STRUCTURAL TESTING OF SCREWS THROUGH THICK EXTERIOR INSULATION

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RDH BUILDING SCIENCE

Outline

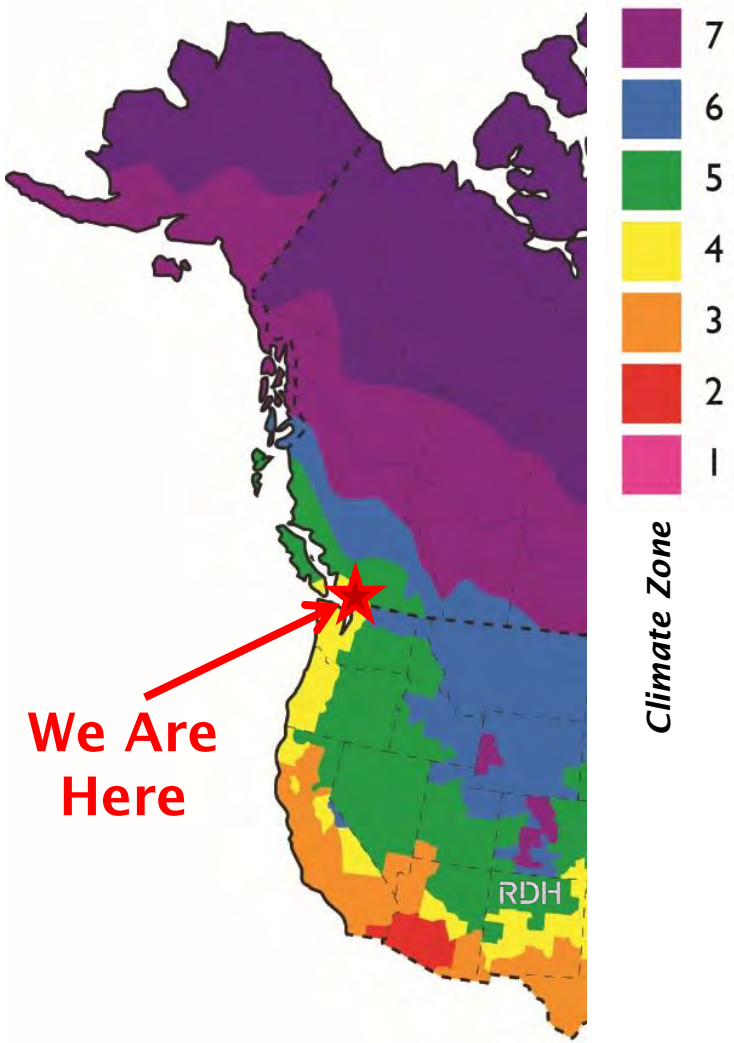
- → Why & How We are Insulating More
- → Test Results of Long Screws through Insulation
- → Available Guidance

Why We are Insulating More

→ Increasing energy efficiency expectations are **changing insulation requirements in codes**

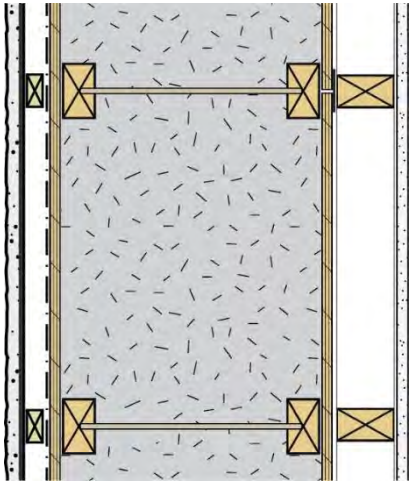
- → **Passive House**
- → **R-22 walls requirement for Part 9** in CoV has instigated widespread change in approach

→ **Better accounting for thermal bridging** means not overlooking bridging by cladding attachments

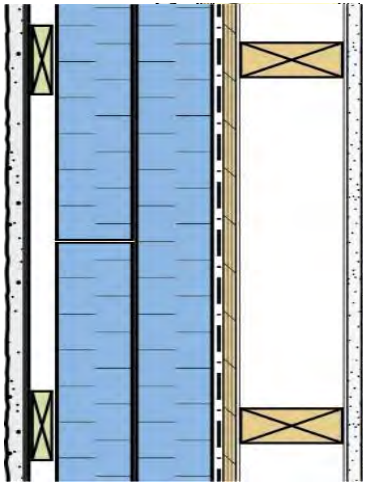


How to Insulate More

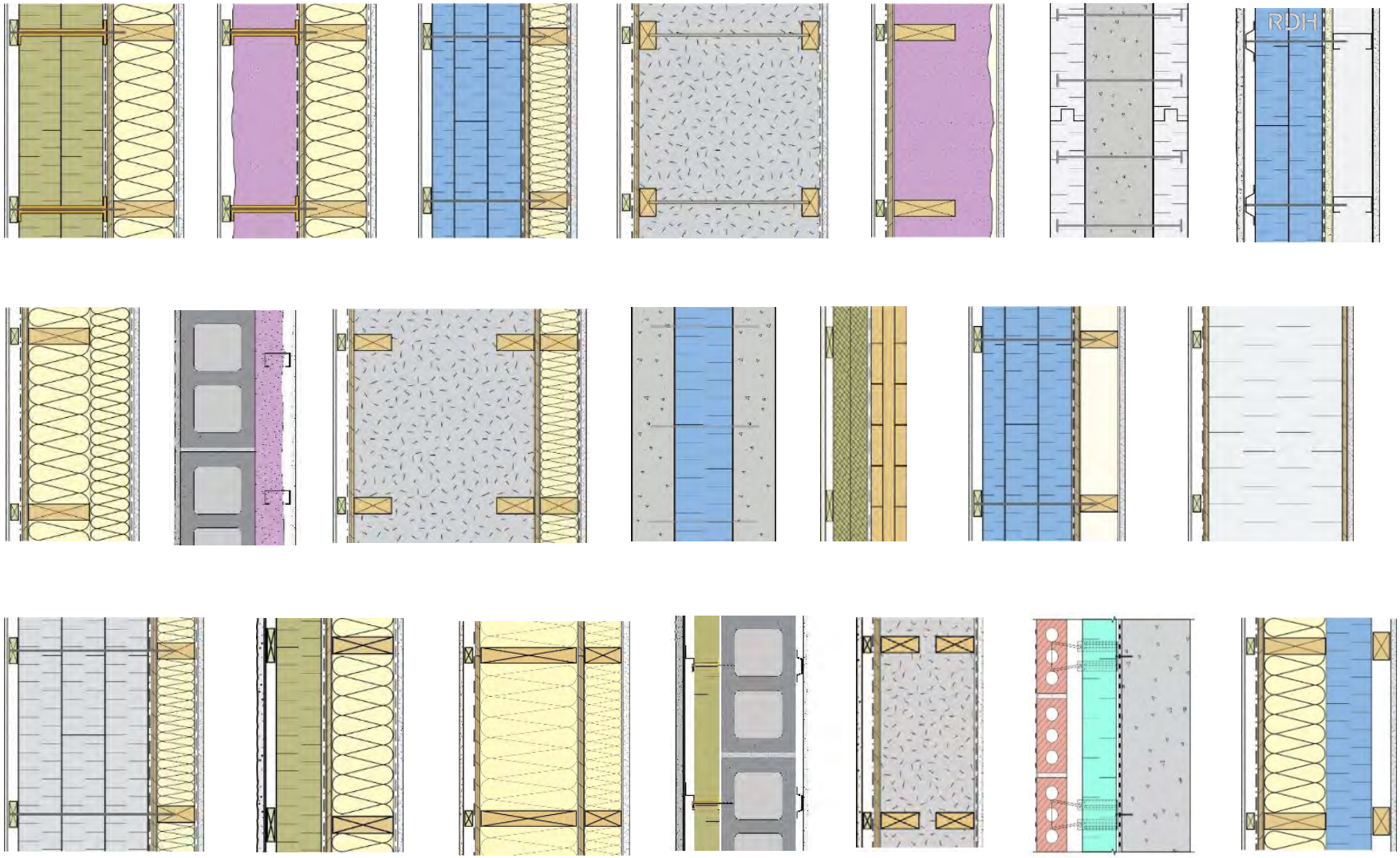
Stuff It?



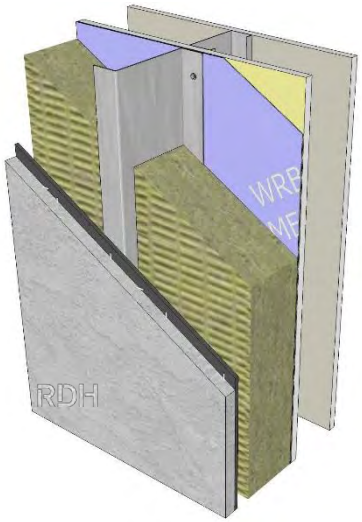
Wrap It?



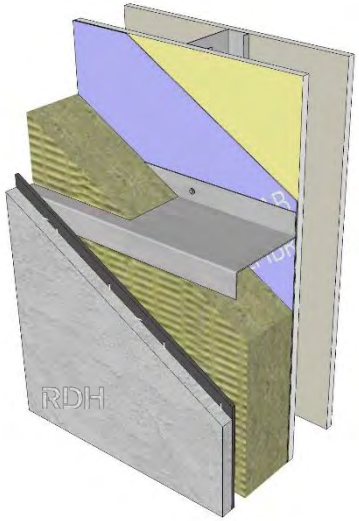
More than one way to get there…



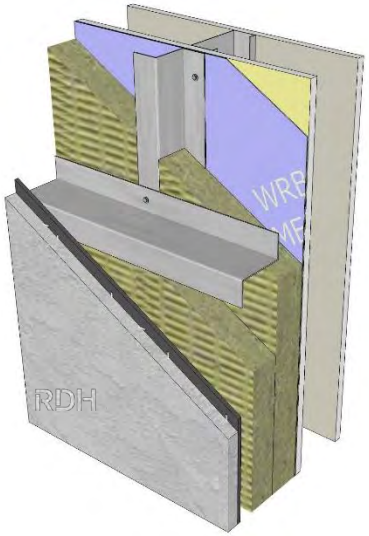
Exterior Insulation Approaches Gaining Popularity



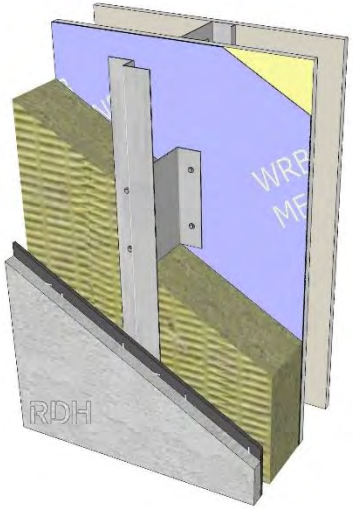
Vertical Z-girts



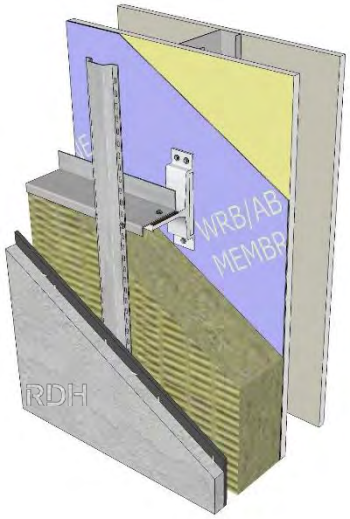
Horizontal Z-girts



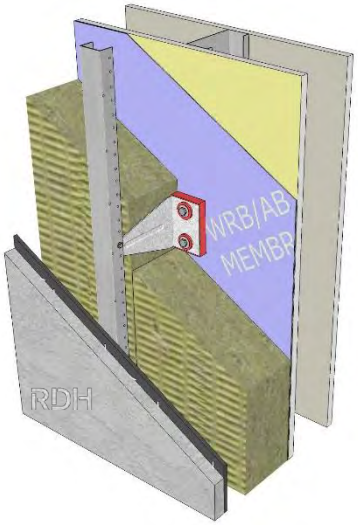
Crossing Z-girts



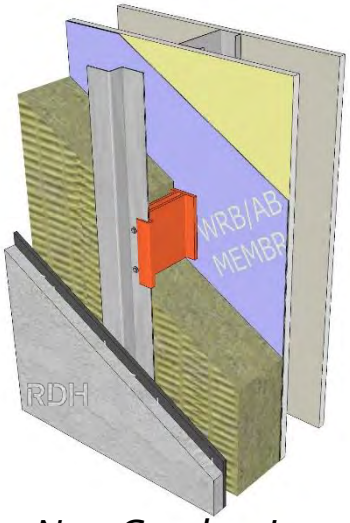
Galvanized/Stainless Clip & Rail



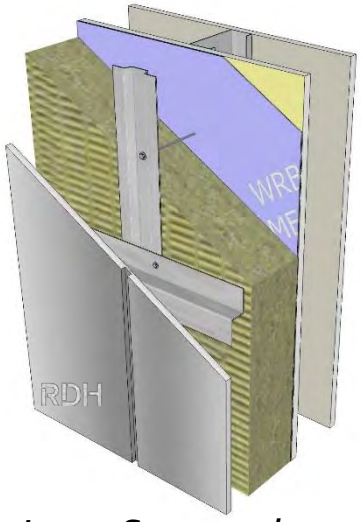
Aluminum Clip & Rail



Thermally Improved Clip & Rail

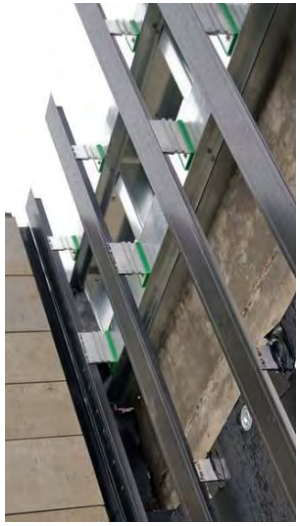


Non-Conductive Clip & Rail

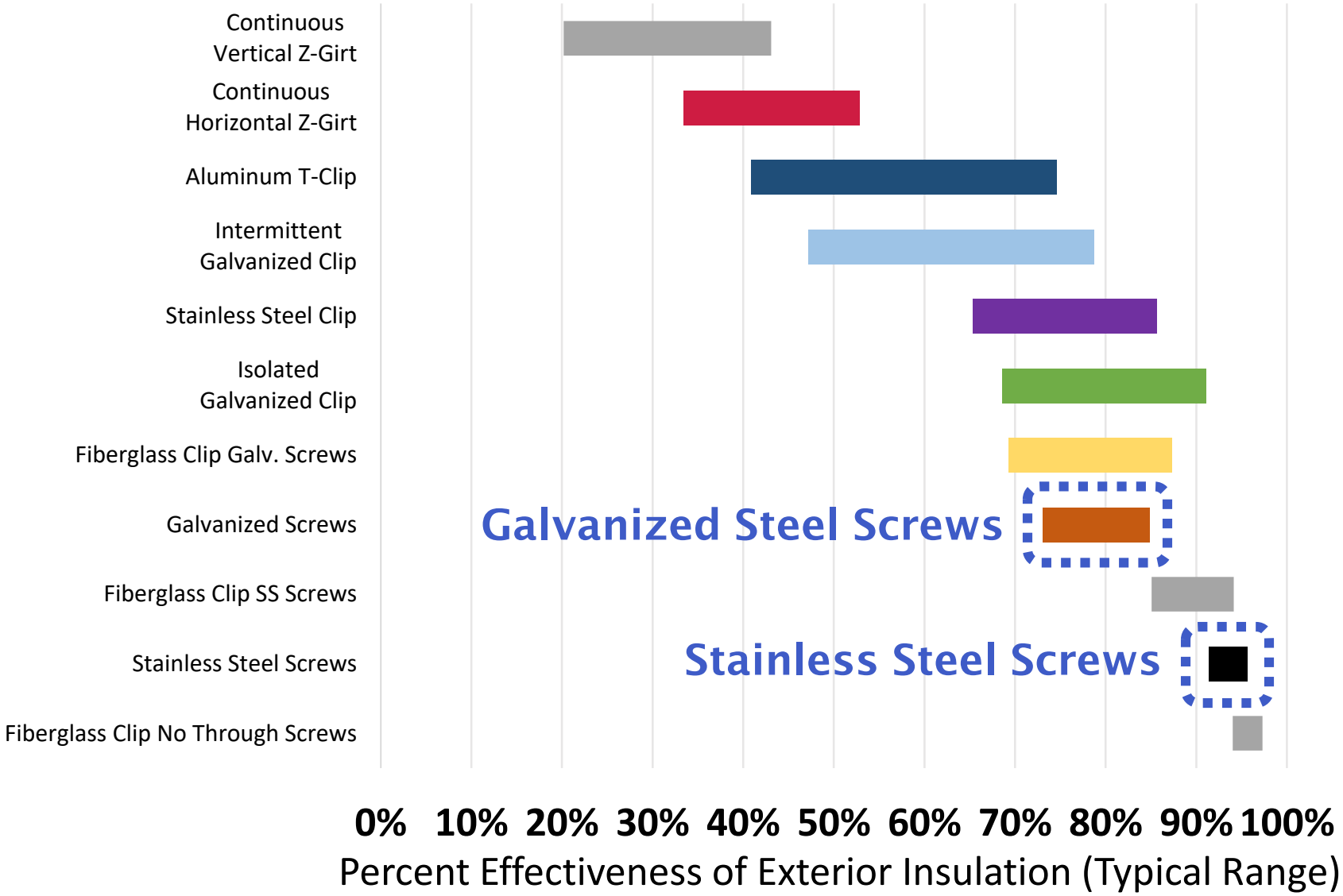


Long Screws through Insulation

Exterior Insulation Approaches



Screws Through Insulation Highly Effective

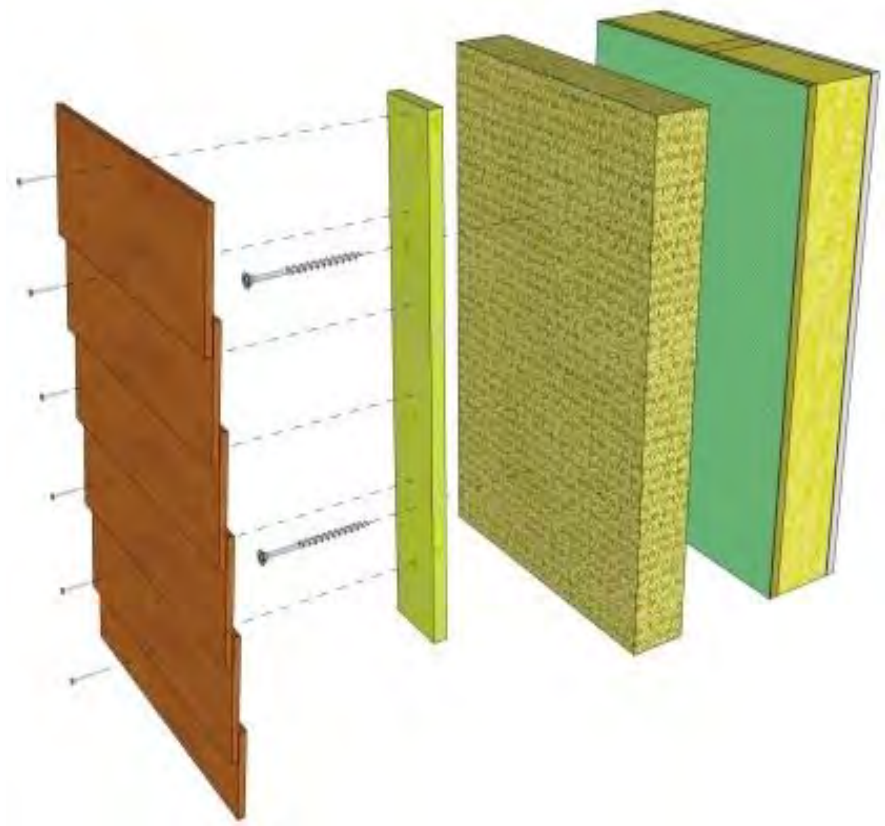


Screws Through Insulation

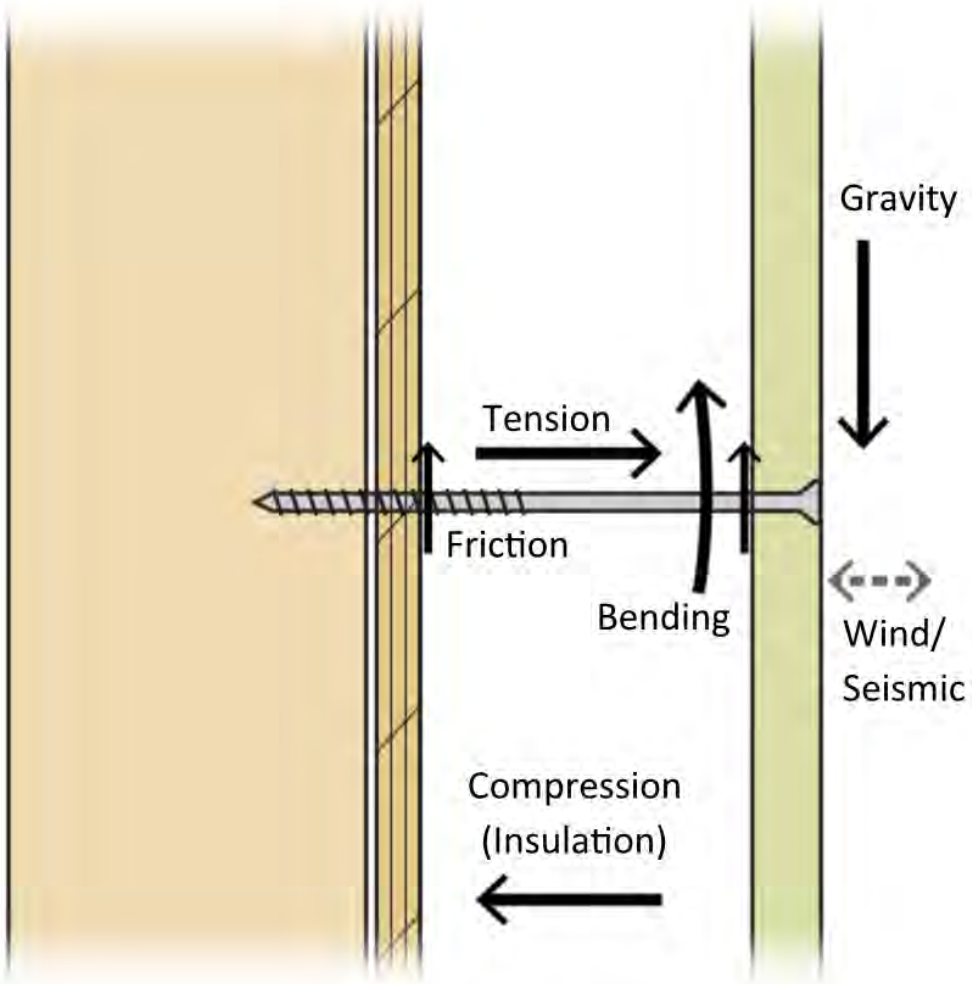
→ Rapidly gaining popularity to meet increasing R-value requirements

→ Uncertainty about:

- → How to do it
- → Allowable loads
- → Fastener types
- → Fastener spacing
- → Angle of installation
- → Deflection



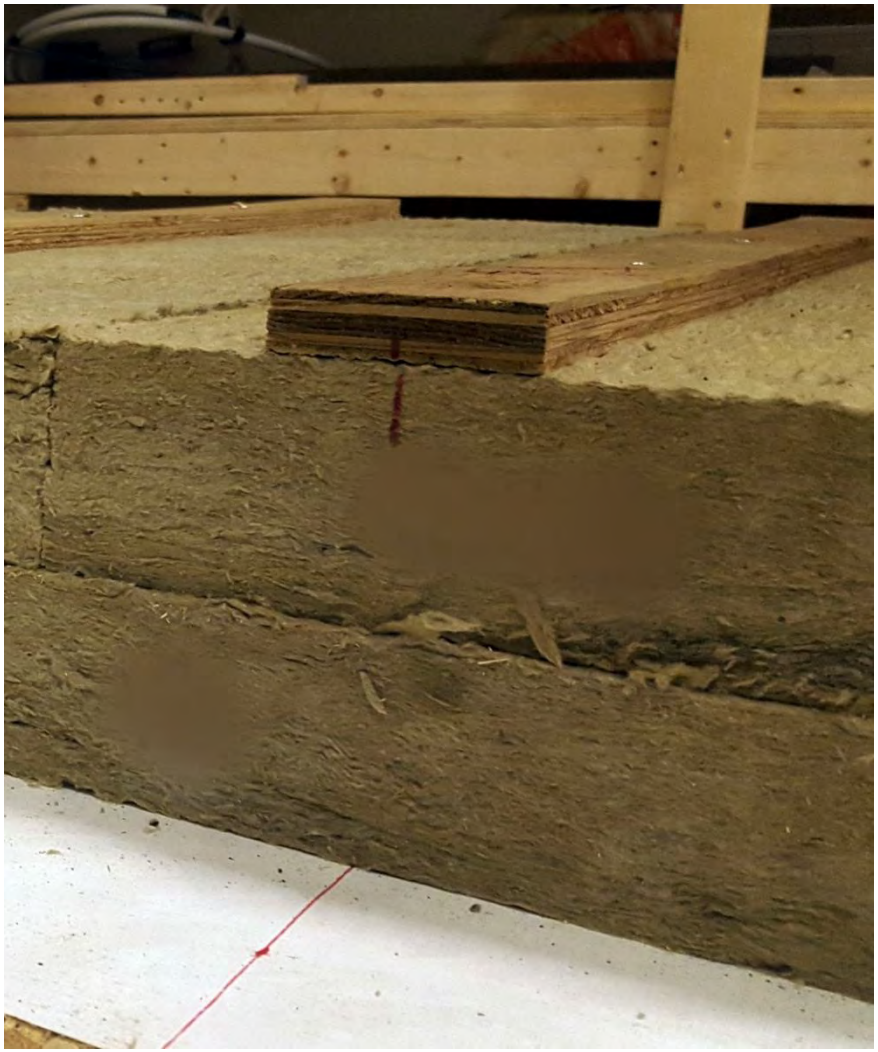
Design and Forces

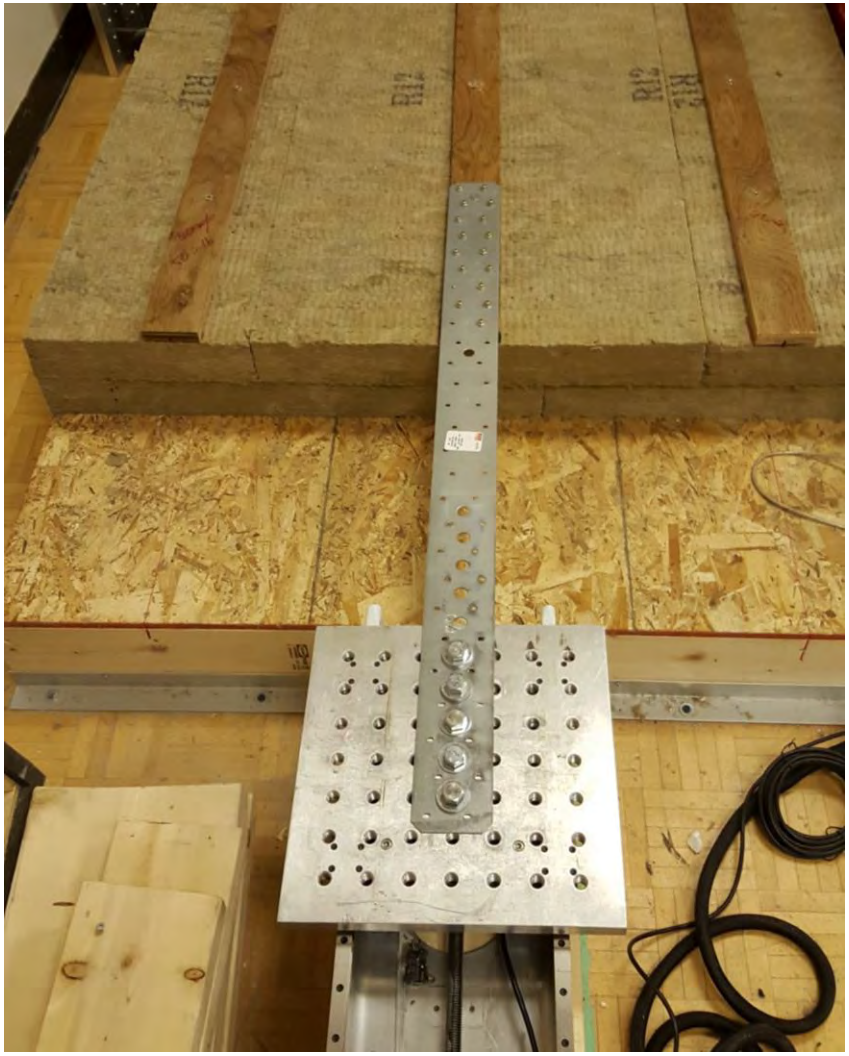


Service Load State
(Section View)

Testing

Testing





Testing

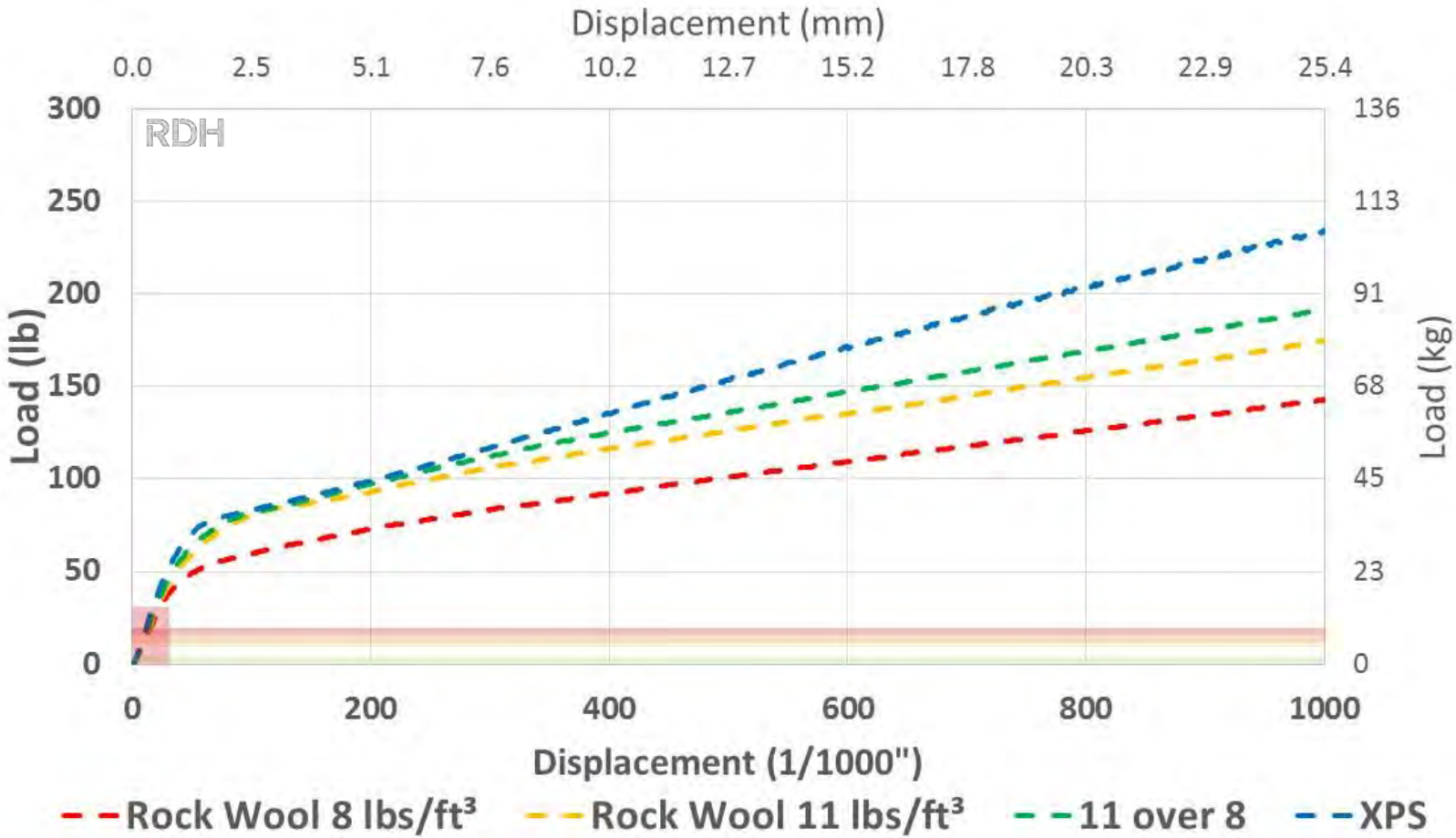
→ 3”, 6”, 9” and 12” thicknesses of insulation

→ Different insulation types (mineral wool and XPS) and different compressive strengths

→ Different screw head types (pan and countersunk)

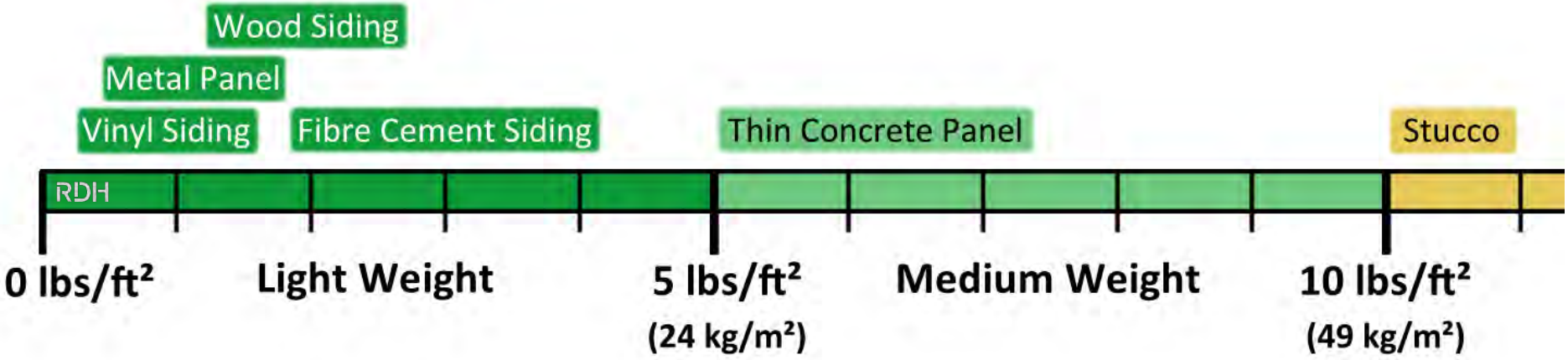
Testing – Insulation Type

Load Displacement for Different Insulation Types (6" Thick)

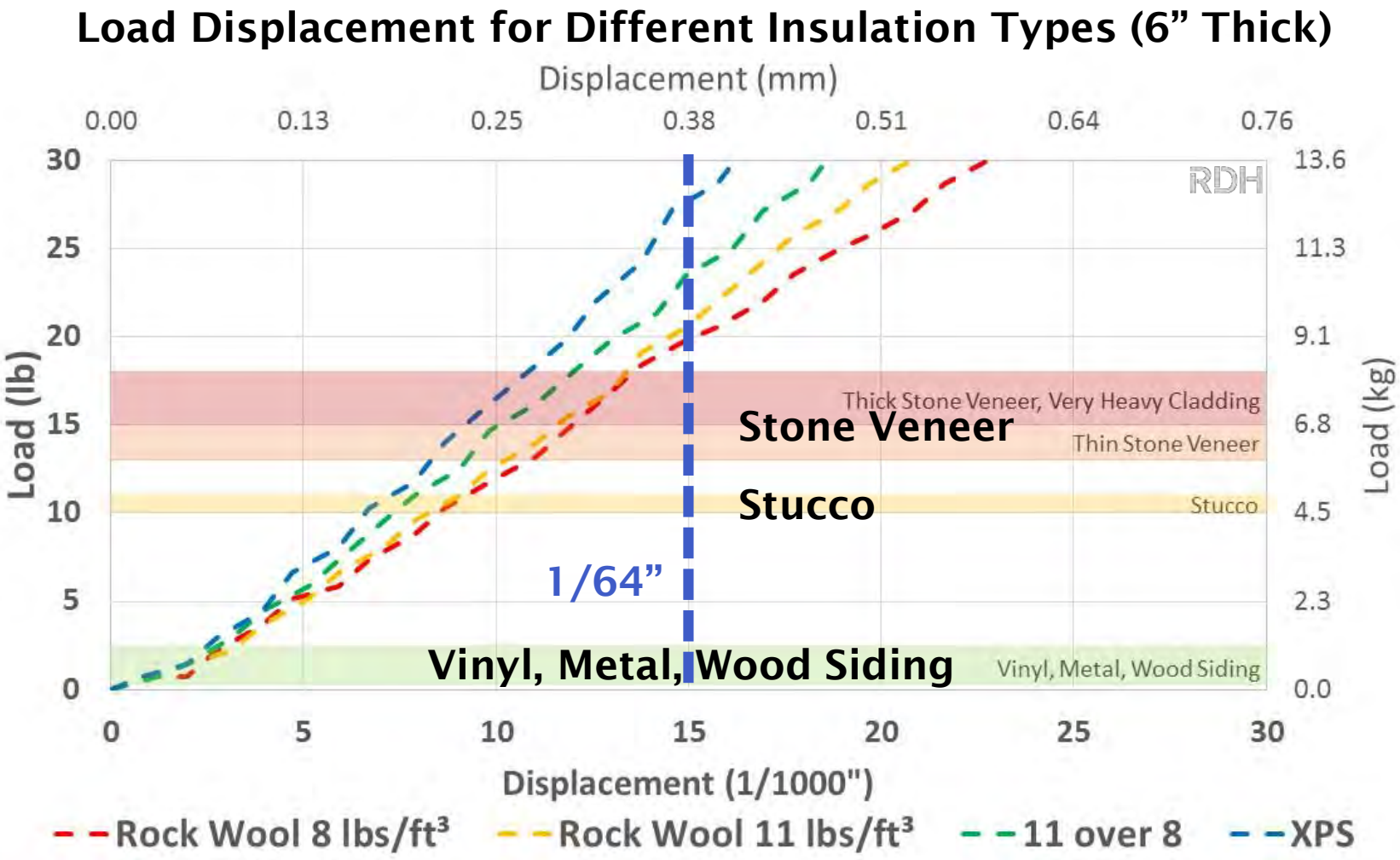


Cladding Weights

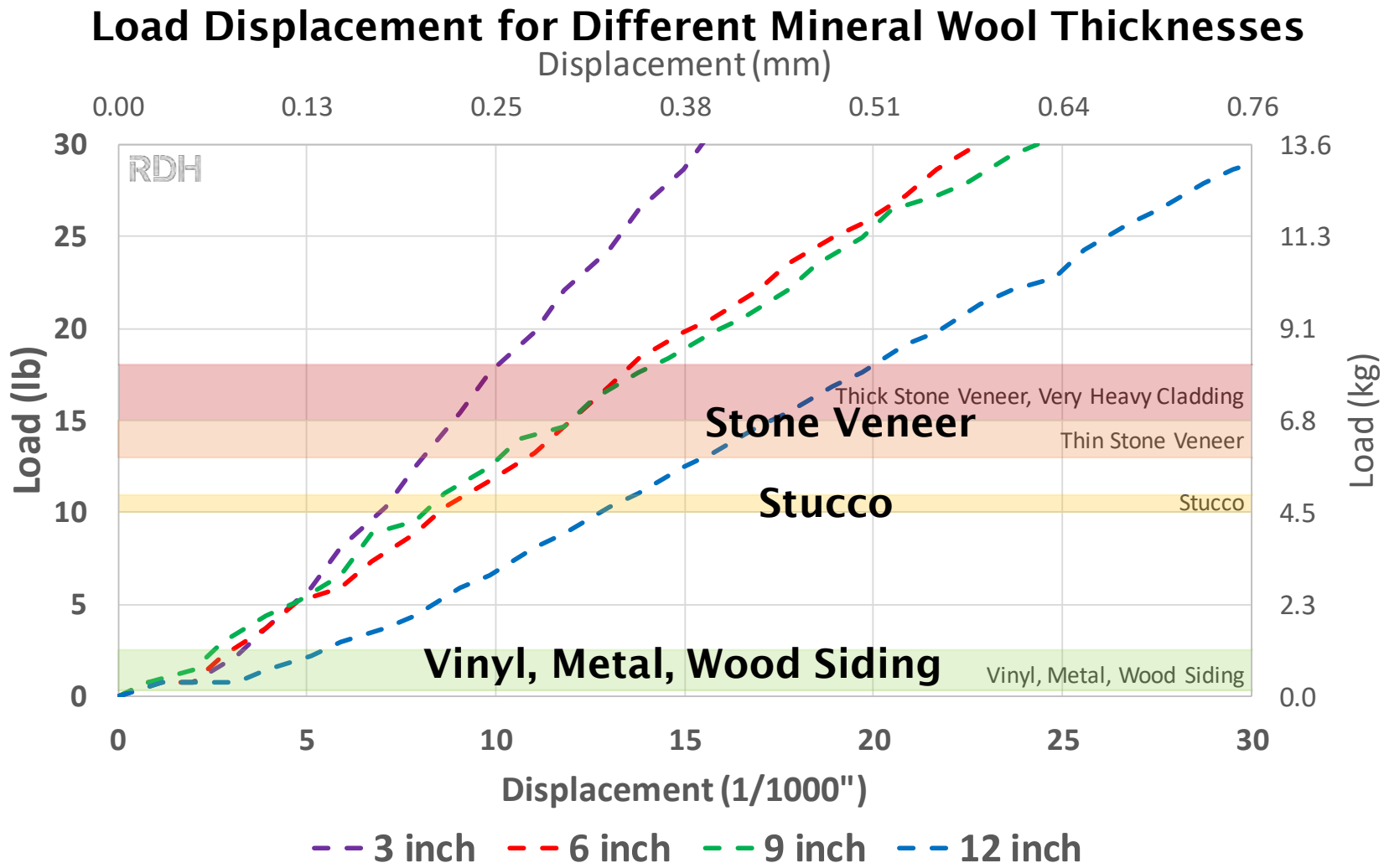
→ Most claddings are "light weight" with only a few select products being heavier



Testing – Insulation Type



Testing – Insulation Thickness

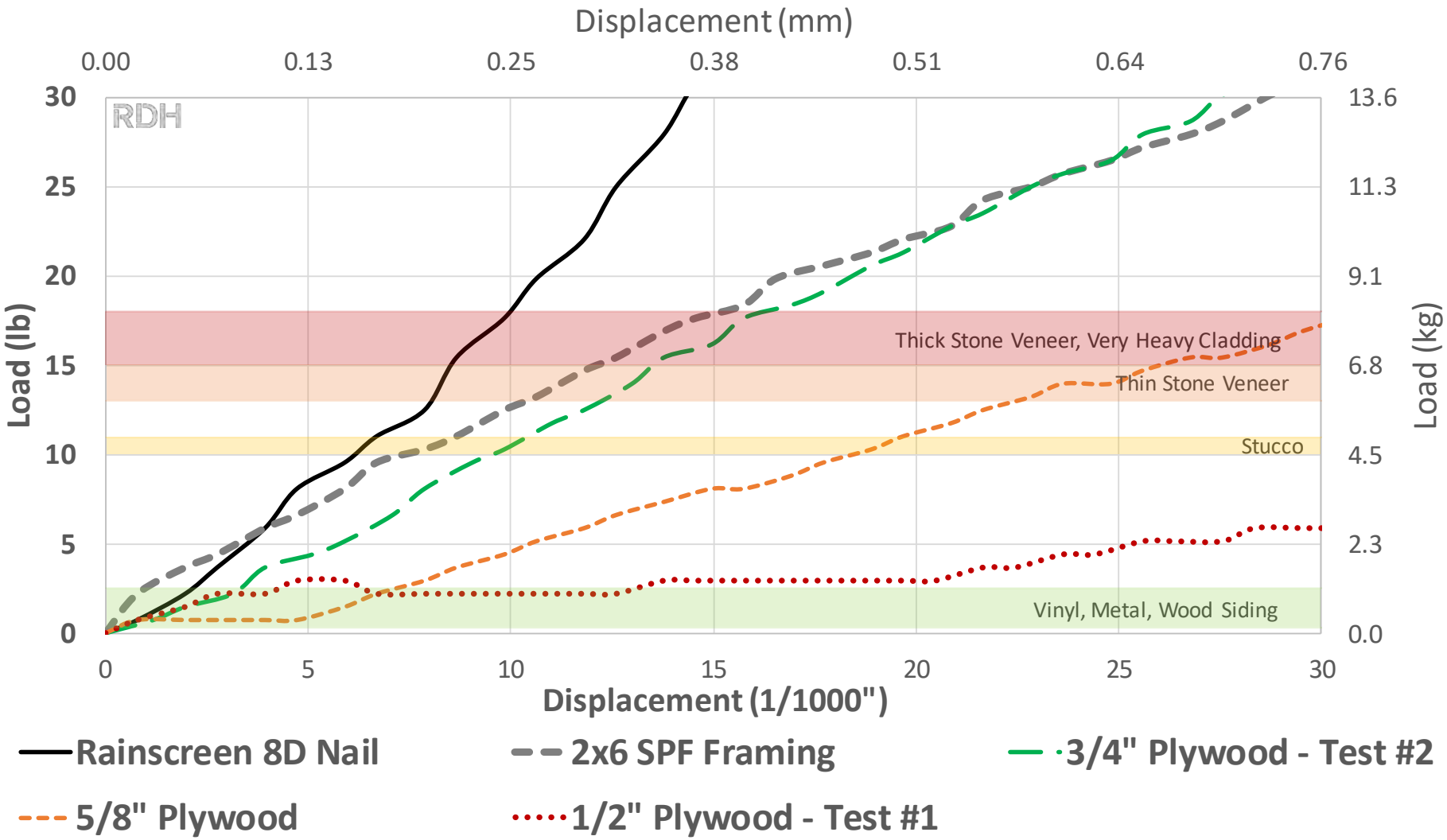


Testing – Insulation Thickness

→ For the record, this is what 12” of insulation looks like…

Testing – What if we miss the stud?

Load Displacement for Screw Penetration into Framing vs. Non-Framing (9“ Insulation) and 8D Nail Rainscreen (No Insulation)

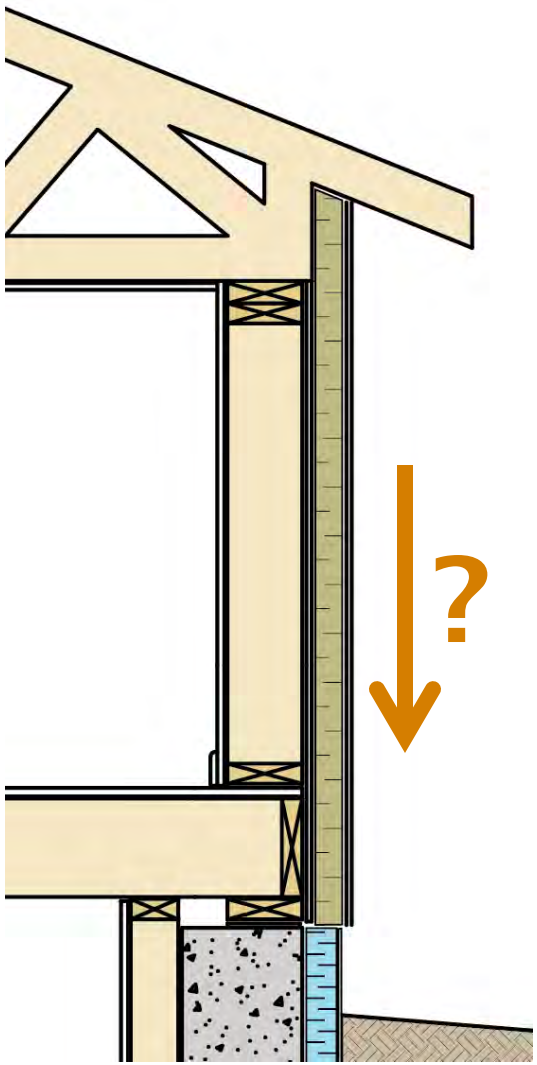


Deflection - How much is too much?

→ Difficult to define precise deflection limit but many claddings can easily accommodate 1/8" (125 mil, 3mm) deflection

→ Staged loading of the support system helps to "pre-deflect" the strapping prior to cladding completion

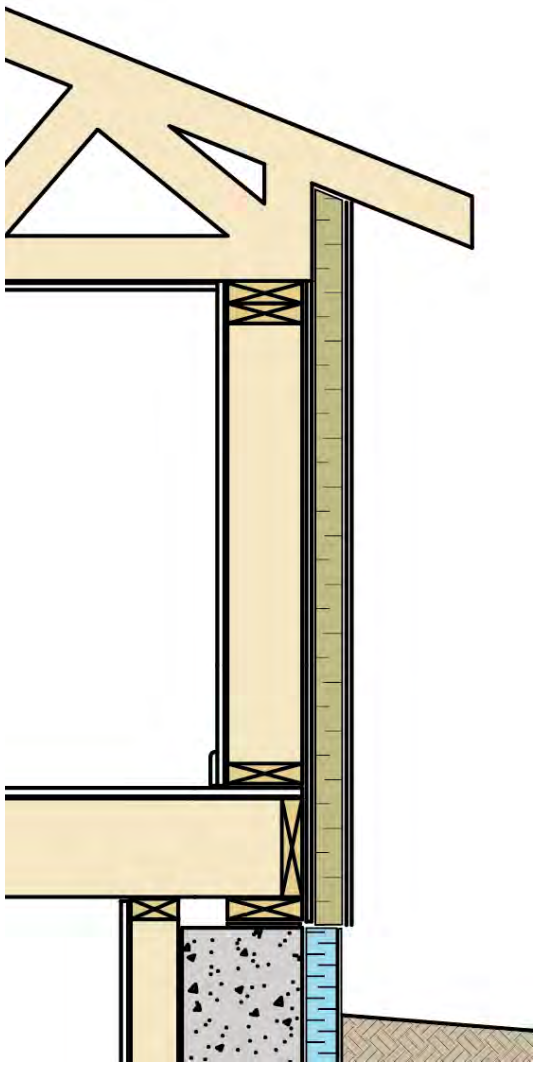
→ Can see it is different than strapping direct to sheathing, but not much



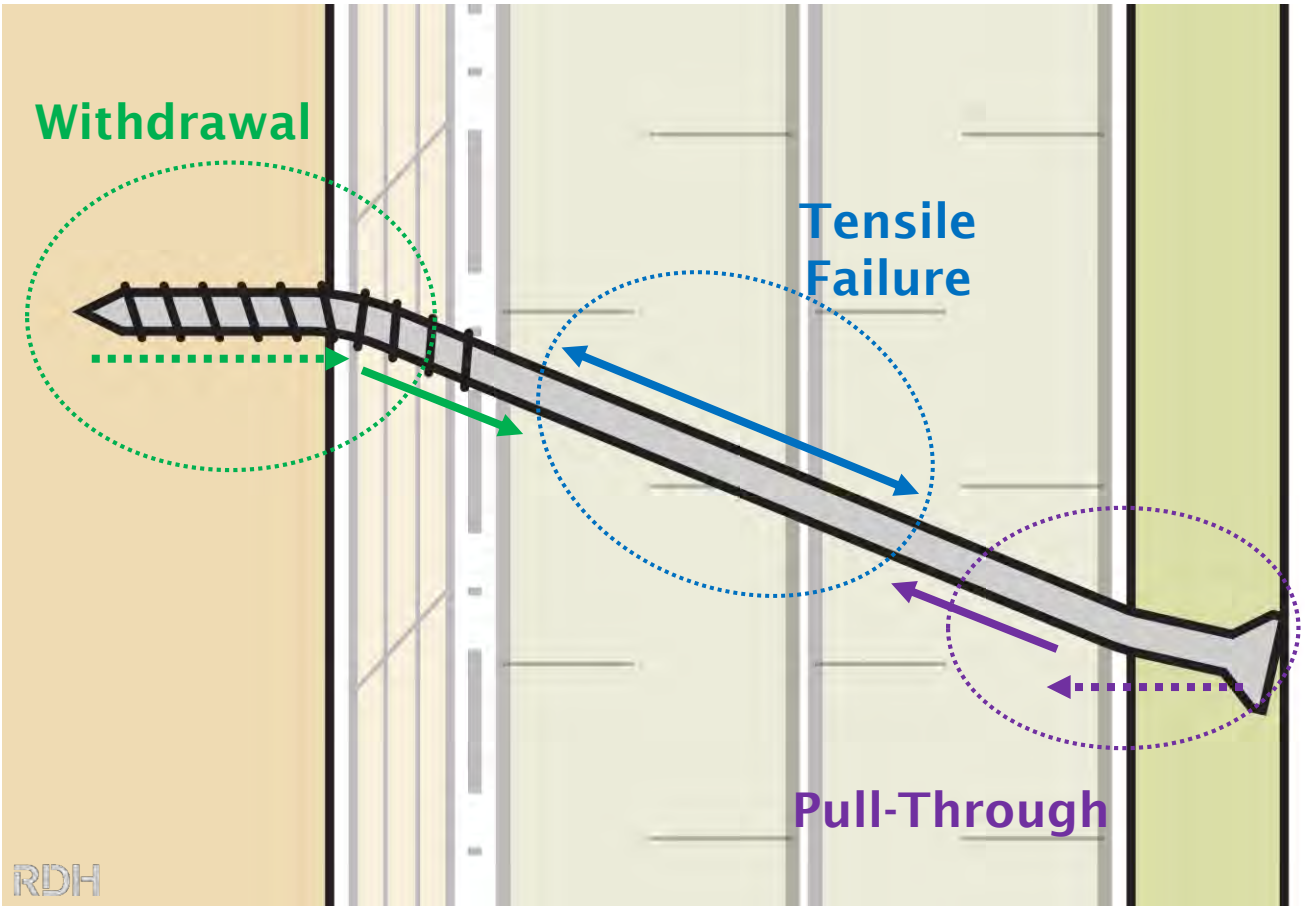
Deflection - How much is too much?

→ Comparison: Wood Shrinkage

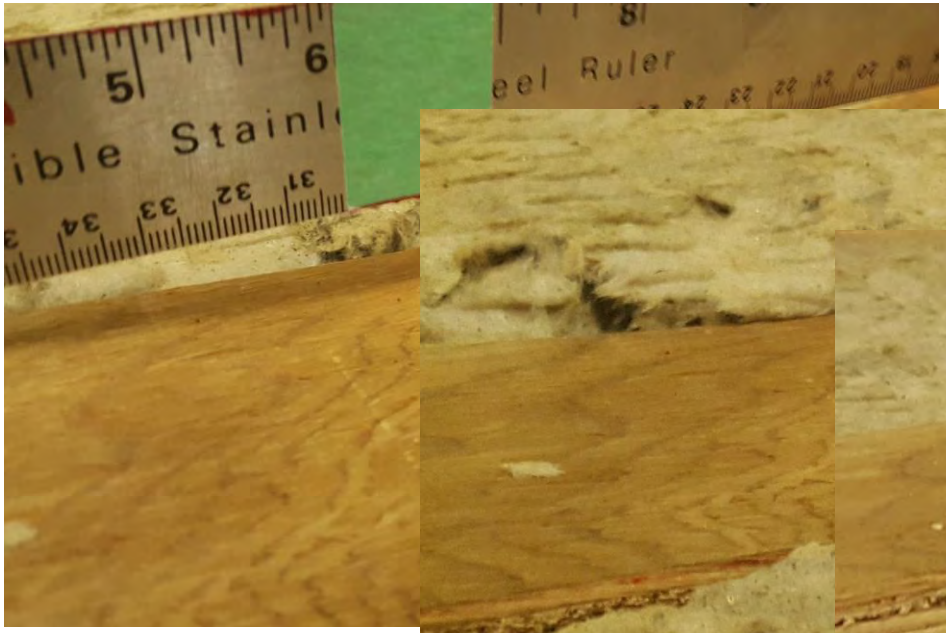
- → One wood-frame storey: Double top plate, single bottom plate, 8' ceilings, rim joist
- → Assume 19% initial MC and 10% final MC at equilibrium with interior
- → Wood shrinkage due to drying
  - › 0.25%/MC across grain
  - › 0.0053%/MC with grain
- → Approximately **3/8" (375mil, 10mm)** shrinkage in one storey height
  - › **Roughly 10x** more than measured deflection in test for any arrangement



Testing – Ultimate Failure Modes



Testing – Ultimate Failure Mode

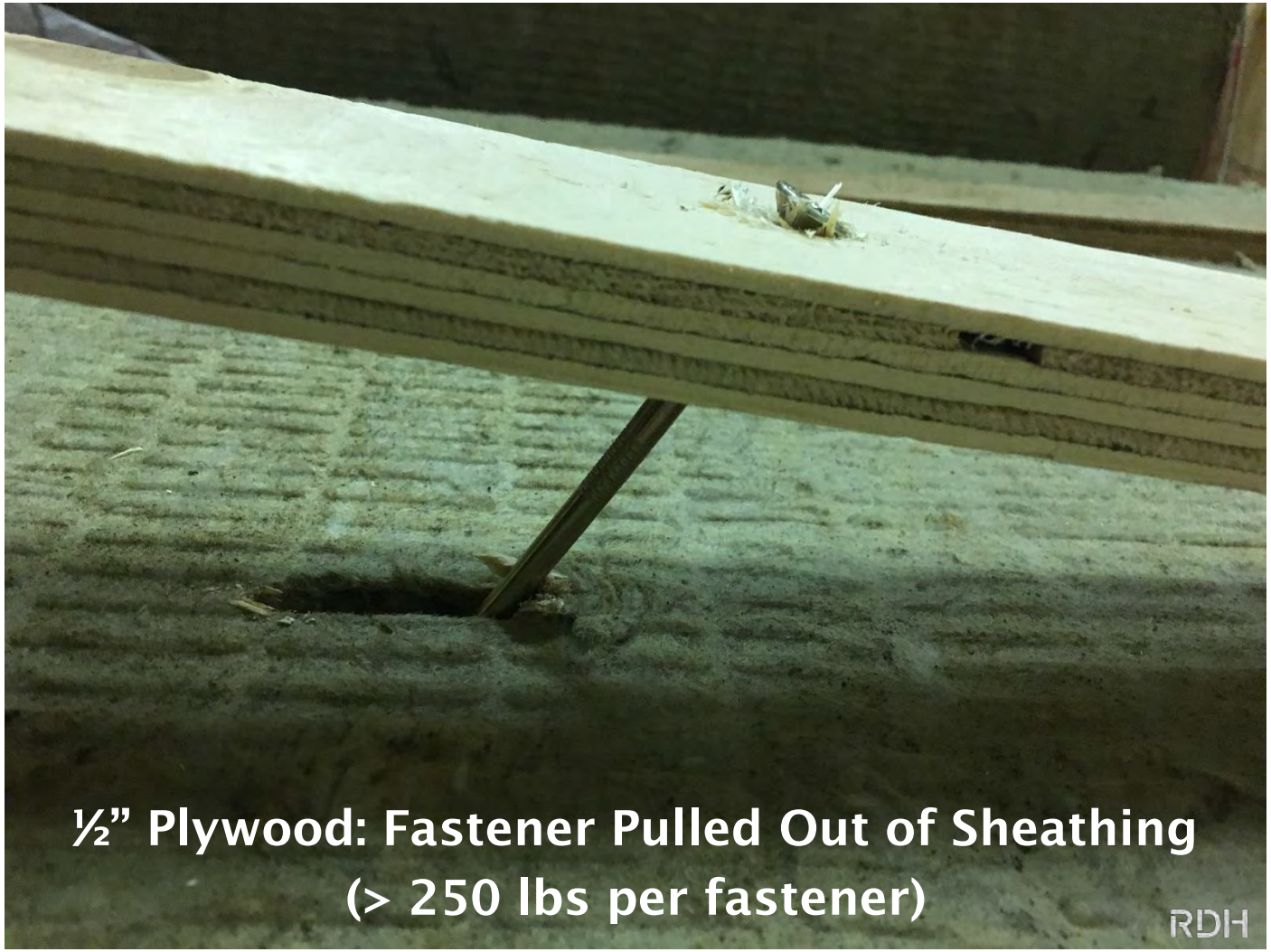


4 ½” (115 mm)
807 lbs

5 1/8” (131 mm)
719 lbs

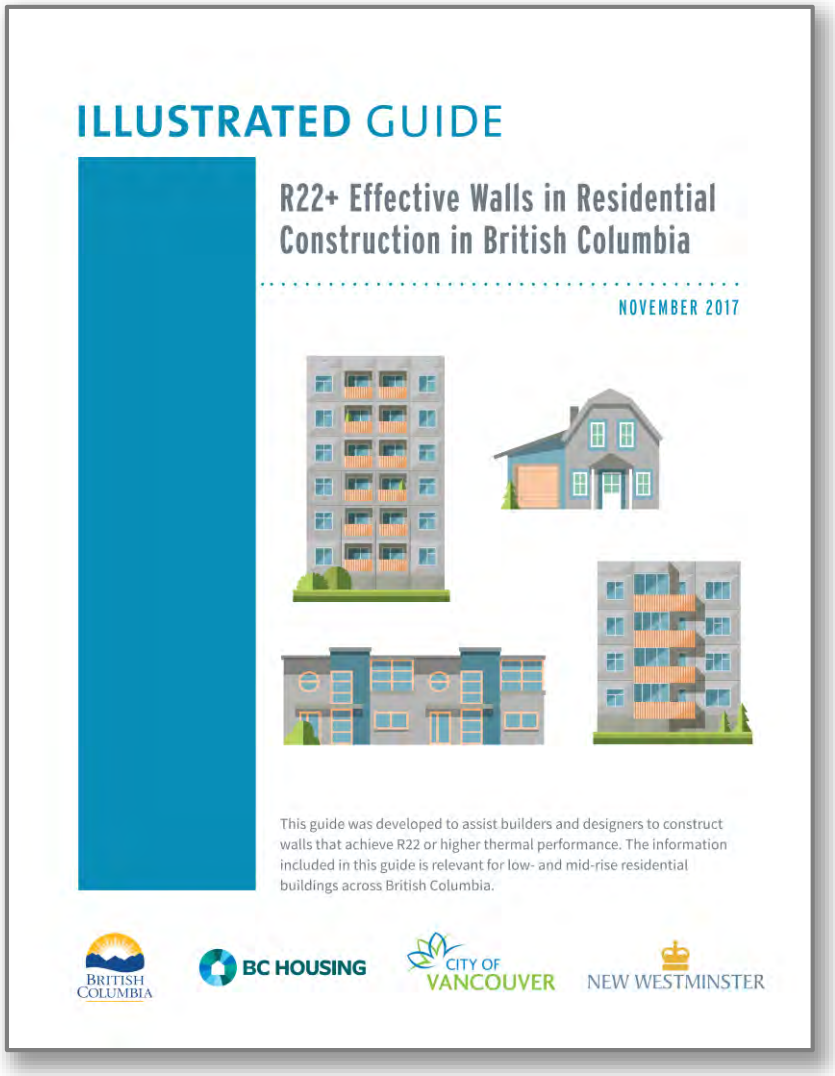
5 ¼” (133 mm)
0 lbs (failure)

Testing – Ultimate Failure Mode



Case Study – Bella Bella Passive House

R22+ Wall Guide Update



ILLUSTRATED GUIDE

R22+ Effective Walls in Residential Construction in British Columbia

NOVEMBER 2017

This guide was developed to assist builders and designers to construct walls that achieve R22 or higher thermal performance. The information included in this guide is relevant for low- and mid-rise residential buildings across British Columbia.

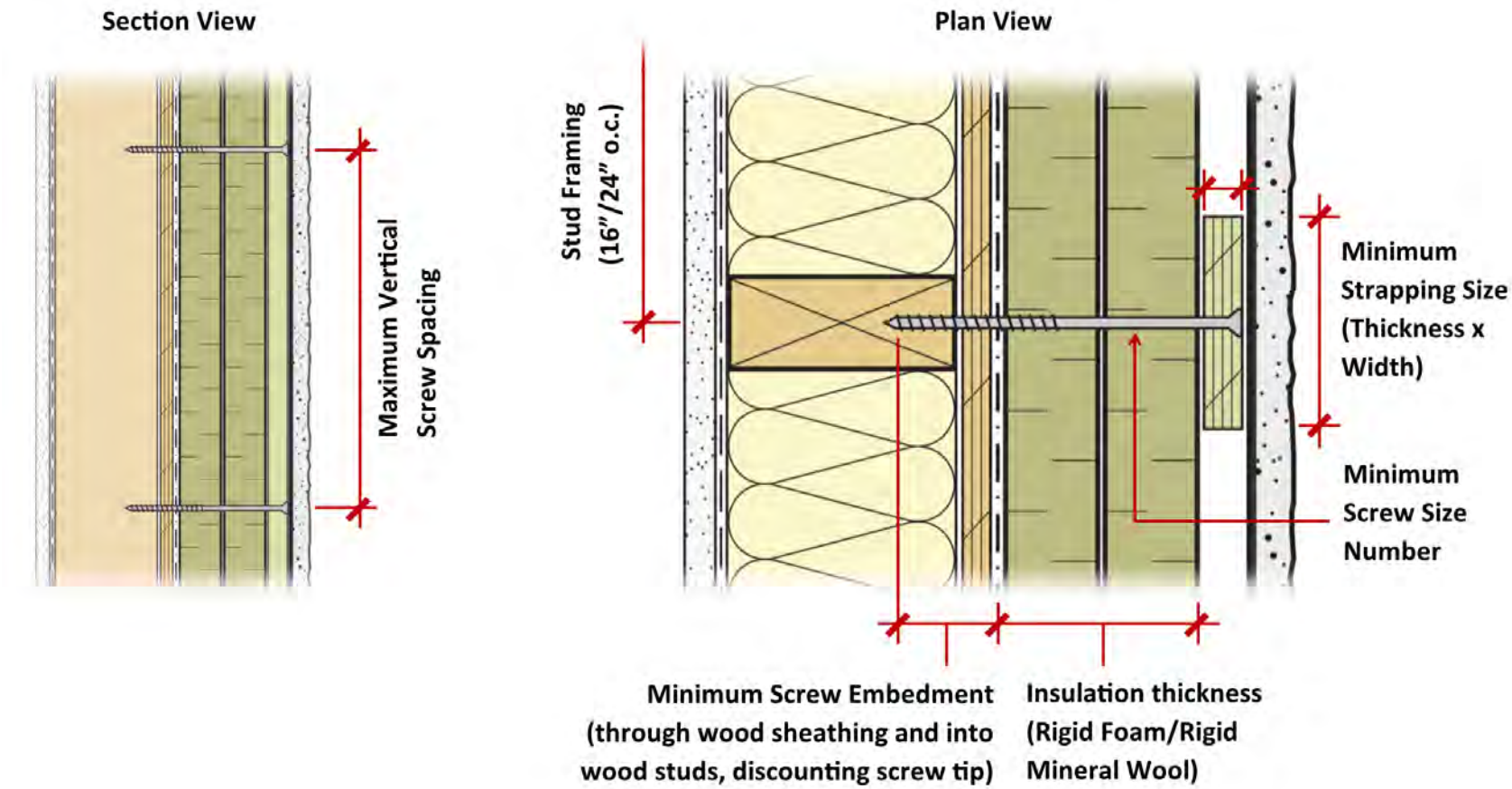
BRITISH COLUMBIA

BC HOUSING

CITY OF VANCOUVER

NEW WESTMINSTER

Design Tables

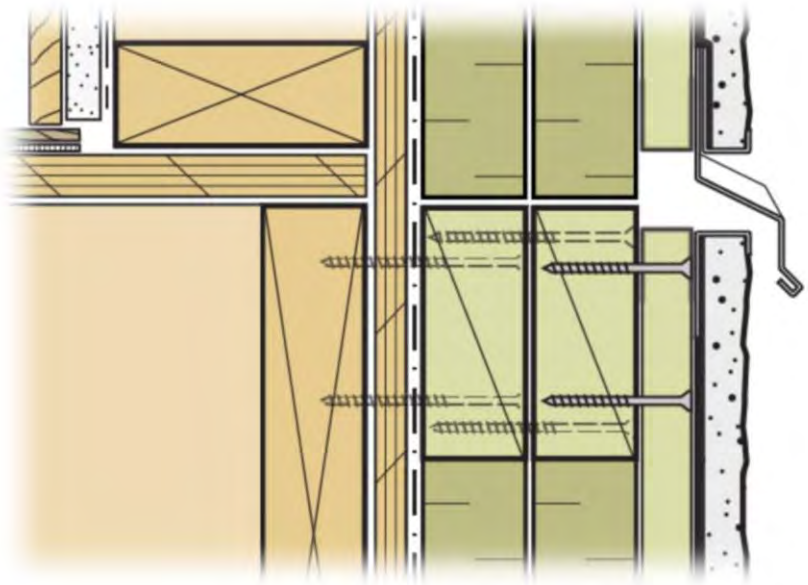


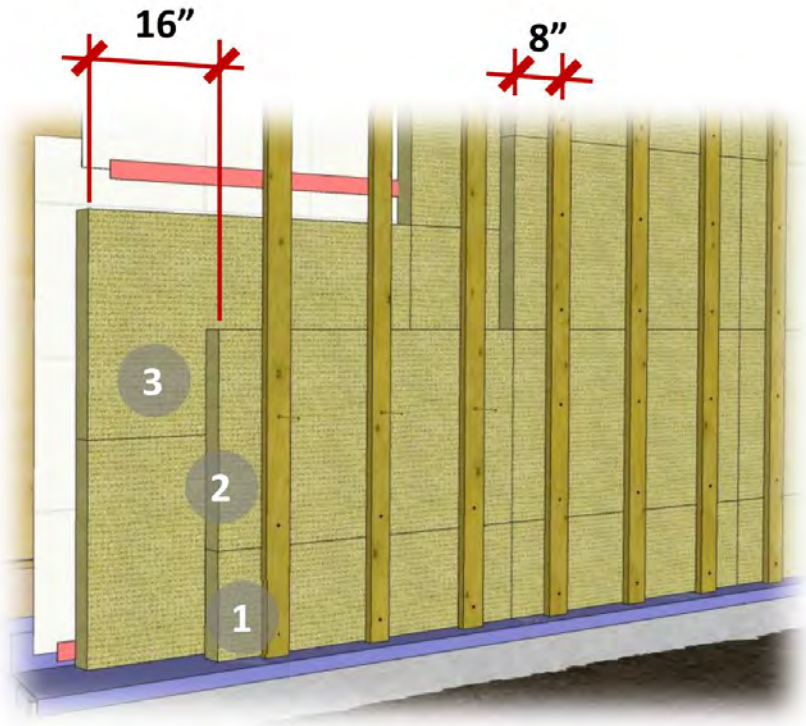
Design Tables

Fastener/Strapping Installation Requirements—Light Weight Cladding					
Thickness of Exterior Insulation	Maximum Vertical Screw Spacing	Minimum Screw Size	Minimum Screw Embedment	Minimum Strapping Size	
				Rigid Foam	Rigid Mineral Wool
Light Weight Cladding Below 5 lbs/ft² - 16" o.c. Stud Framing					
1" to 2" *	24"	#10	1"	3/8" x 1-1/2"	3/8" x 2-1/2"
>2" to 8"	16"				
Light Weight Cladding Below 5 lbs/ft² - 24" o.c. Stud Framing					
1" to 2" *	16"	#10	1"	3/8" x 2-1/2"	3/8" x 2-1/2"
>2" to 8"	12"				

Additional Guidance

Deflection Block →





← Installation Methods

Discussion + Questions

FOR FURTHER INFORMATION PLEASE VISIT

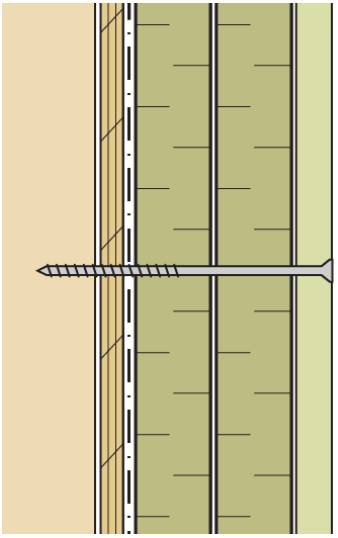
→ www.rdh.com

→ www.buildingsciencelabs.com

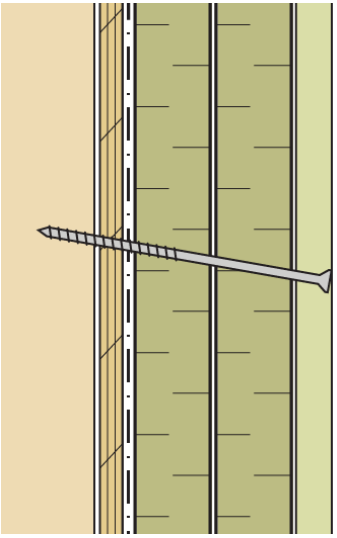
→ **Lorne Ricketts - lricketts@rdh.com**

RDH BUILDING SCIENCE

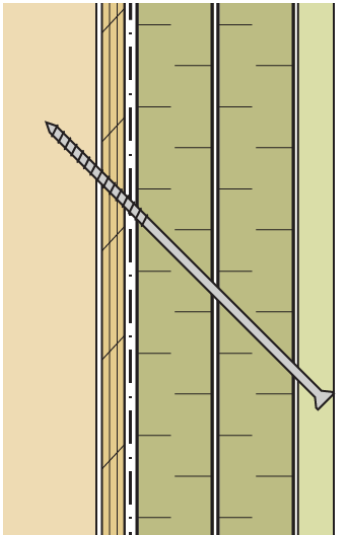
Testing – Different Fastener Arrangements



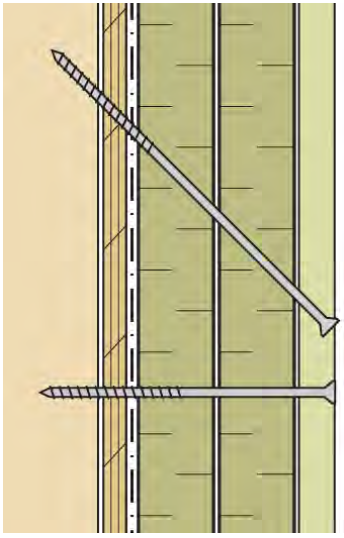
Horizontal
(90°)



1:6
(80.5°)

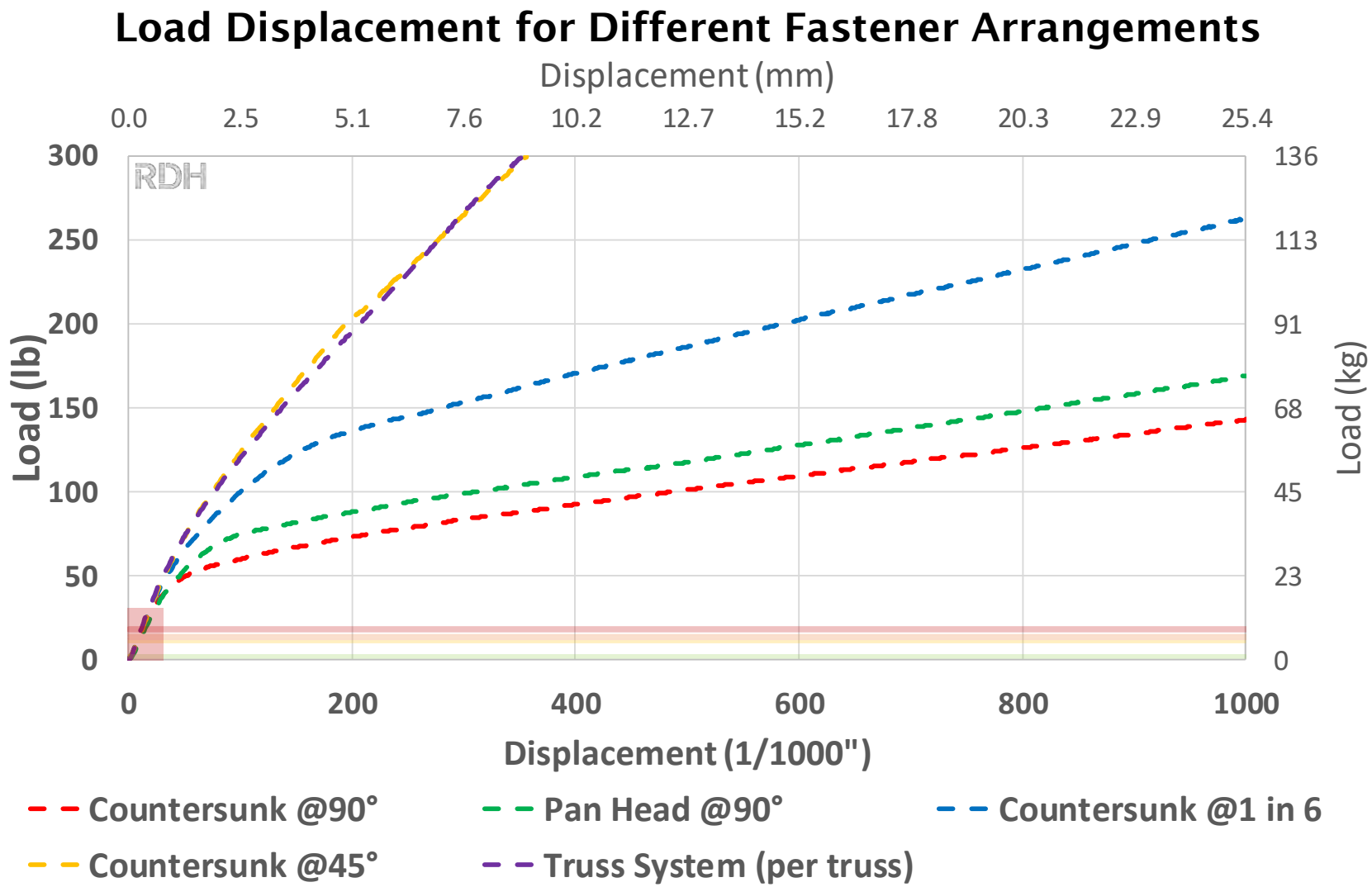


45°

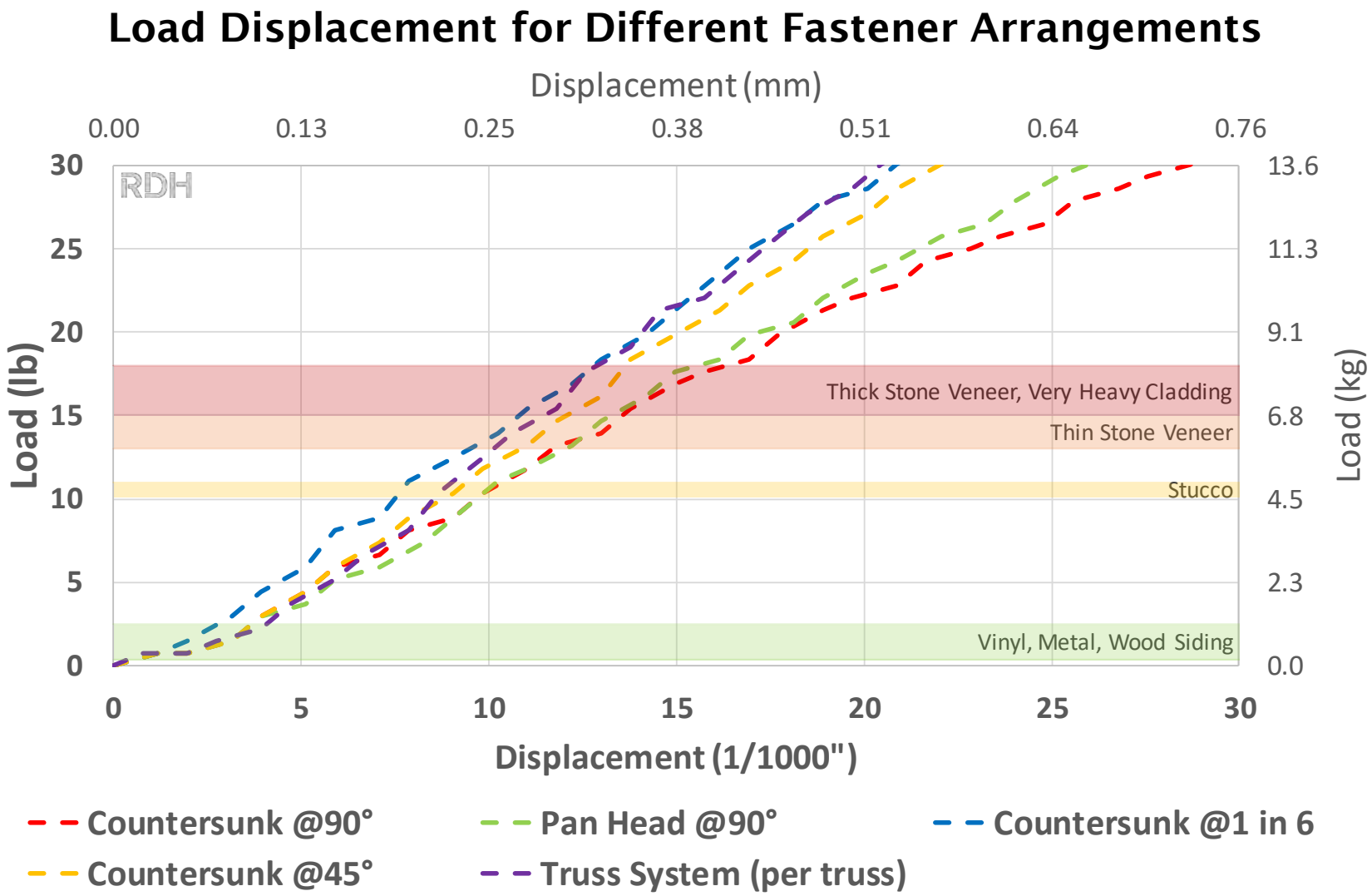
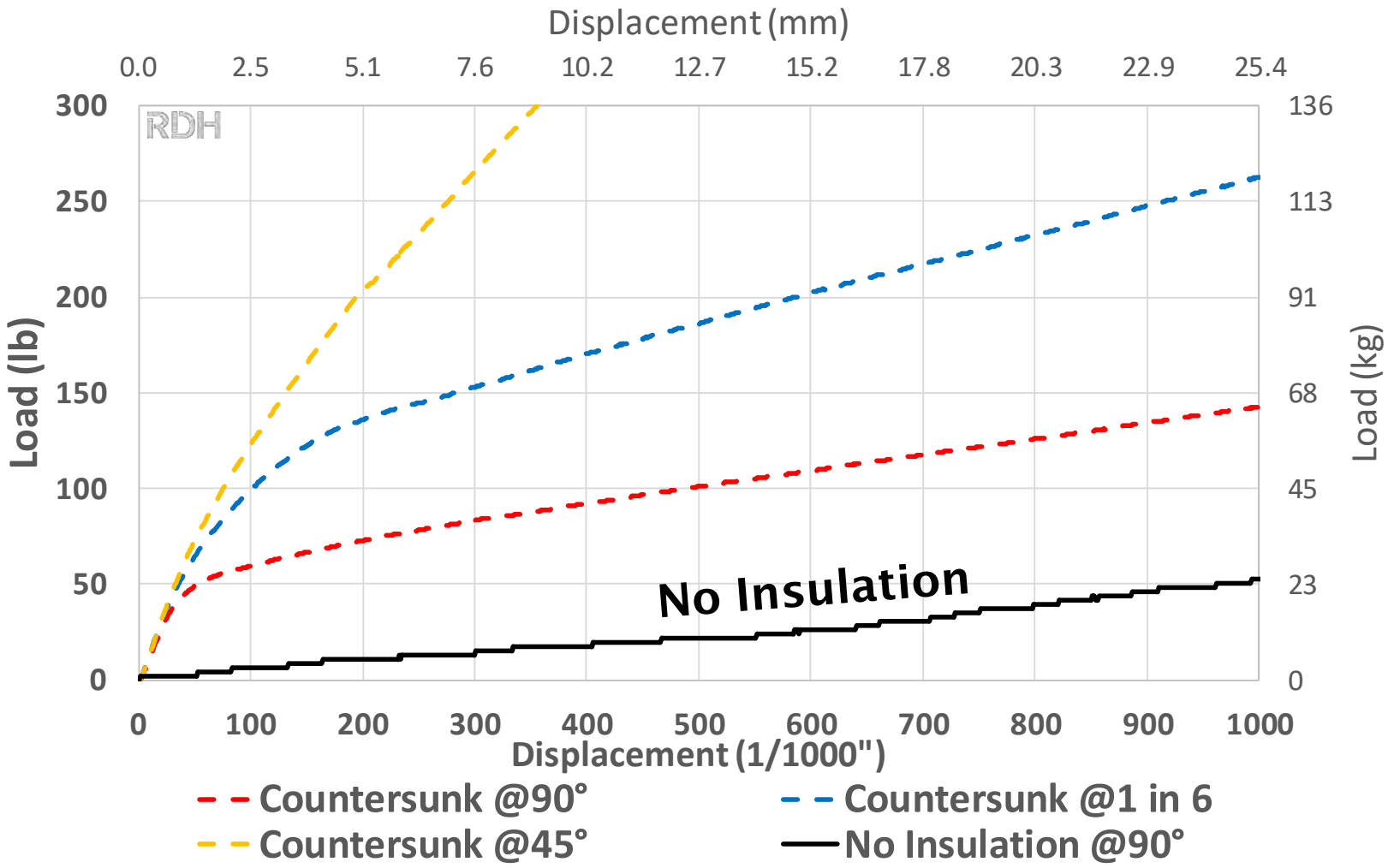


Truss
(90° + 45°)

Testing – Fastener Arrangements



Testing – Fastener Arrangements



Testing – Is this just the fastener?