



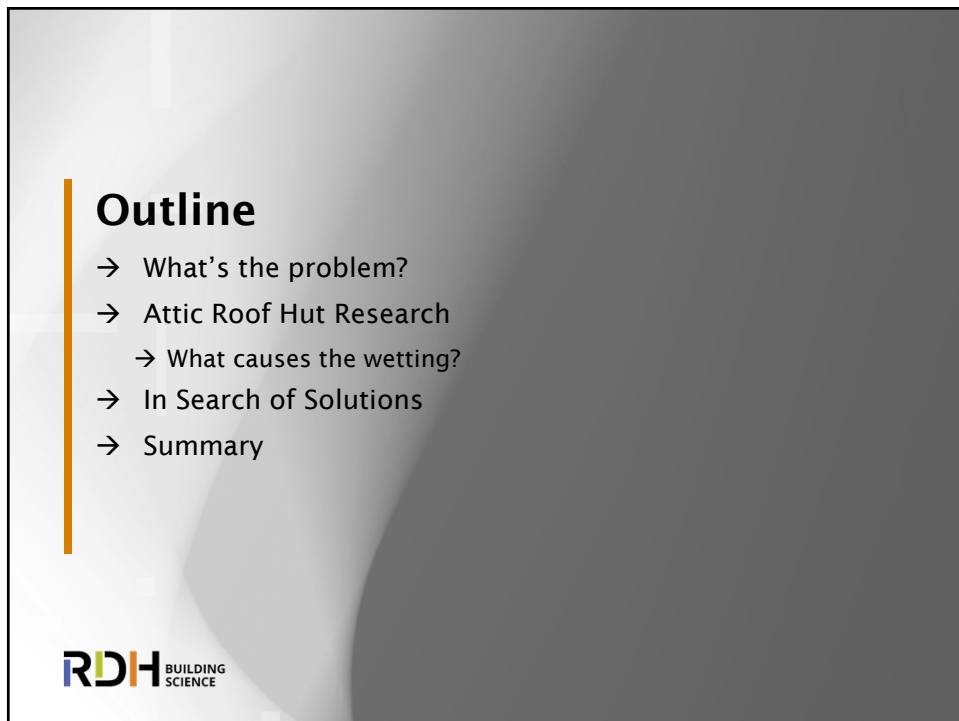
**Attics: Problems and Solutions**

SeaBEC Meeting

March 15, 2018

Presented by: Lorne Ricketts | M.A.Sc., P.Eng.

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**Outline**

- What's the problem?
- Attic Roof Hut Research
  - What causes the wetting?
- In Search of Solutions
- Summary

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## Factors Affecting Moisture Problems in Attics

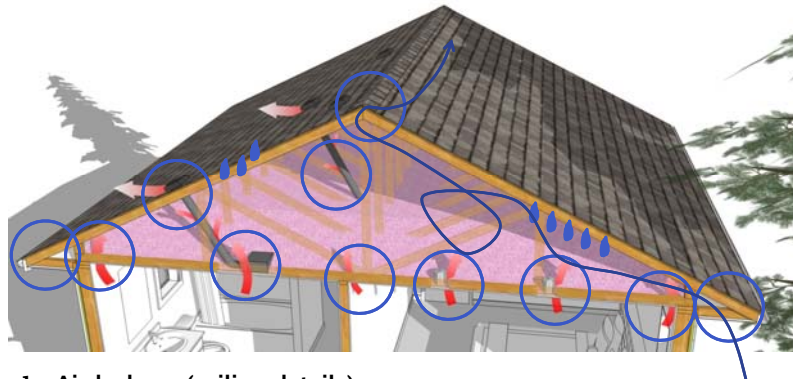
What influences attic moisture issues & what can we **control by design**?

- Roof orientation (solar radiation)
- Roof slope (solar radiation)
- Roofing material/color
- Adjacent buildings - shading
- Trees - shading & debris
- Outdoor climate
- Indoor climate
- Roof Leaks
- Insulation R-value
- Air leakage from house
- Duct leakage in attic
- Vent discharge location
- Vent area and distribution
- Sheathing durability
- Roof maintenance
- Other things...



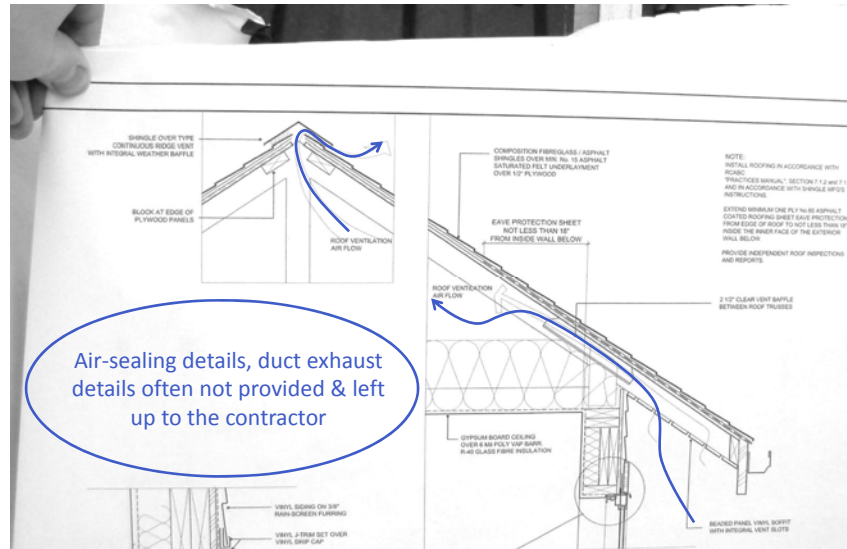
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## Where are we Seeing the Biggest Issues?



1. Air leakage (ceiling details)
2. Exhaust duct leaks & discharge location (roof, soffit, or wall)
3. Inadequate venting provisions (amount, vent location, or materials)
4. Outdoor moisture: night sky condensation on underside of sheathing
5. Wetting through shingles/roofing (tipping the moisture balance)

### Standard Faith-Based Air-Sealing Approach



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### The Localized Nature of Air Leakage Condensation



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### Other Not So Great Ideas...



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### But we know how to solve these problems...

**Guide to Best Practices for Air Sealing and Insulation Retrofits** - Produced by RDH and published by BC Housing



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## Key Findings from Field Investigations

- Seeing widespread issues with mold growth in wood-frame attics in Coastal Pacific Northwest in past decade
- Wetting exceeding drying capacity provided by ventilation
- Problem is most often NOT due to a lack of ventilation
- Usual culprits of air-leakage condensation (leaky ceiling, leaky ducts & discharge point)
- Also seeing supplemental exterior moisture sources (night sky condensation, rainwater seepage)



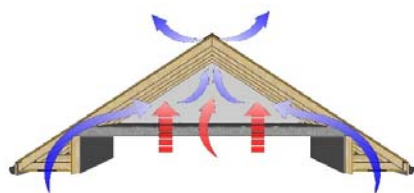
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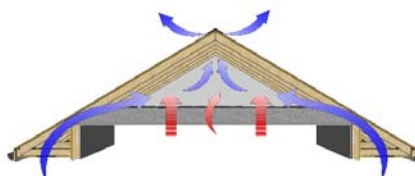


**Field Monitoring Study**

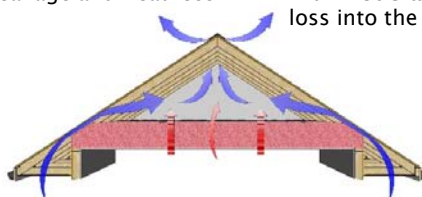
## Industry Trends – Less Heat Flow into Attic Spaces



<1970's attic construction with **excessive** air leakage and heat loss into the attic



1980's to 1990's attic construction with **moderate** air leakage and heat loss into the attic



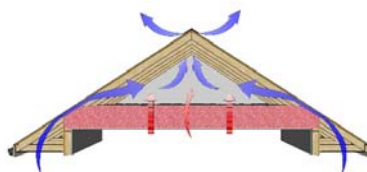
2000's attic construction with **minimal** air leakage and heat loss into the attic



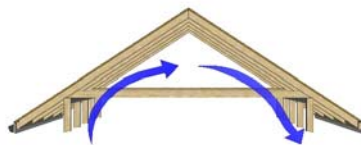
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## Research Study

- Controlled field monitoring study to isolate exterior wetting mechanisms from interior sources (air, vapor)
- To specifically evaluate impact of orientation, slope (3:12, 4:12 and 6:12) & shingle underlay
- Remove influence of air leakage or heat gain from house
- Monitor the performance of surface treatments



Typical ventilated attic construction with air leakage and heat loss into the attic



Theoretical attic with **no air leakage or heat loss** into the attic and unrestricted ventilation (Arrangement for Study)



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### Roof Test Hut Field Monitoring Setup



a) 3:12 Slope roof with roofing felt underlay



b) 4:12 Slope roof with roofing felt underlay



c) 6:12 Slope roof with roofing felt underlay



d) 3:12 Control roof with SAM underlay

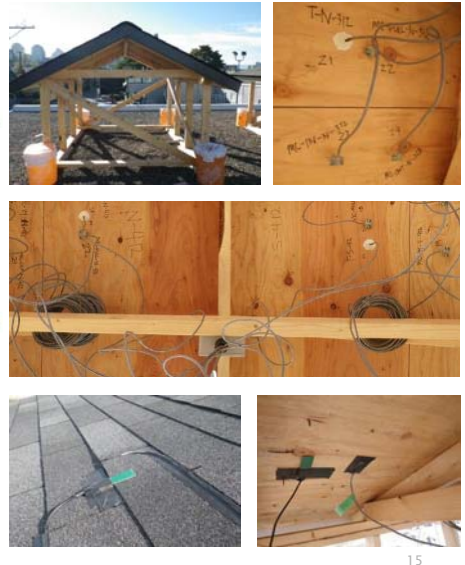
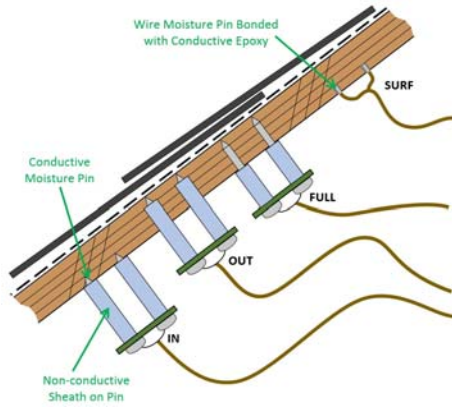
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### Roof Test Hut Field Monitoring Setup



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### Monitoring Equipment & Sensors

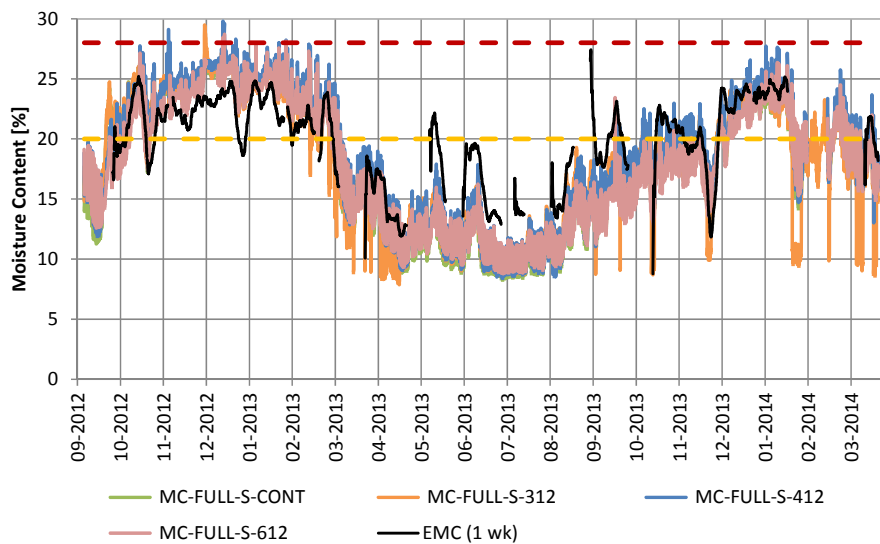


Moisture Content, Temperature, Relative Humidity and surface Condensation sensors – north and south slopes x 4 huts



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### Results –Roof Sheathing Moisture Contents



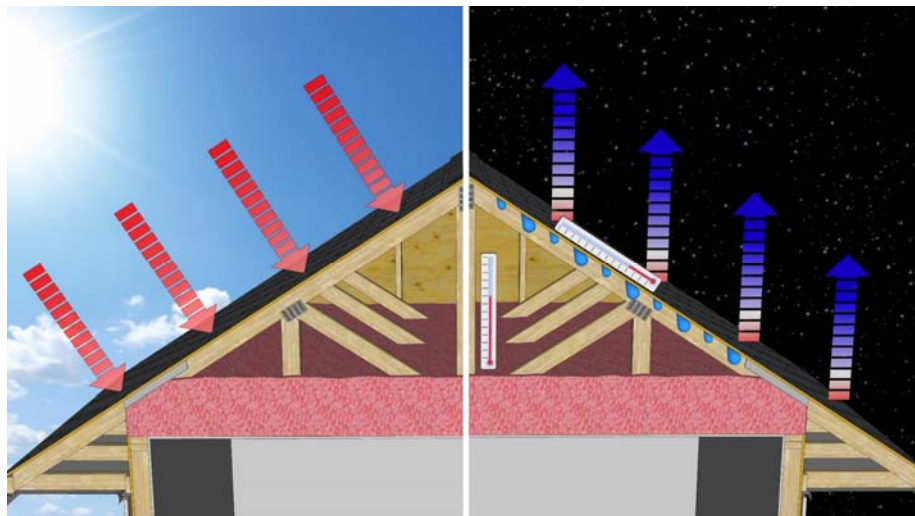


### What Makes the Sheathing Wet?

Night sky condensation!  
(Important: It happen when all moisture sources eliminated.)



### Influence of Solar Radiation & Night Sky Radiation



## Typical Issues - Impact of Orientation

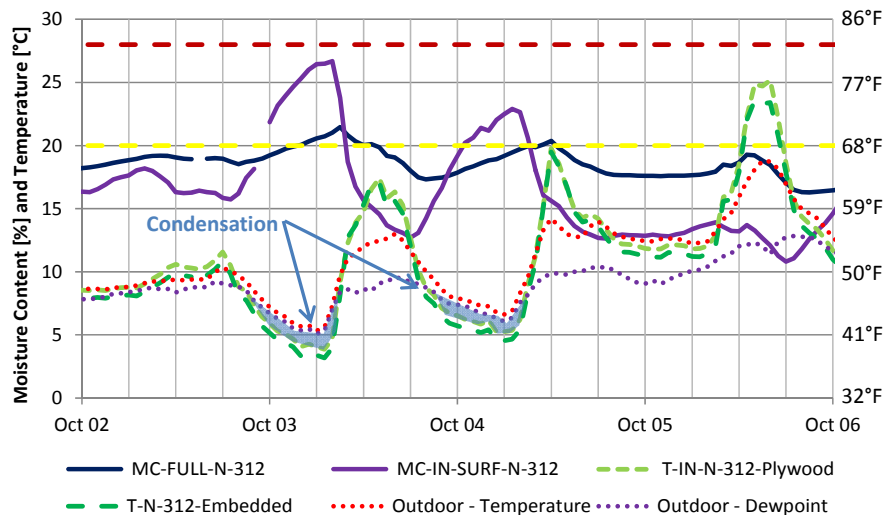
South Facing



North Facing



## When Does it Occur?



## Tracking Mold Growth

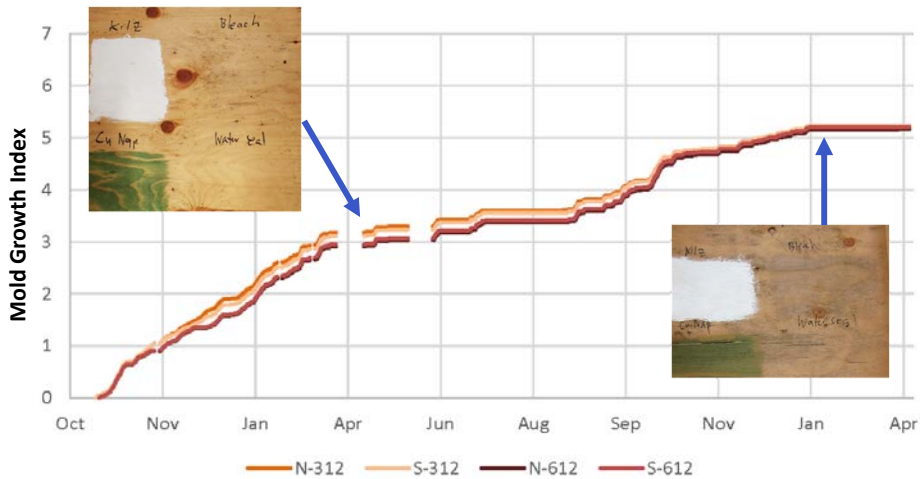
**TABLE 2: VITTANEN'S MOLD GROWTH INDEX DESCRIPTIONS**

INDEX	GROWTH RATE	DESCRIPTION
0	No growth	Spores not activated
1	Small amounts of mold on surface (microscope)	Initial stages of growth
2	<10% coverage of mold on surface (microscope)	---
3	10% - 30% coverage of mold on surface (visual)	New spores produced
4	30% - 70% coverage of mold on surface (visual)	Moderate growth
5	>70% coverage of mold on surface (visual)	Plenty of growth
6	Very heavy and tight growth	Coverage around 100%



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## Tracking Mold Growth - Year 1



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## A Localized Problem...

- ▨ High Risk Climate for  
Night Sky Radiation  
Attic Moisture Issues



## Surface Treatment Application - Round 1

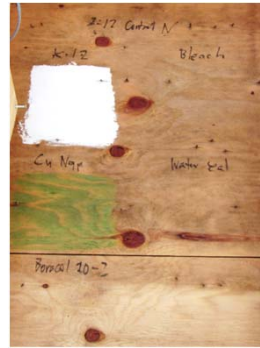
- 4 huts x 2 orientations = 8 applications of each
- Fungicides, Cleaners, Sealers
    - › Boracol® 20-2
    - › Boracol® 20-2 BD
    - › Bleach
    - › Thompson's WaterSeal®
    - › Kilz® Paint
  - Wood Preservatives
    - › Copper Naphthenate
    - › Zinc Naphthenate



### Wood Preservative & Fungicide Treatments



When Applied



1 Year Later



Fungal Growth observed is Cladosporium

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### Visual Assessment of Surface Treatment Efficacy

VISUAL ASSESSMENT OF SURFACE TREATMENT EFFICACY							
Test Roof	Surface Treatments (north left, south right)						
	Sansin Boracol® 20-2	Copper Naphthenate	Bleach	Thompsons WaterSeal®	Kilz® Paint	Zinc Naphthenate	Sansin Boracol® 20-2BD
Control	Orange	Green	Red	Red	Green	Orange	Green
3:12	Red	Green	Red	Red	Green	Orange	Green
4:12	Red	Green	Red	Red	Green	Orange	Green
6:12	Orange	Green	Green	Red	Green	Green	Green

**VISUAL ASSESSMENT SCALE**

- Green: Pristine or very light fungal growth
- Orange: Moderate fungal growth
- Red: Significant fungal growth

*In our experience Kilz® & Boracol® 20-2BD while okay here after 2 years may not be best long term for fungal growth*



Need duplicate samples - slope not a big factor (heartwood vs sapwood is)

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### Wood Preservative & Fungicide Treatments



The best decay fungicide looked okay in years 1 and 2 - but not in year 3



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### A Caution with Surface Treatments



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### A Caution with Surface Treatments

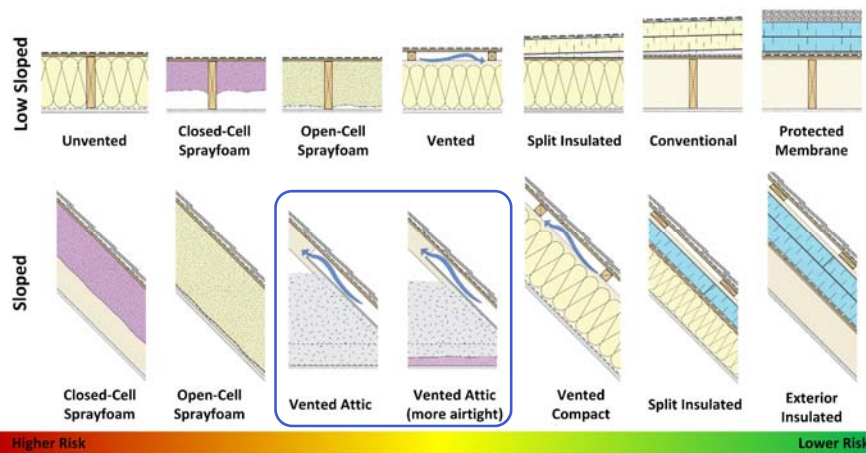
Mold can re-grow on surface of encapsulating paints.



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### Relative Risk of Wood-Frame Roof Assemblies

Could debate this for hours...



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## Final Thoughts

- Ventilated attics & roof assemblies 'built to code' are experiencing mold growth on underside of sheathing (plywood or OSB)
  - Wetting from night sky condensation and may be exacerbated by air leaks & water leaks
  - Hard to reliably stop night sky condensation
  - Ventilation on its own is not a solution
  - Mold growth may be minor but perceived as risk
- Could build other roof assemblies but unlikely to replace ventilated attics any time soon
- Need to address durability & sensitivity of wood based sheathings to mold growth, various groups are developing products
  - Just make sure the fungicide is no more harmful to humans than the mold is...

## Additional Resources

**RDH Technical Bulletin No. 10 - Mold in Vented Wood-Frame Roofs in the Coastal Pacific Northwest**

**RDH Blog Article - Re-Thinking Ventilated Attics: How to Stop Mold Growth in Coastal Climates**

**Why Wood Frame Attics Get Wet & Moldy in the Pacific Northwest** - Conference Paper at 30<sup>th</sup> RCI International Convention & Tradeshow

**Guide to Best Practices for Air Sealing and Insulation Retrofits** - Produced by RDH and published by BC Housing





## Discussion + Questions

FOR FURTHER INFORMATION PLEASE VISIT

→ [www.rdh.com](http://www.rdh.com)

→ [www.buildingsciencelabs.com](http://www.buildingsciencelabs.com)

OR CONTACT ME

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