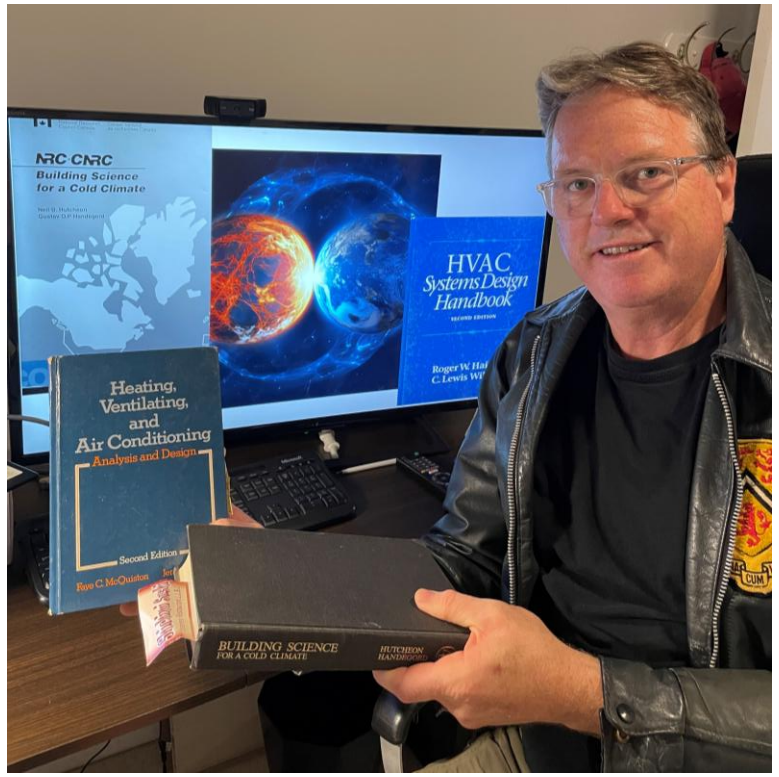
Executive Summary

- We have known all of this for time immemorial.
- More walls, less windows, understand roofs, = Walls matter a lot.
- Mistakes continue to be made
- Thermal tables do not reflect how buildings are built, only a guide.
- Not all thermal systems [clips] are the same, although people spec them like they are.
- Blair knows how to do this.



Blair with engineering textbooks from a long long time ago ☺

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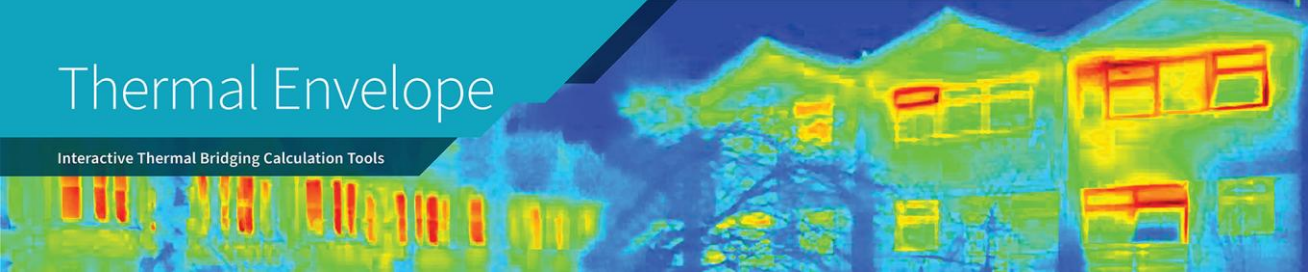

The following is a **FSI interpretation** of the excellent database of Thermalenvelope.ca, and **past experiences being exposed and asked to assist in design of facades of all types**.

- Three types of heat transfer: **conductive, convective and radiation**.
- **Thermalenvelope.ca deals with conductive**.
- Radiative is more about windows, although ventilated cavities are warmed by the sun, reducing the Δt through the wall. This is not measured.
- Convective heat transfer would have more about warming up the building and therefore about cooling during the summer. That is not in the scope of this work.

We are talking about **Conductive Heat Transfer**

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Flaws in the how we use thermal data in our industry

- Model assumes general spacing, and all buildings have concentration of support hardware on the building for structural purposes such as supporting cladding around window.
- Model does not take in account weight of the cladding. The user needs to be very careful to pick reasonable spacing matching the loads of the project.
- Not all clips the same. [see page 9
- Using this a guide, real building info is needed. A 10-point increase in R-value can reduce heat loss by about 30-40%, leading to a 10-25% reduction in heating bills, depending on fuel type and system efficiency.

- Simple meaning. If you invest a $1 in anything how much of it is used – ROI. The structure is designed for structural needs, so the right way to measure ROI is the system's return on the insulation investment. For insulation outboard, one should add in the subsystem, which would reduce the ROI.

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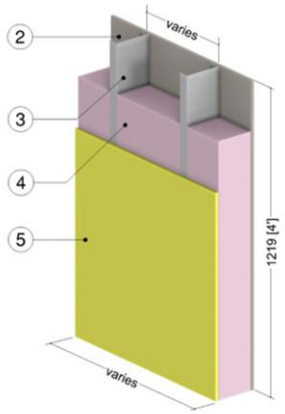


Insulate between studs

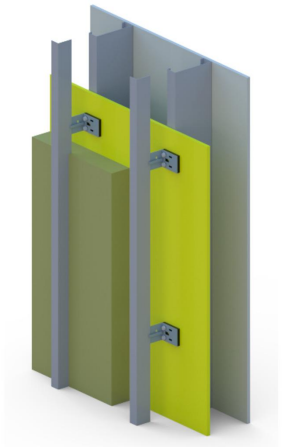
Spend money on R20, get R13.

Why bother?

Move Insulation Outboard

More insulation, higher efficiency. Normal since 2012. We have known about this forever.

Chart stops at 6” and all clips can do this.



More Insulation Outboard

Meet better goals: passive, carbon based design means > 6” of insulation

Clips limit is 6”. Engineered systems >10”

Didn’t have precast info

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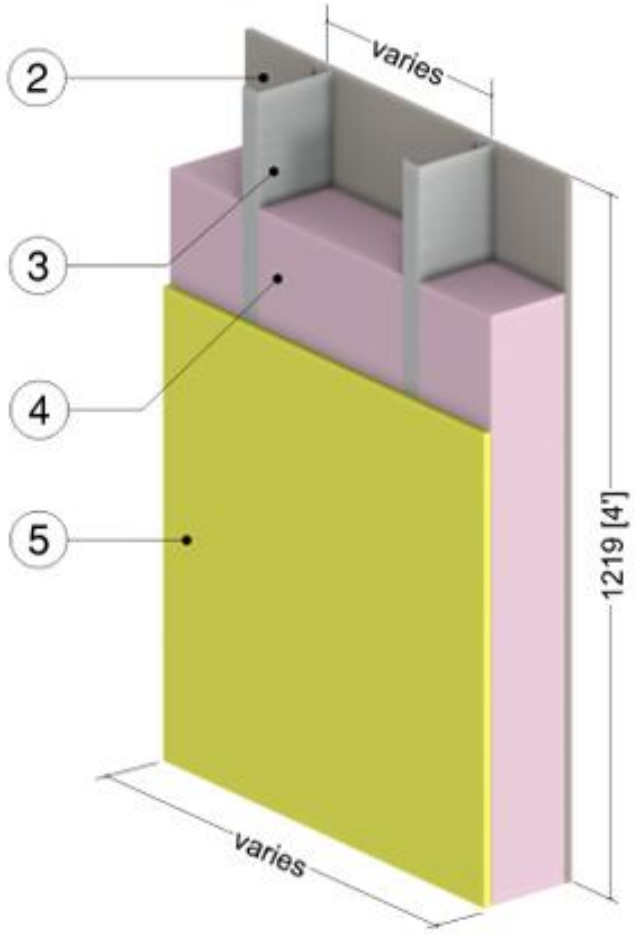
View from Interior View from Exterior

Nominal (1D) vs. Assembly Performance Indicators

Stud Spacing	Stud Cavity Insulation	R_{1D} ft²·hr·°F / Btu (m² K / W)	R_o ft²·hr·°F / Btu (m² K / W)	U_o Btu/ft² ·hr ·°F (W/m² K)
16" o.c.	Air	R-3.2 (0.56)	R-3.1 (0.55)	0.320 (1.82)
	R-19 (3.35 RSI) Batt	R-21.3 (3.75)	R-11.4 (2.01)	0.088 (0.50)
	R-20 (3.52 RSI) Batt	R-22.3 (3.92)	R-11.6 (2.05)	0.086 (0.49)
	R-22 (3.87 RSI) Batt	R-24.3 (4.27)	R-12.1 (2.14)	0.082 (0.47)
	R-24 (4.22 RSI) Batt	R-26.3 (4.63)	R-12.6 (2.22)	0.079 (0.45)
24" o.c.	Air	R-3.2 (0.56)	R-3.1 (0.56)	0.318 (1.80)
	R-19 (3.35 RSI) Batt	R-21.3 (3.75)	R-13.5 (2.37)	0.074 (0.42)
	R-20 (3.52 RSI) Batt	R-22.3 (3.92)	R-13.8 (2.44)	0.072 (0.41)
	R-22 (3.87 RSI) Batt	R-24.3 (4.27)	R-14.5 (2.56)	0.069 (0.39)
	R-24 (4.22 RSI) Batt	R-26.3 (4.63)	R-15.2 (2.68)	0.066 (0.37)



Spend money on R20, get R13

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Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-Value (RSI)	R_{1D} ft²·hr·°F / Btu (m² K / W)	R_o ft²·hr·°F / Btu (m² K / W)	U_o Btu/ft² ·hr ·°F (W/m² K)
R-8.4 (1.48)	R-11.6 (2.04)	R-10.8 (1.90)	0.093 (0.53)
R-12.6 (2.22)	R-15.8 (2.78)	R-14.1 (2.48)	0.071 (0.40)
R-14.7 (2.59)	R-17.9 (3.15)	R-15.7 (2.77)	0.064 (0.36)
R-16.8 (2.96)	R-20.0 (3.52)	R-17.2 (3.03)	0.058 (0.33)
R-21.0 (3.70)	R-24.2 (4.26)	R-20.1 (3.54)	0.050 (0.28)
R-25.2 (4.44)	R-28.4 (5.00)	R-22.7 (4.00)	0.044 (0.25)

Exterior Insul R-Value	**Calculated thickness**	**Efficiency [Exterior Insulation R-Value/Ro**	**Comment**
8.4	2”	77%	Could be any clip, spacing gets tighter much less performance
21	6”	90%	Pretty Good investment. All clips can do 6”, but most not more.

Detail 5.1.21

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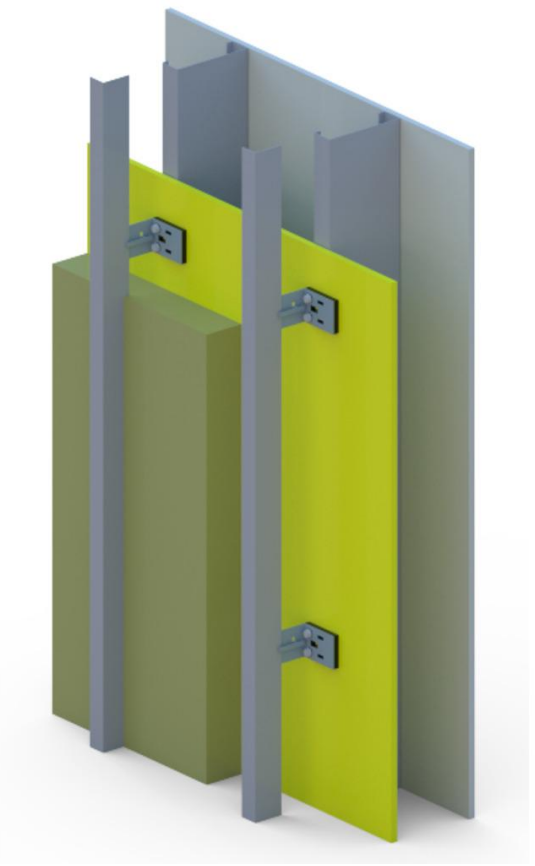
Chart only goes to 6” – 2012 guidelines

*Rockwool Cavity Rock R4.3/inch

Nominal (1D) vs. Assembly Performance Indicators

Exterior Insulation 1D R-Value (RSI)	R_{1D} $ft^2 \cdot hr \cdot {}^oF$ / Btu (m^2 K / W)	24" Vertical Clip Spacing		36" Vertical Clip Spacing	
		R_o $ft^2 \cdot hr \cdot {}^oF$ / Btu (m^2 K / W)	U_o Btu/ft^2 ·hr ·^oF (W/m^2 K)	R_o $ft^2 \cdot hr \cdot {}^oF$ / Btu (m^2 K / W)	U_o Btu/ft^2 ·hr ·^oF (W/m^2 K)
R-12.6 (2.22)	R-15.9 (2.80)	R-14.2 (2.50)	0.070 (0.40)	R-14.7 (2.58)	0.068 (0.39)
R-16.8 (2.96)	R-20.1 (3.54)	R-17.7 (3.11)	0.057 (0.32)	R-18.3 (3.23)	0.055 (0.31)
R-21.0 (3.70)	R-24.3 (4.28)	R-21.1 (3.71)	0.047 (0.27)	R-21.9 (3.86)	0.046 (0.26)
R-25.2 (4.44)	R-28.5 (5.02)	R-24.8 (4.37)	0.040 (0.23)	R-25.8 (4.54)	0.039 (0.22)
R-42.0 (7.40)	R-45.3 (7.98)	R-38.9 (6.86)	0.026 (0.15)	R-40.7 (7.17)	0.025 (0.14)

Exterior Insul R-Value	Calculated thickness	Efficiency [Exterior Insulation R-Value/Ro	Comment
12.6	3"	88%	Could be any clip, spacing gets tighter much less performance
42	10"	90%	Pretty Good investment. All clips can do 6", but most not more.



Very few thermally broken systems offer past 6" of insulation
Passive, carbon driven design will require this type of performance

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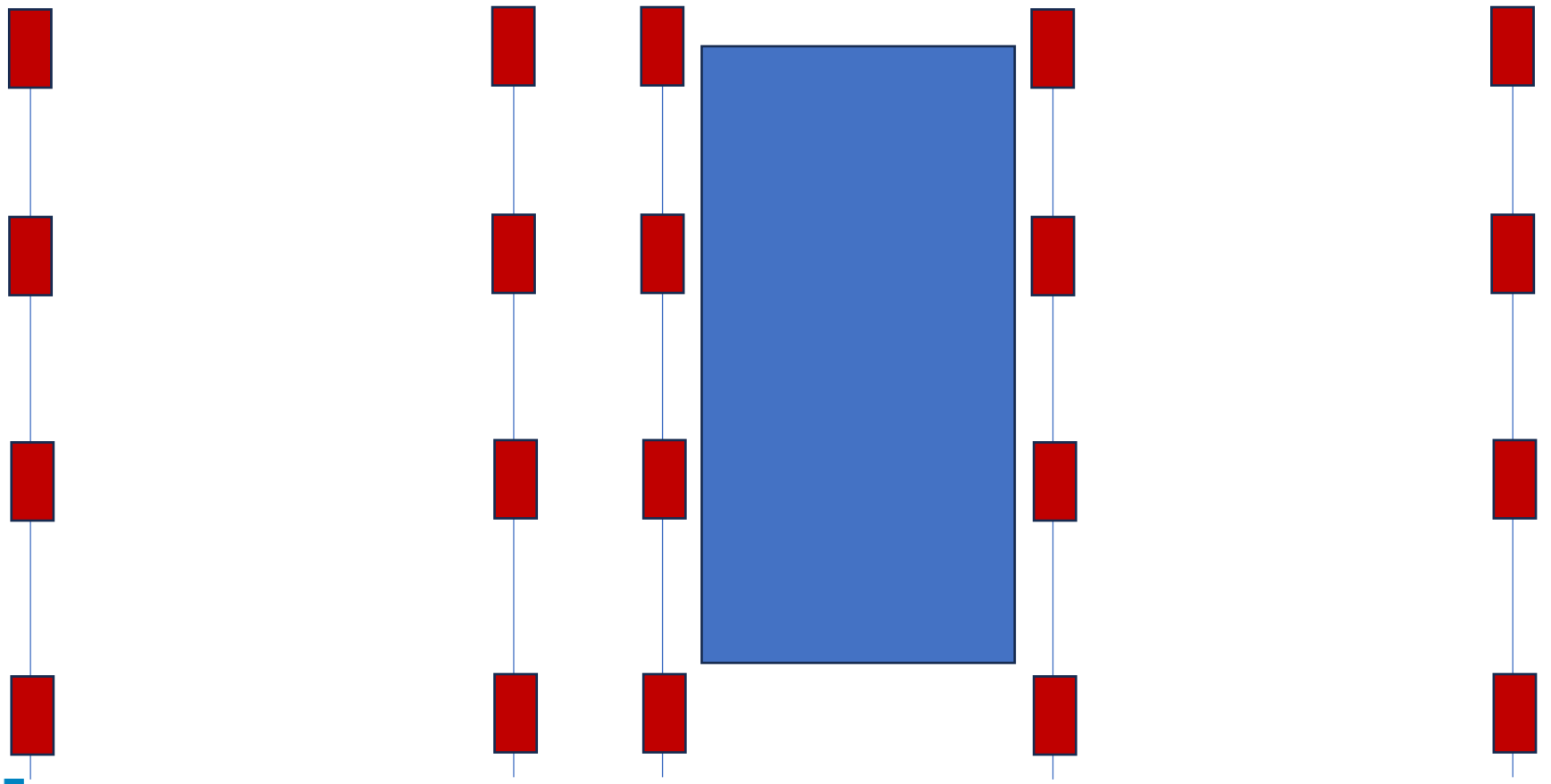
Spacing used in thermal performance table

Actual Spacing encountered around windows

=

More windows, more thermal systems, more bridging



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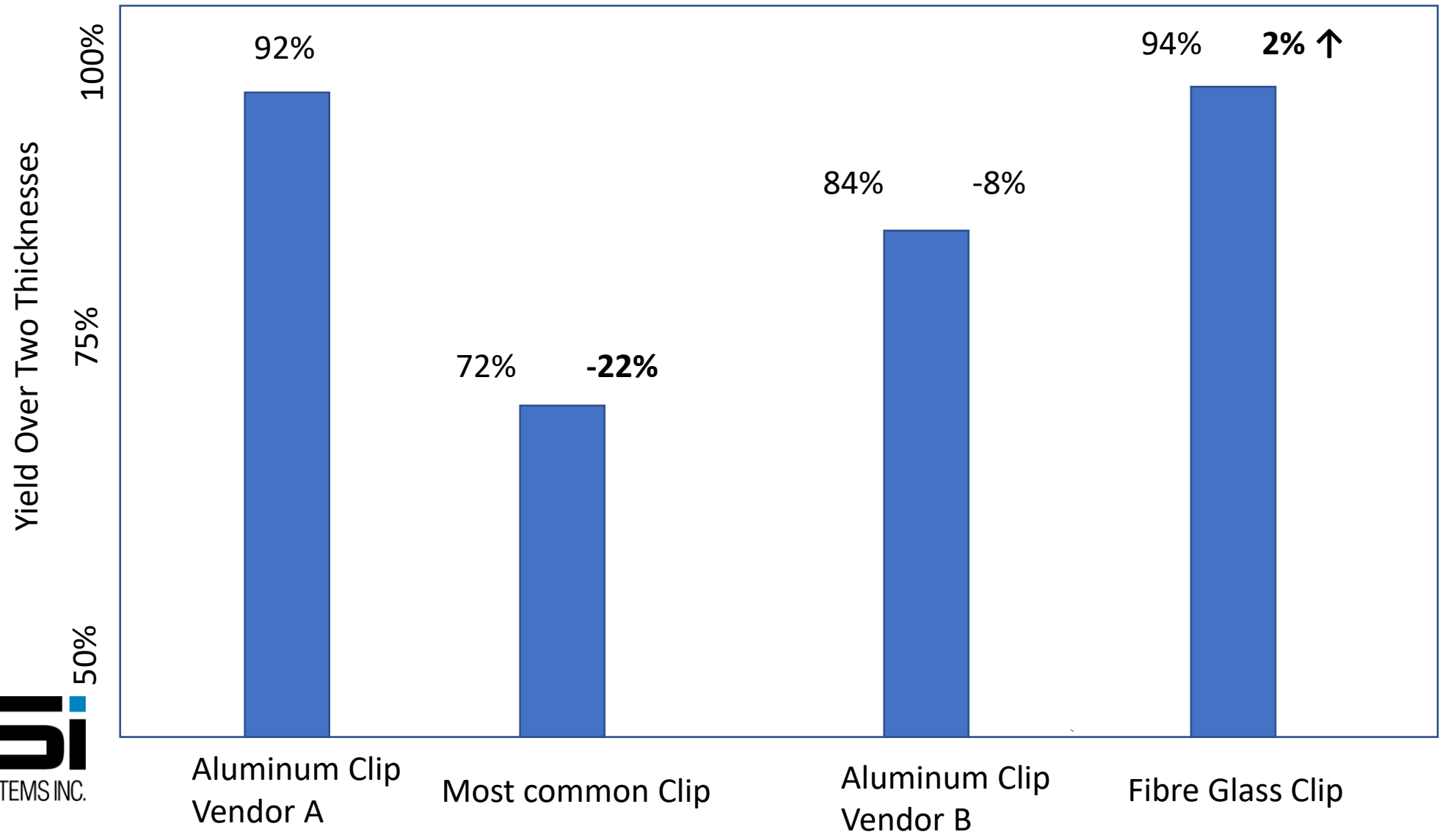
>> No accounting for comparative structural capacity<<

Source Third Party ThermalEnvelope.ca



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Much more to come – join us

March 19, Lunch Time, Cosentino

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