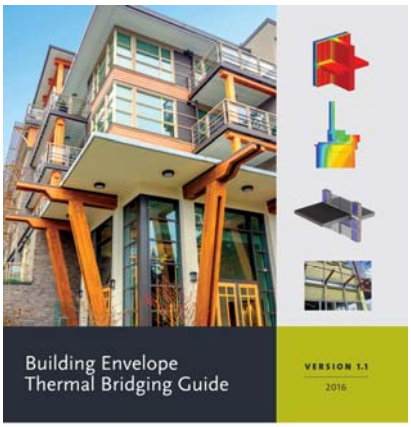
"LOW TEDI GUIDE"



http://blog.morrisonhershfield.com/intro-to-low-tedi-guide-how-can-high-rise-buildings-meet-net-zero-standards

What is Net Zero (Ready)?

Definitions

Net Zero Site Energy

Net Zero Source Energy

Net Zero Carbon

Renewable Energy Sources

On Site

Off Site

RECs

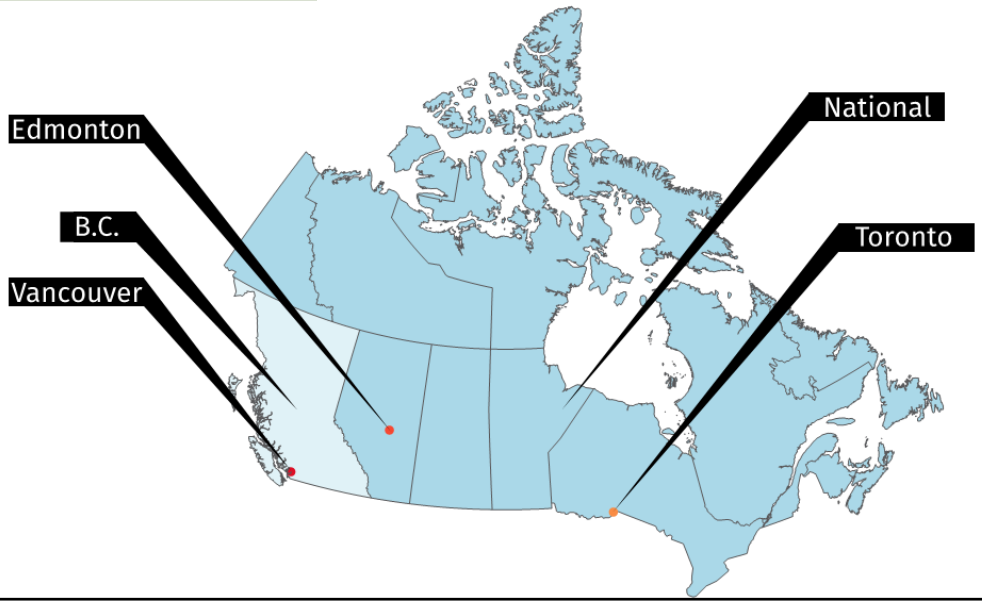
What is Net Zero (Ready)?

1. Low Thermal Loads

2. Low Electrical Loads

3. High Efficiency / Low Carbon Supply

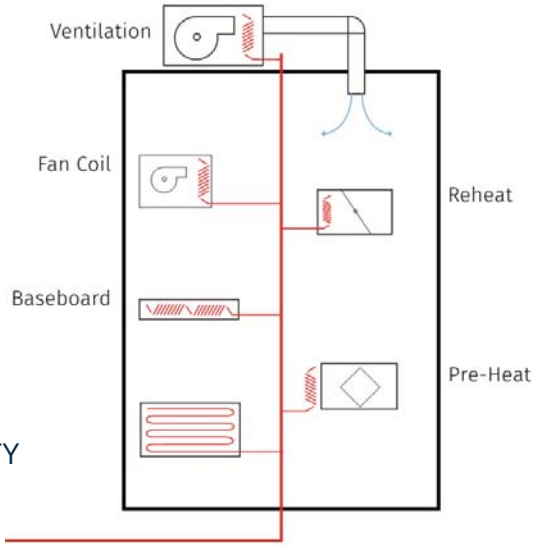
Net Zero (Ready) Policies



Net Zero Policies

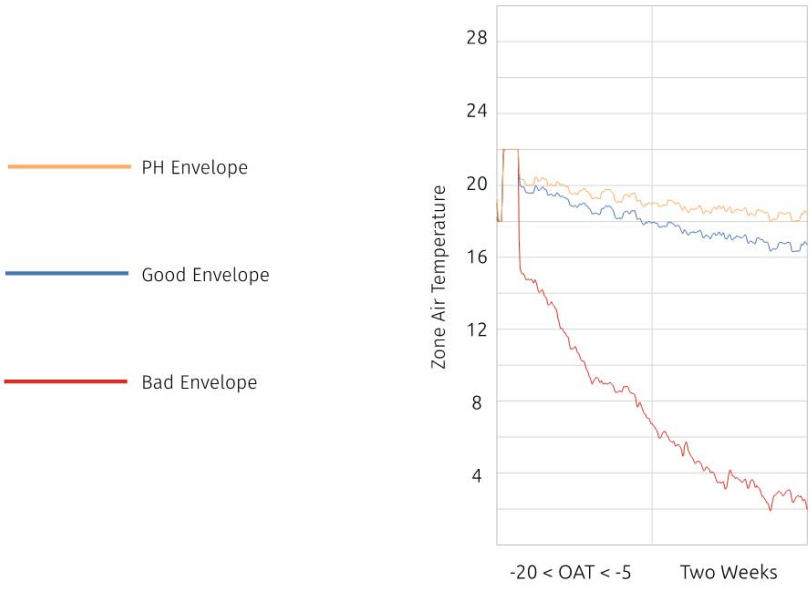
		Toronto	Vancouver	British Columbia	CaGBC
		Zero Emissions Building Framework	*Zero Emissions Building Plan*	*B.C. Energy Step Code*	*Zero Carbon Building Standard*
kWh/m² (kbtu/sf)	EUI	↘ 75 (24)	↘ 100 (32)	↘ 100 (32)	
	TEDI	↘ 15 (5)	↘ 15 (5)	↘ 15 (5)	C.Z 4 5 6 7 8 TEDI 30 32 34 36 40
$kgCO_2/m^2$	GHG	↘ 5	↘ 0	n/a	0

What is TEDI?

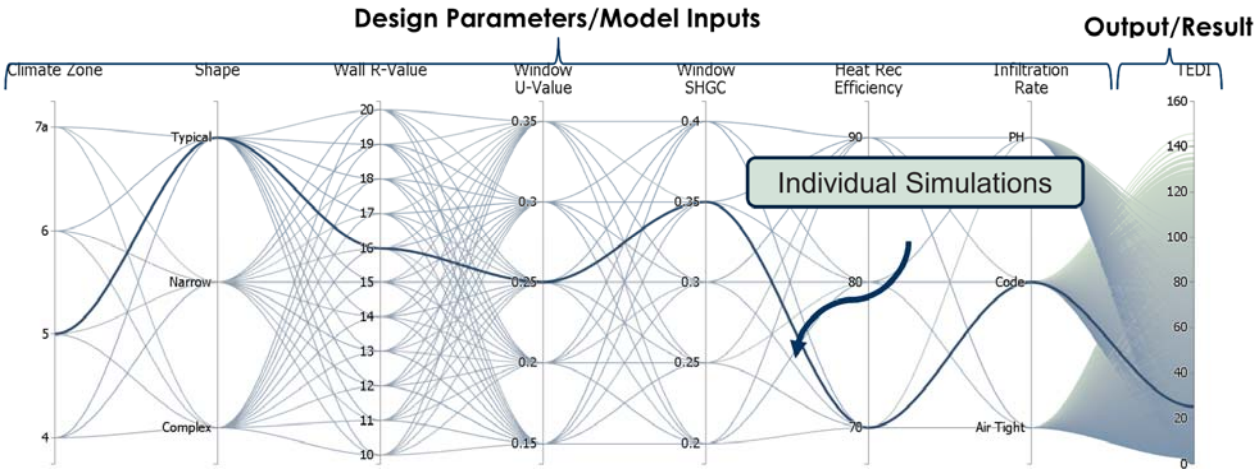


Thermal Energy Demand Intensity
Heating Load Per Unit Area
Similar to Passive House Metric

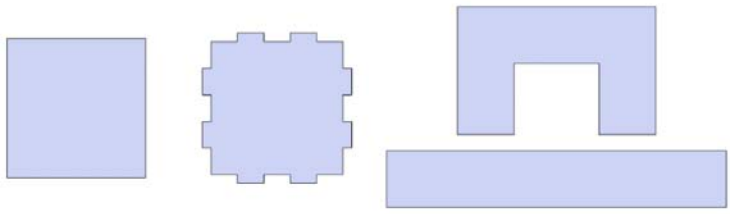
Co-Benefits of Low TEDIs



MANY ROADS LEAD TO NZR TEDI

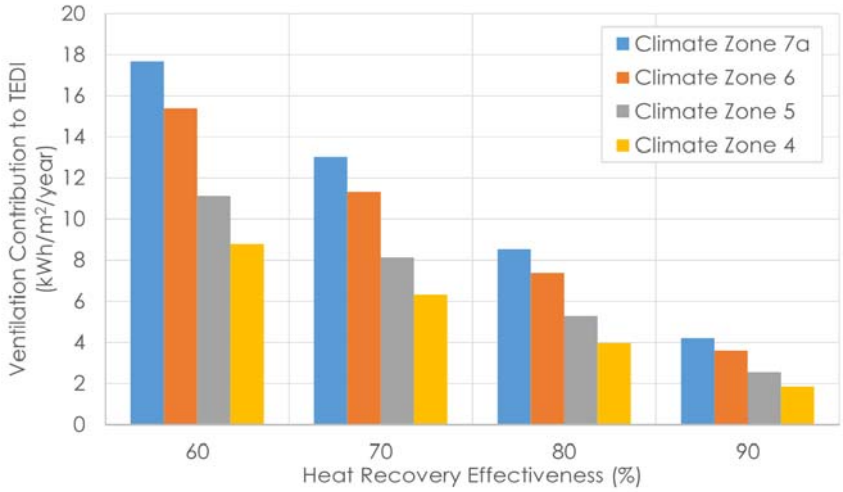


STRATEGY 1: OPTIMIZE SHAPE

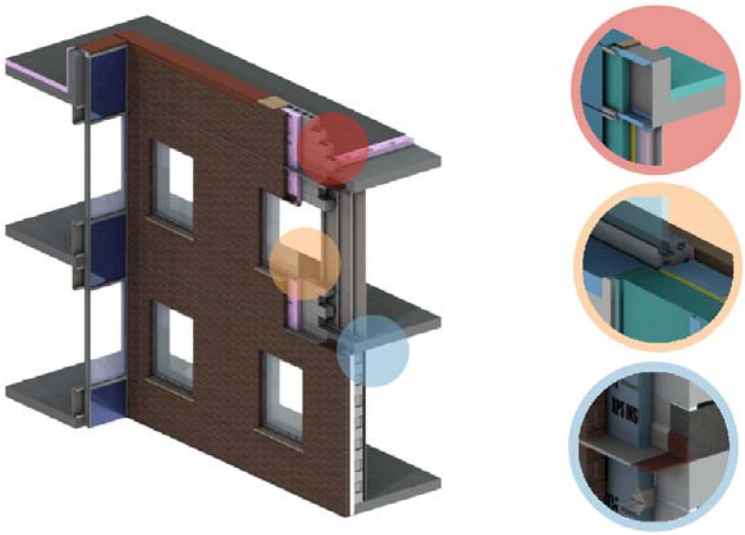


	Square	Articulated	Narrow
VFAR	0.49	0.59	0.7
TEDI (kWh/m²)	15.1	20.3	26.1

Strategy 2: High Efficiency Heat Recovery



Strategy 3: Reduce Heat Loss



Strategy 3: Reduce Heat Loss

Table 4.2: Wall Thermal Transmittance for Conventional Assemblies and Details

Detail	Area or Length	Transmittance Value	Heat Flow (W/K)	Percent of Total Heat Flow (%)
Steel Stud Wall	5903 m²	0.35 W/m²K	2066	36.7%
Balcony Slab at Door	226 m²	4.72 W/m²K	1068	18.9%
Parapet at Wall	55 m	0.78 W/m K	43	0.8%
Parapet at Glazing	73 m	0.98 W/m K	72	1.3%
Intermediate Floor at Wall	616 m	0.20 W/m K	123	2.2%
Intermediate Floor at Balcony	778 m	1.06 W/m K	825	14.6%
Intermediate Floor at Glazing	1536 m	0.20 W/m K	307	5.5%
Window to Wall	5559 m	0.20 W/m K	1112	19.7%
Interior Wall Separation	988 m	0.20 W/m K	20	0.4%
		Overall Thermal Transmittance (W/m² K)		**0.92**
		Effective R-Value (hr·ft²·F/BTU)		**6.2**

Table 4.3: Wall Thermal Transmittance for Low TEDI Assemblies and Details

Detail	Area or Length	Transmittance Value	Heat Flow (W/K)	Percent of Total Heat Flow (%)
Wall with FRP Brackets	6129 m²	0.142 W/m²K	870	67.4%
Delta U for Aluminum Brackets	6129 m²	0.041 W/m²K	251	19.5%
Wall to Roof	128 m	0.171 W/m K	22	1.7%
Intermediate Floor	2930 m	0.003 W/m K	10	0.8%
Window to Wall	5559 m	0.024 W/m K	133	10.3%
Interior Wall Separation	988 m	0.003 W/m K	3	0.3%
		Overall Thermal Transmittance (W/m² K)		**0.21**
		Effective R-Value (hr·ft²·F/BTU)		**27.0**

Strategy 4: Improve Air Tightness

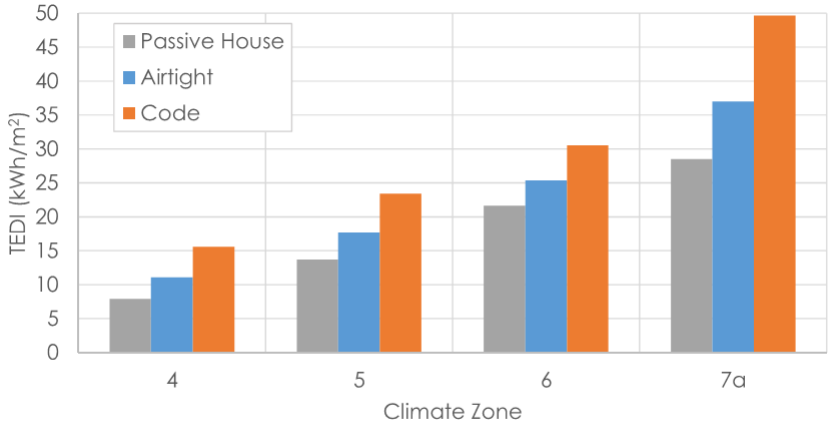


Figure 4.6: Impact of Air Infiltration on TEDI

Other Strategies

Lower Window to Wall Ratios

High Performance Windows

Orientation and Solar Heat Gain

Climate Zone 5 Examples

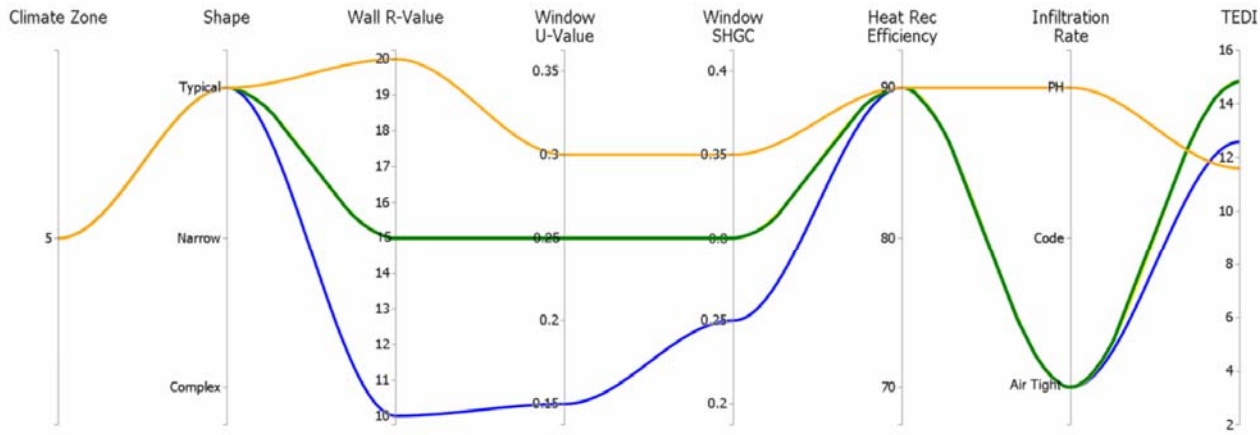
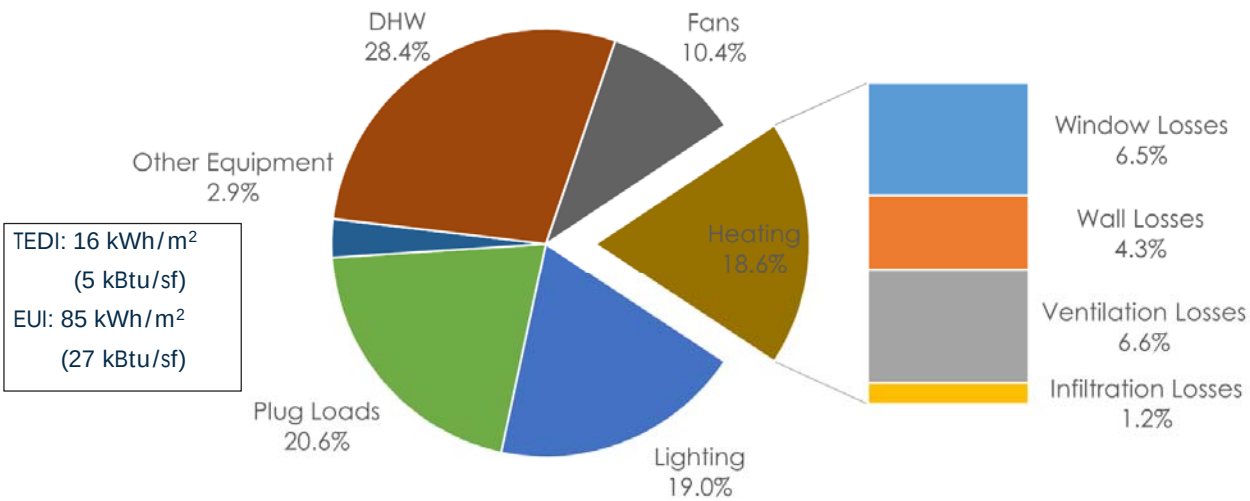


Figure 4.10: Example Paths to Low Energy Buildings in Climate Zone 5

"Net Zero Ready" High Rise Residential



TEDI: 16 kWh/m^2
(5 kBtu/sf)
EUI: 85 kWh/m^2
(27 kBtu/sf)

Figure 4.1: End-use Breakdown for a Low Energy MURB in Climate Zone 6

"Net Zero Ready" High Rise Residential

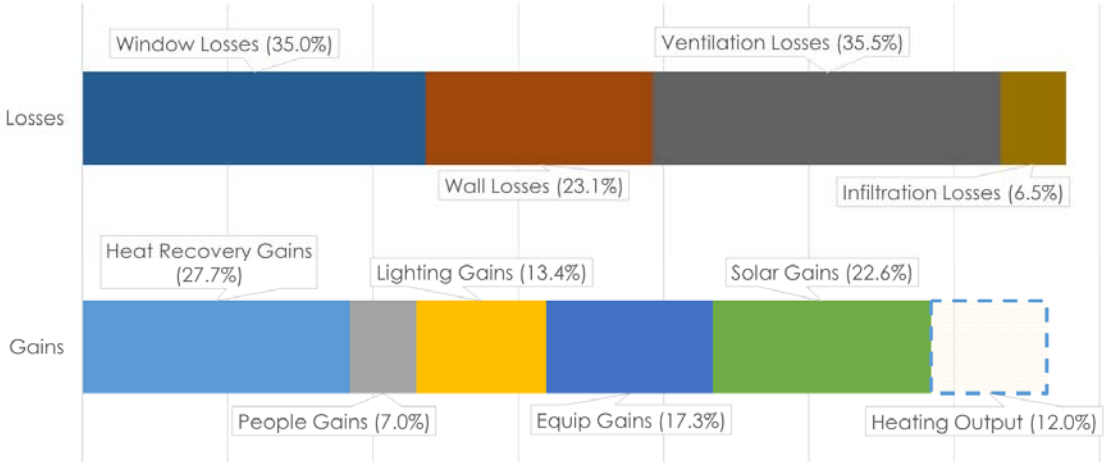


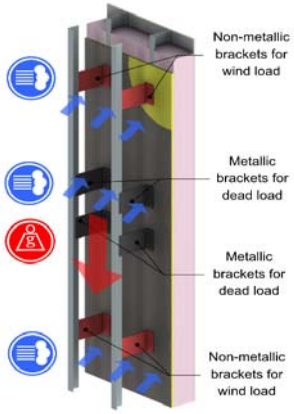
Figure 4.2: Example Breakdown of Heating Load Components

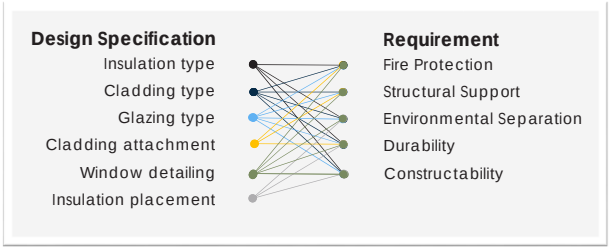
What Net-Zero High-rise Look Like

More than Thicker Walls and Extra Insulation

All Stakeholders to Recognize:

- The impact of thermal bridging at every junction between building components
- Deviation from conventional practice is required, but it is in everyone's best interest to minimize disruption and build on local practice
- Success will come from a holistic viewpoint to design specifications and project requirements
- More effort will be required, by everyone, until new norms are established



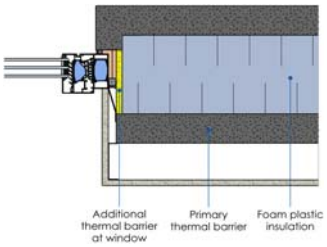


Fire Protection and Combustibility

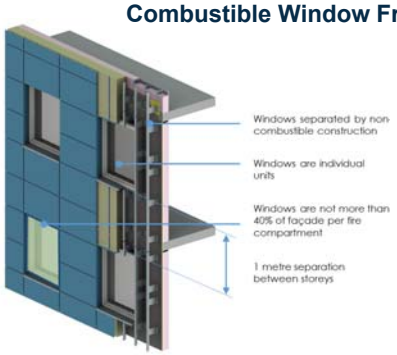
Significant differentiator and challenge for high-rise MURBs

- Many components relied upon to reduce thermal bridging and minimize wall thickness have combustible components.

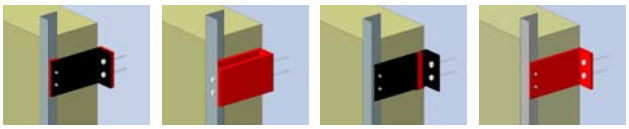
Foam Plastic Insulation



Combustible Window Frames



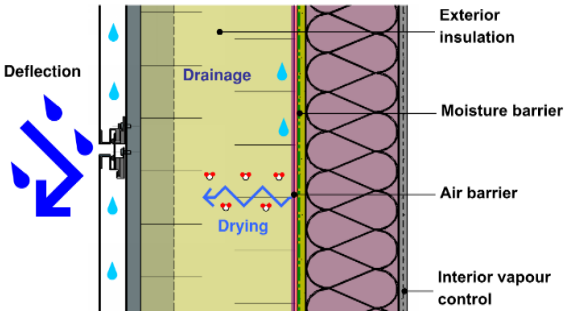
Non-metallic Cladding Attachments



Environmental Separation and Durability

Same Minimum Requirements

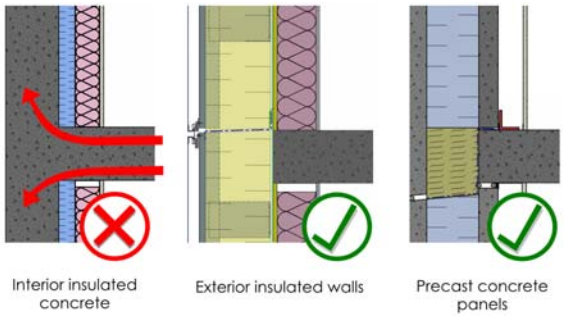
- Less energy transfer
- Less forgiveness

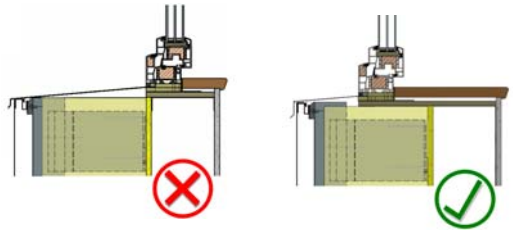


Structural Support

Some easy and efficient designs are non-starters

- More complex connections, such as required for balconies or overhangs
- More accommodation in structural design for other requirements, such as
  - Cladding attachments with combustible components
  - Thermal breaks
  - Continuity of the thermal insulation across the structure
  - Windows positioned outboard of the structure

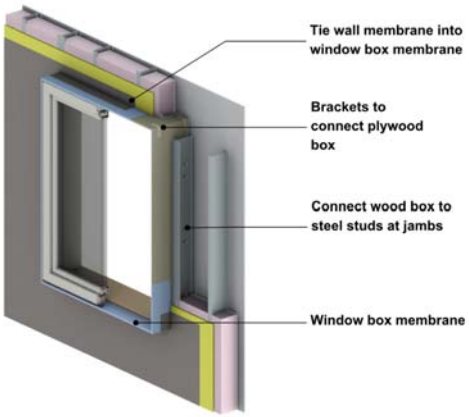




Constructability

Critical to quality and cost control

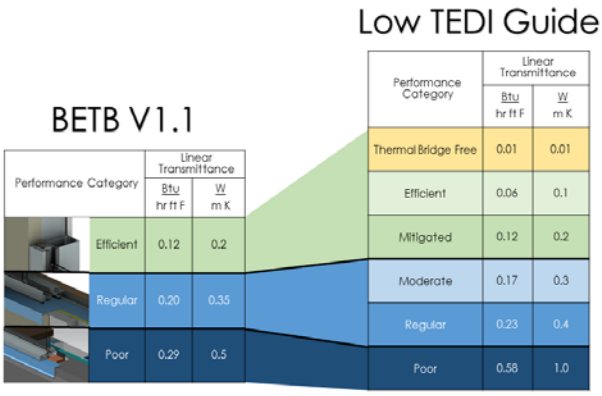
- Familiarity and availability
- Engineering and testing for jurisdiction
- Site-built versus pre-fabricated
- Field review and testing
- Sequencing and exterior access
- Crane use



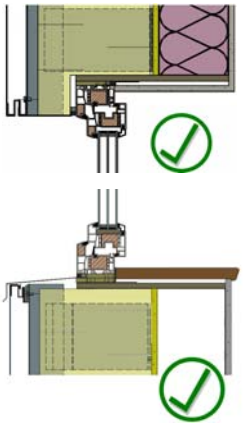
EXPECTATIONS FOR THERMAL BRIDGING

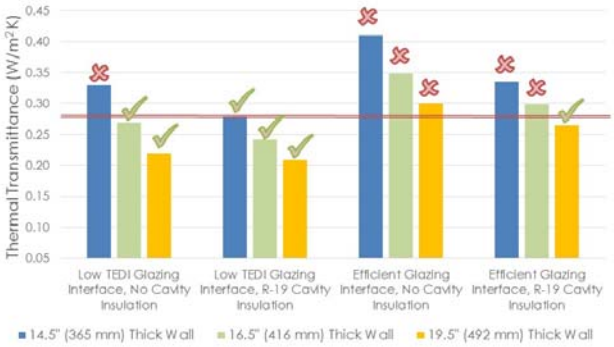
NZE is difficult without high thermal quality details

- Small differences in detailing can be significant
- The **wall to window interface** demands the greatest attention for thermal transmittance calculations because of the potential variation in values and overall impact



EXPECTATIONS FOR THERMAL BRIDGING





RESOURCES

Thermal.ly
Buildingpathfinder.com
Step Code Design Guide

CHRISTIAN CIANFRONE, P.ENG.
ccianfrone@morrisonhershfield.com

PATRICK ROPPEL, P.ENG.
proppel@morrisonhershfield.com

MORRISON HERSHFIELD