



Thermal Bridging Tools for Energy Modeling

Façade Tectonics Forum
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MORRISON HERSHFIELD

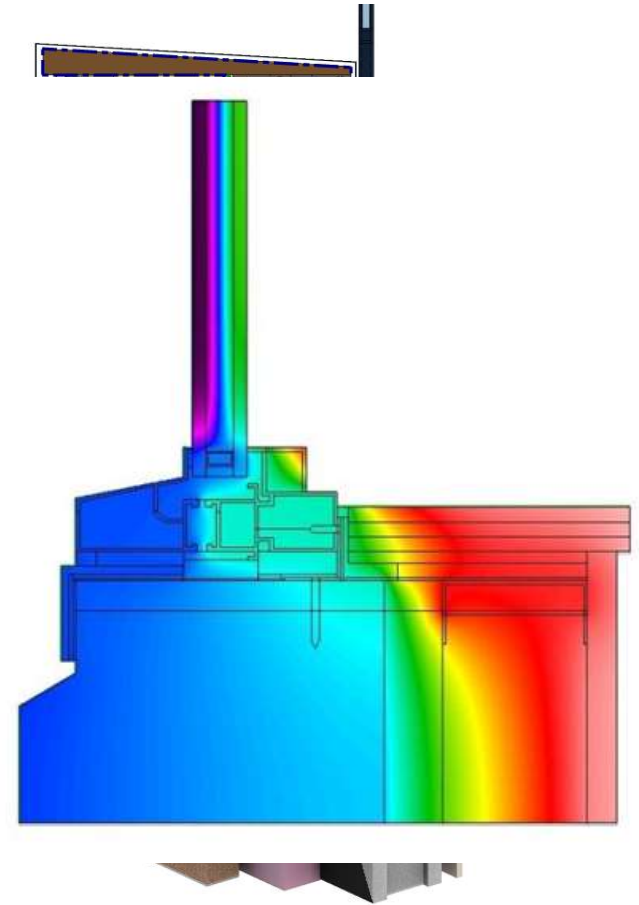
Energy Modeling | Assembly Heat Flow



- Determine assembly thermal transmittance (**U-values**)
- Thermal bridging de-rates performance
 - Increased space heating/cooling energy
 - Increased risks for condensation (in cool and cold climates)
 - Potential interior comfort issues

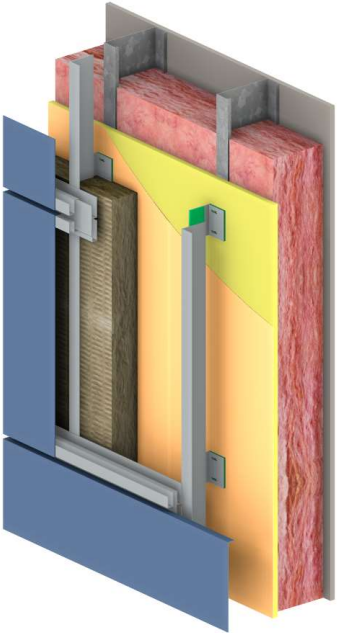
What is a Thermal Bridge?

- A** A highly conductive material that bypasses the insulation layer
- B** Increased heat transfer due to more exterior surface area compared to the interior
- C** Misaligned, missing, or reduced insulation



Overall Building Performance

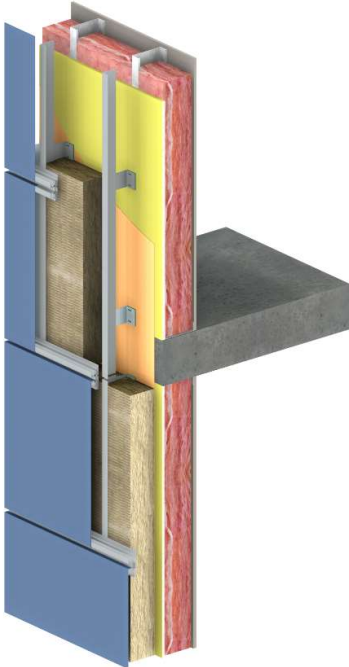
Clear Field



$$U_o$$

wall, floor, or roof assembly

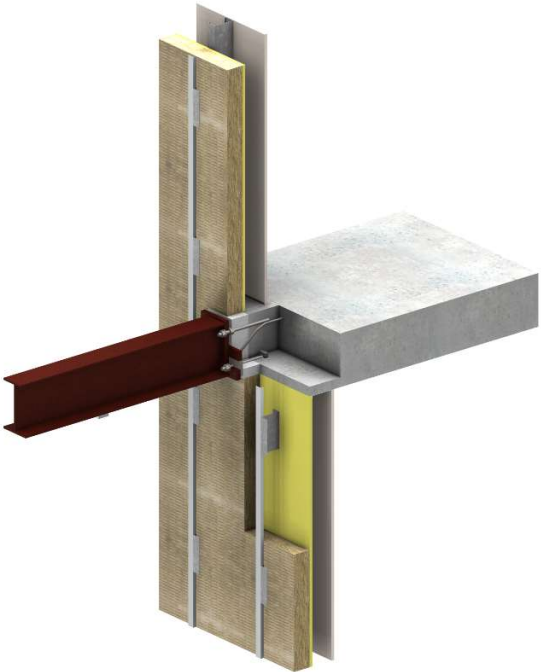
Linear



$$\Psi$$

window to wall, roof to wall, intermediate floor

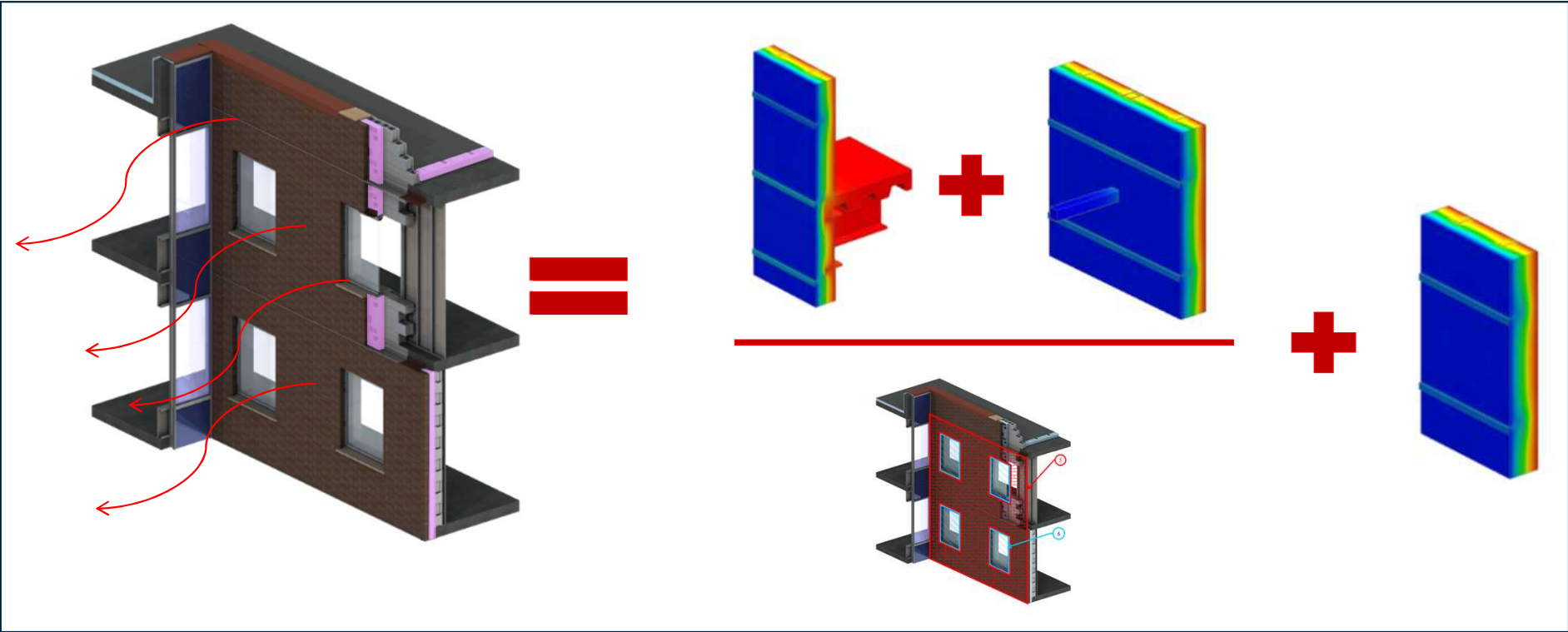
Point



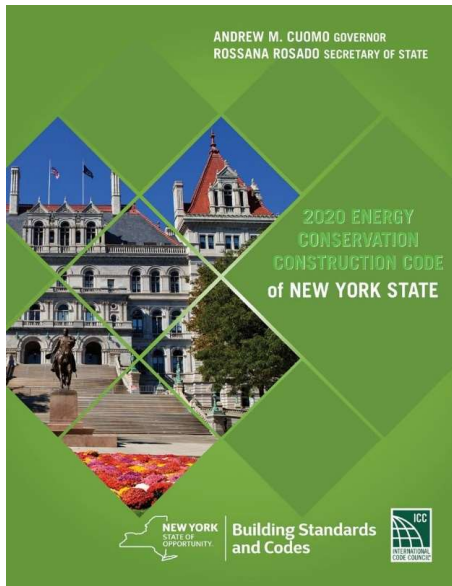
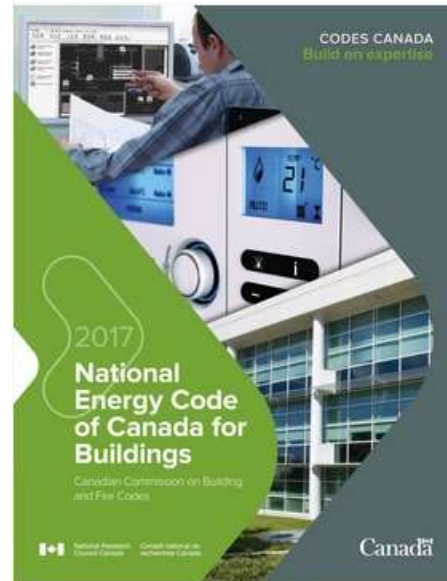
$$\chi$$

beam penetration, roof anchor

Overall Assembly U-Value with Thermal Bridging

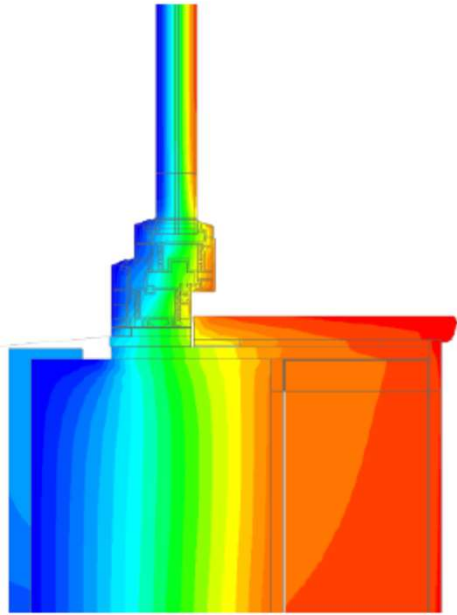


Energy Codes and Standards

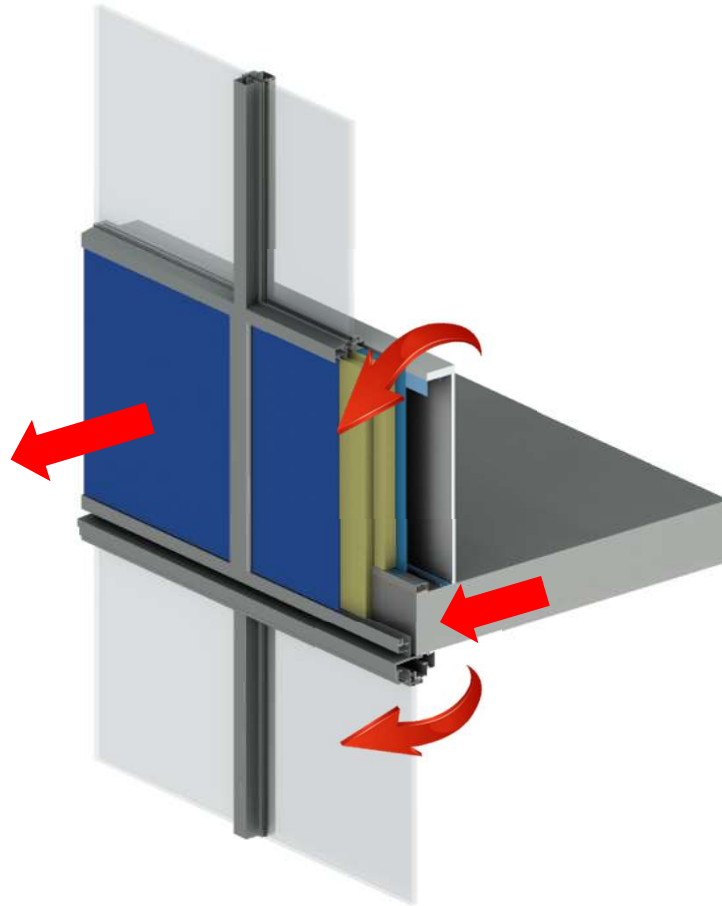


- Thermal bridging included in clear wall
- Thermal bridging at clear wall and detail included in progressive codes:
 - NECB 2017
 - BC Energy Step Code
 - Toronto Green Standard
 - Passive House
 - New York 2020 Conservation Code

Thermal Bridging Modeling



Ψ_{install} : 0.062 W/mK
(0.036 Btu/hr.ft. $^{\circ}$ F)

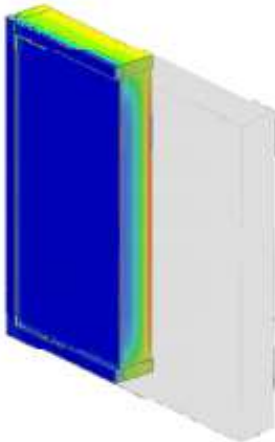


- Heat Transfer Modeling
- 2D Analysis
 - Intermediate floors
 - Window transitions
 - Corners
 - Parapets
- 3D Analysis
 - Discrete/non-continuous components
 - Complex heat flow

Thermal Bridging Analysis



Hotbox Lab Measurement



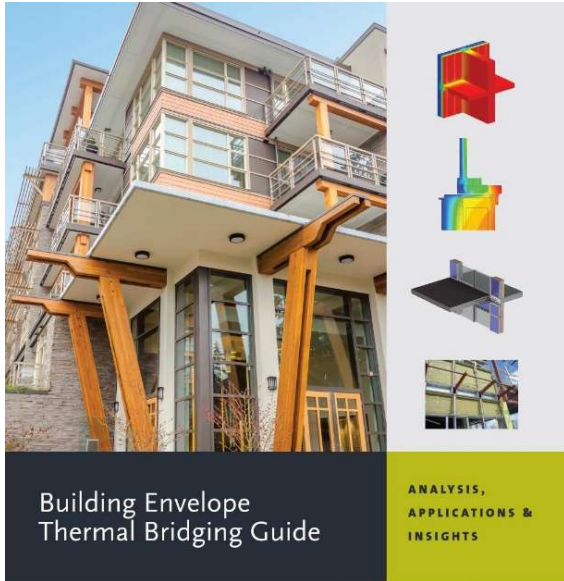
3D Analysis



2D Analysis

Approach	Thermal Transmittance W/m ² K (BTU/ft ² hr°F)	Effective R-value m ² K/W (ft ² hr°F/BTU)	Percent Difference Compared to Hotbox Measurement
Hotbox Measurement	0.87 (0.153)	1.2 (6.5)	-
3D Analysis	0.87 (0.153)	1.2 (6.5)	0%
2D NFRC-100	0.63 (0.111)	1.6 (9.0)	32%
2D NFRC Modified	0.68 (0.120)	1.5 (8.3)	24%

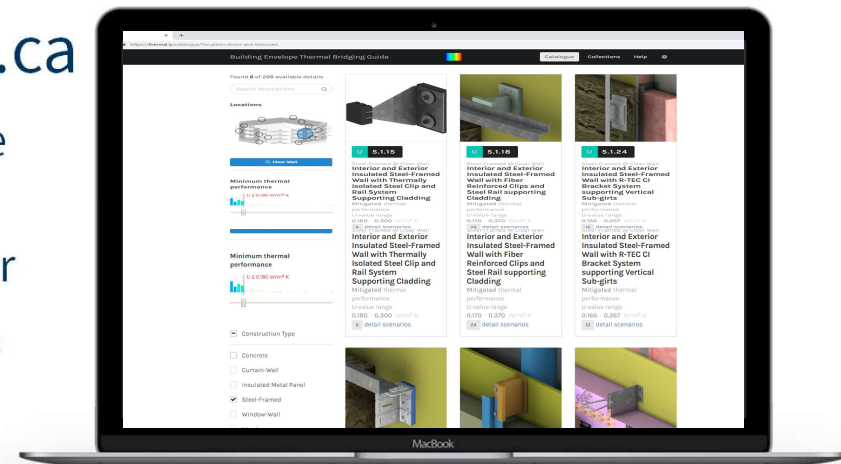
Thermal Bridging Tools



- Over 500 building details with thermal performance information and detailing approaches
- Framed walls and spandrels
- Many standard performance details, but now focusing on net-zero details

Thermalenvelope.ca

- Search and compare details
- Integrated calculator
- Education resources



Thermalenvelope.ca Demo



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