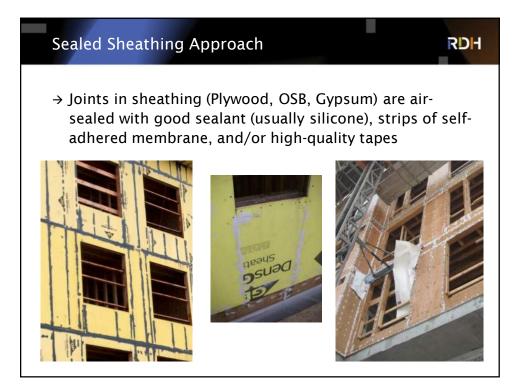


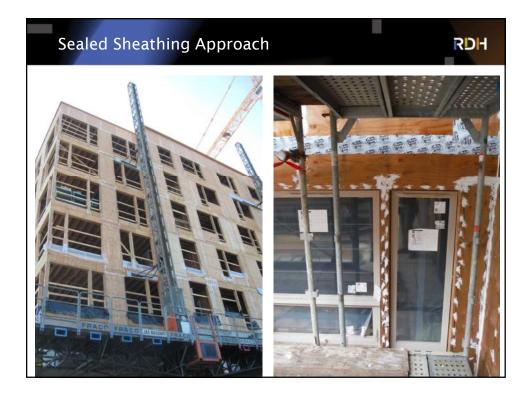


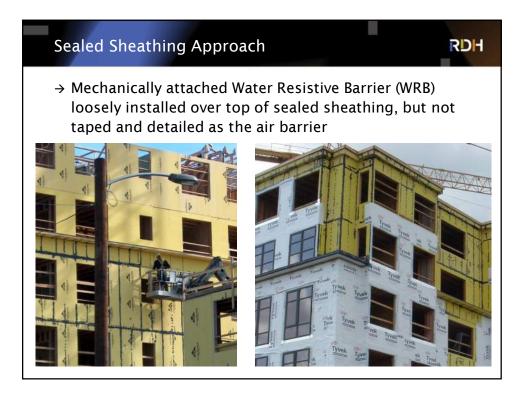


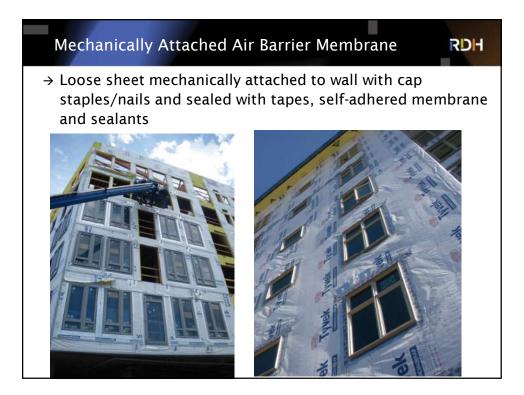






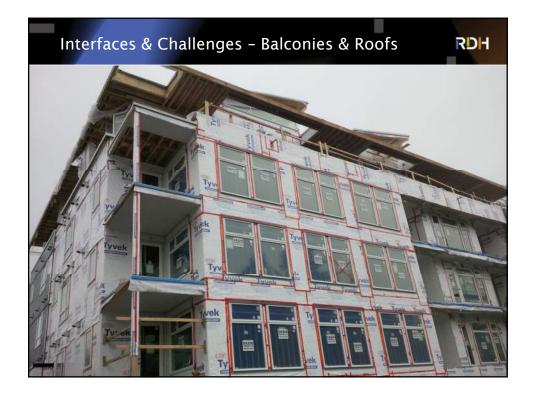




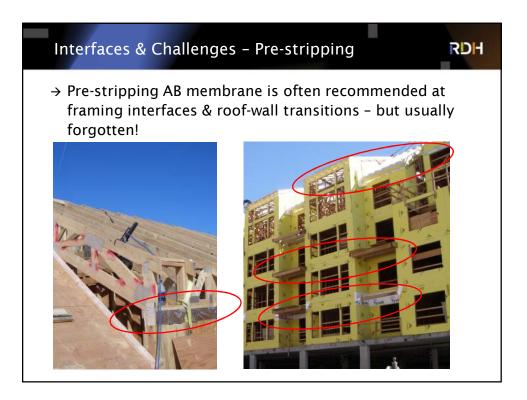


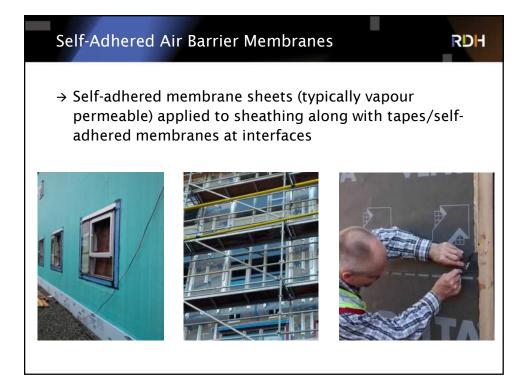






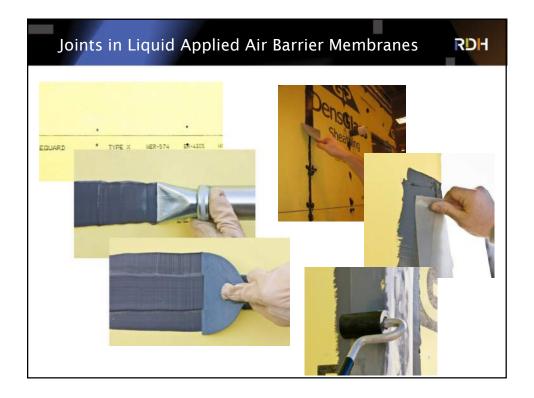


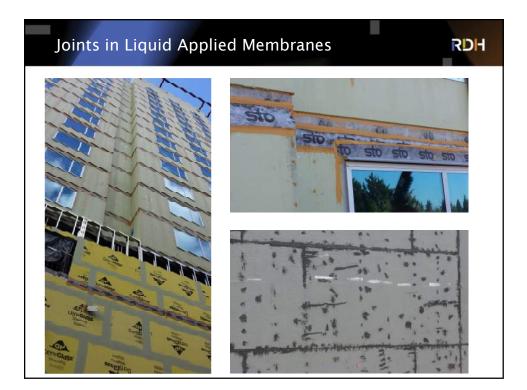


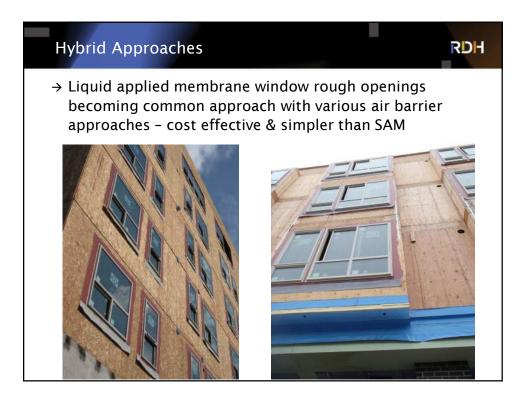


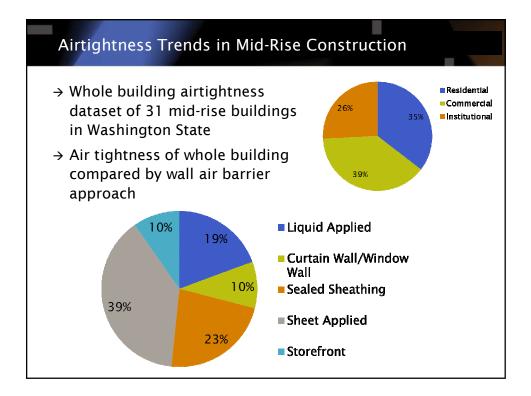


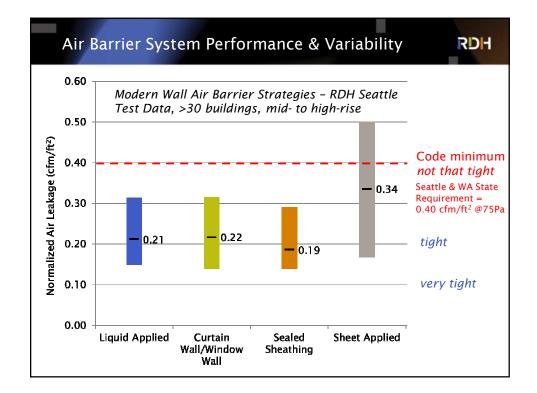


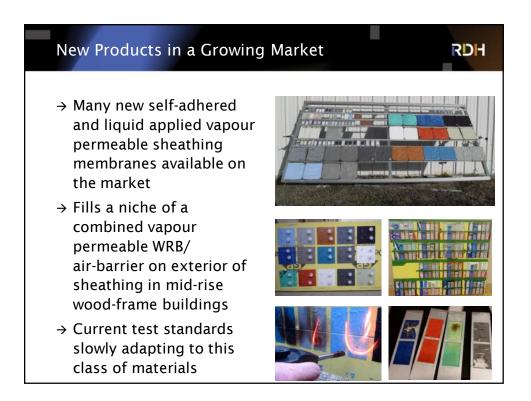




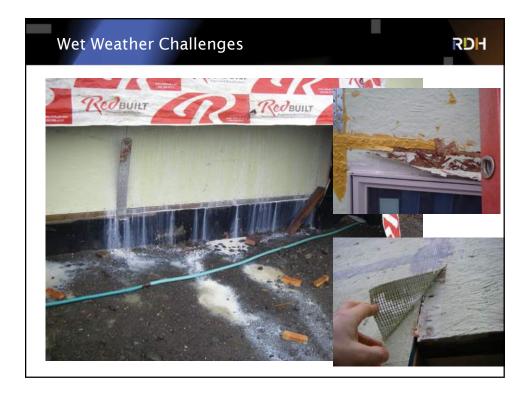


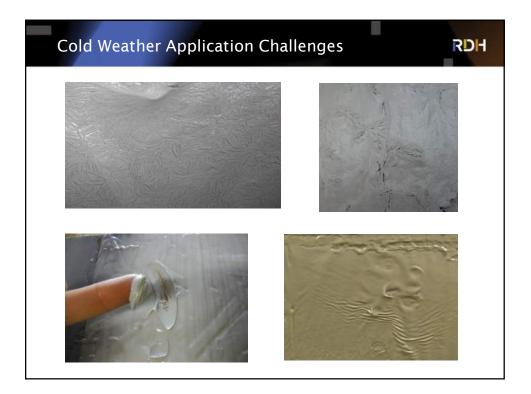






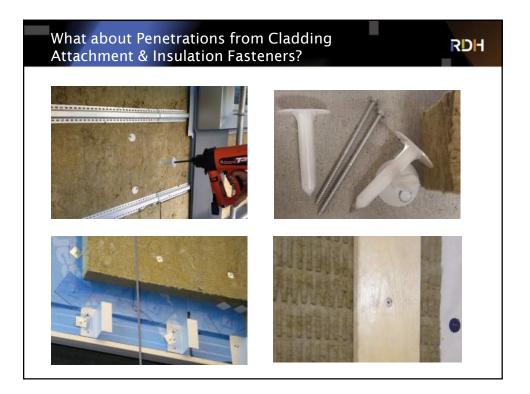




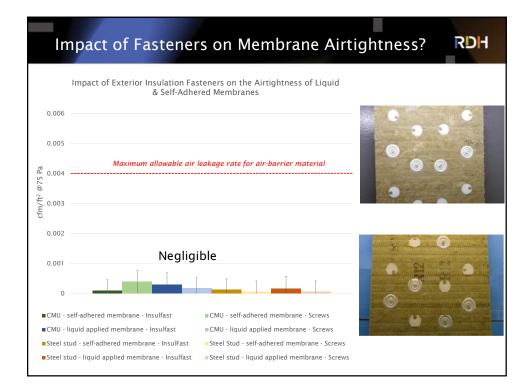


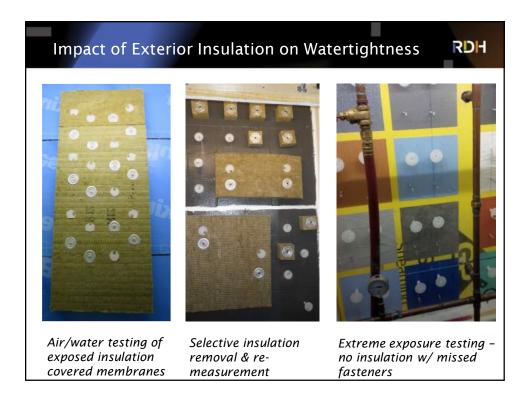


## Minnesota BEC

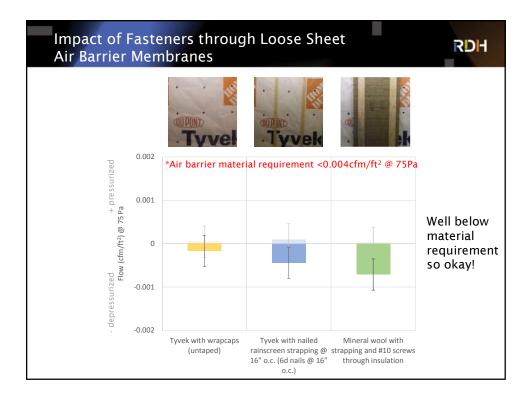


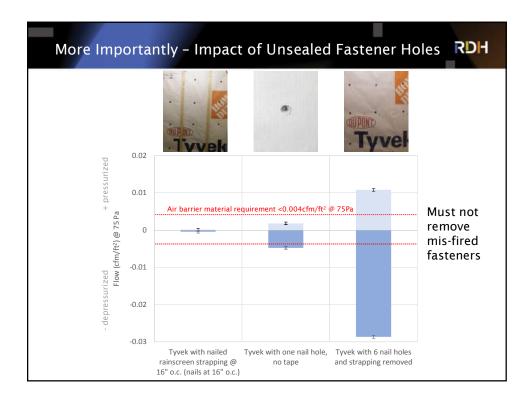


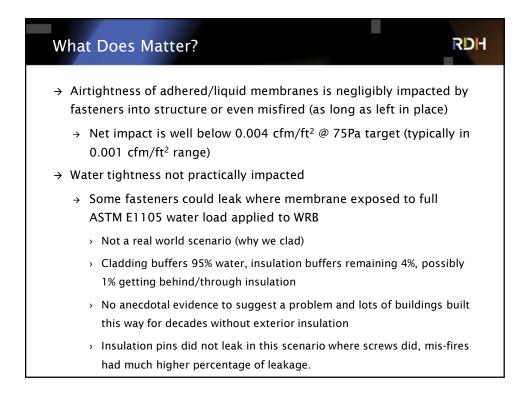




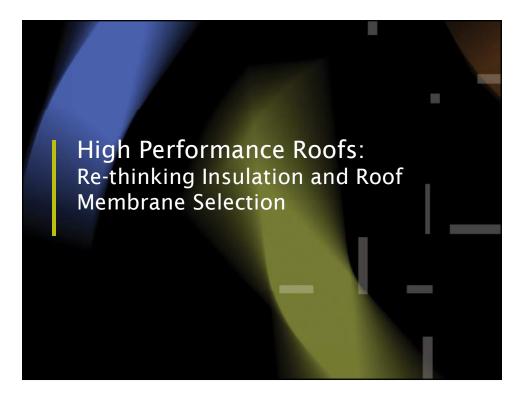






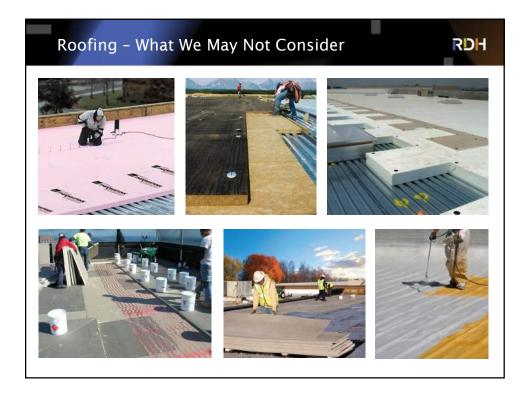


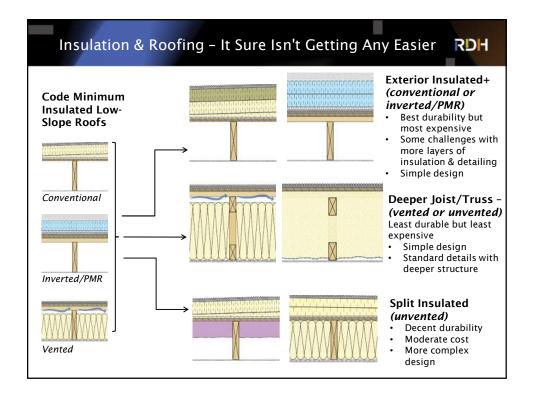




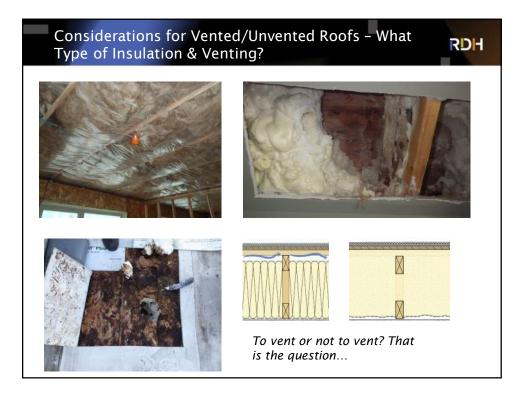


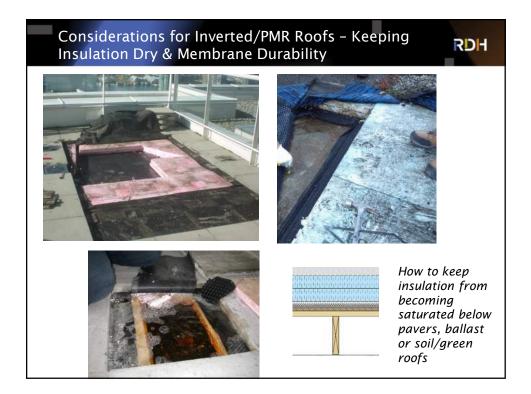


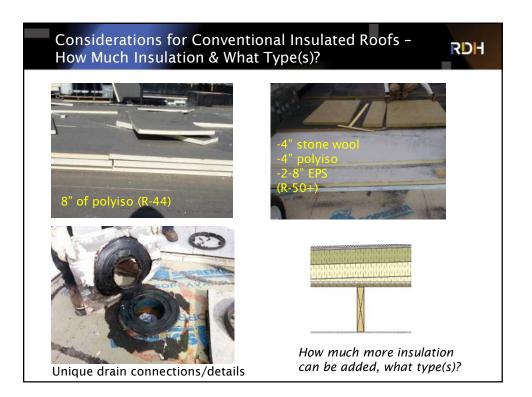




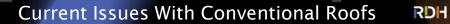
## Minnesota BEC



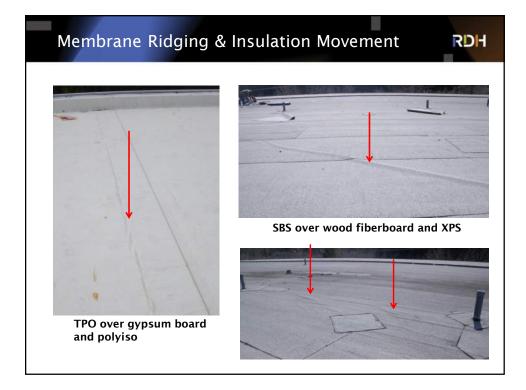




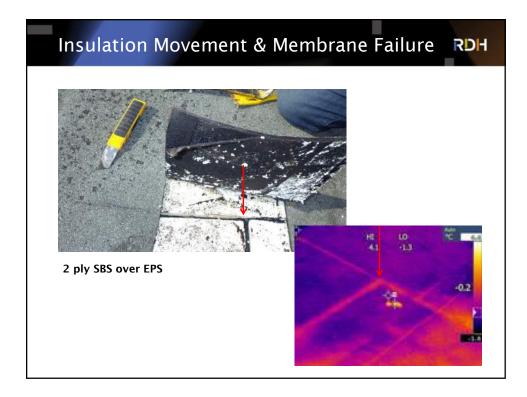
C	Conventional Insulated Roofs	RDH
	Most common low-slope roof application in North America Insulation installed above structure, protected by roofing membrane - Insulation is typically foam plastic (polyiso, EPS), though mineral fiber also	
÷	used Roofing membrane is exposed to temperature, UV, traffic - needs to be durable	
	Roof slope typically achieved by tapered insulation unless the structure is sloped	
<i>→</i>	Attachment of membrane/insulation can be: adhered, mechanically attached, loose laid ballasted, or combination to resist wind uplift	
$\rightarrow$	Wood, concrete, or steel structure substrate	
÷	Air barrier and vapor control layer may be placed below insulation on top of substrate (depending on climate)	

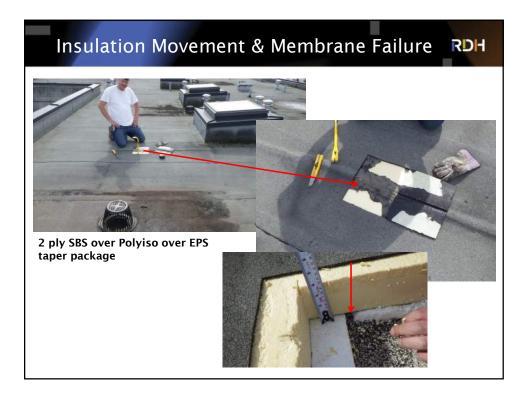


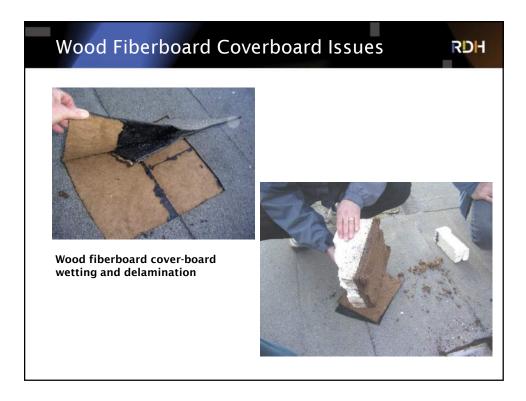
- $\rightarrow$  Roofing membrane issues (Details, materials, workmanship)
- $\rightarrow$  Insulation movement Thermally induced
  - $\rightarrow$  Causes membrane ridging and stresses
  - → More movement with thicker amounts of insulation (becoming more common) and certain insulation types
  - $\rightarrow$  More movement in roofs with darker colored membranes
- $\rightarrow$  Insulation movement Long term shrinkage, expansion, contraction
  - $\rightarrow$  Gaps between insulation boards, induced membrane stresses
- $\rightarrow$  Cover board /protection board failure delamination, softening, organic growth, fastener corrosion
- → Moisture trapped in insulation and roof assembly from wetting during construction or from small leaks in-service
  - → Becoming more common to install leak detection monitoring within conventional roofs and find this out – what to do about it? How to adjust monitoring?





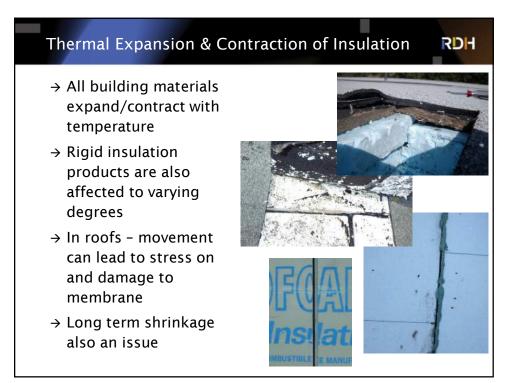


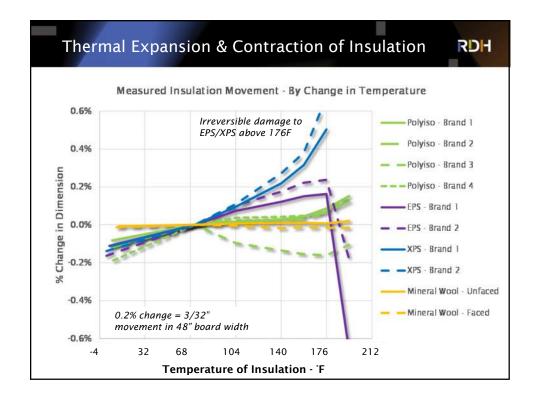


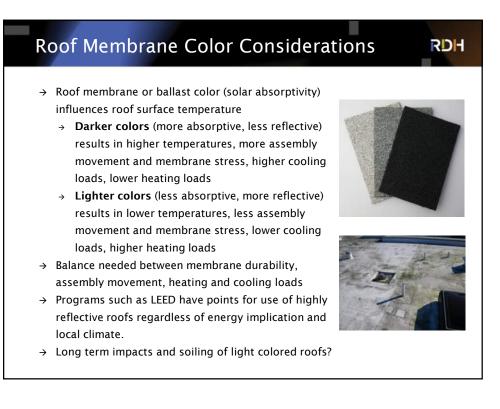






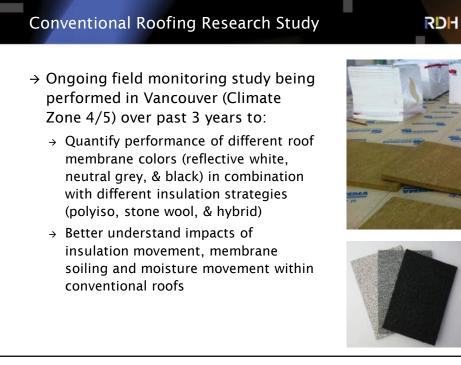












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