ADDRESSING BALCONY THERMAL BRIDGING IN DEEP ENERGY RETROFITS

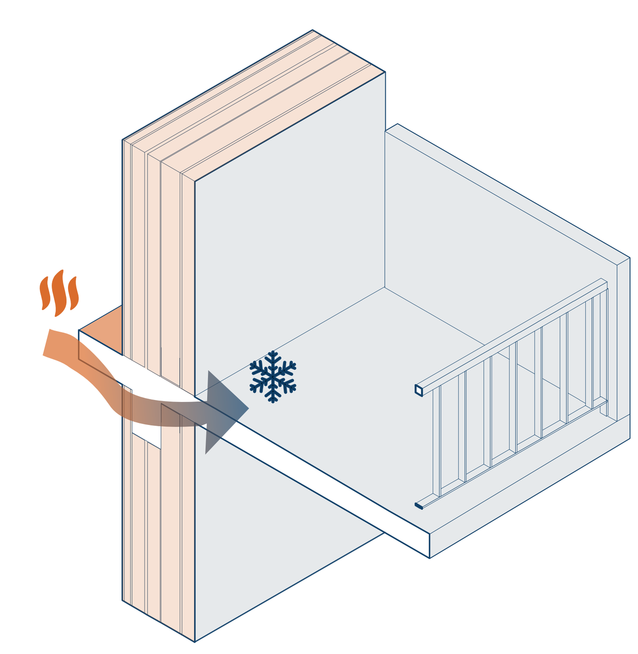
03

CONTEXT

In Canada, at least two thirds of buildings that will exist in 2050 are already built[1]. Most of these buildings perform poorly in terms of energy efficiency; some have thermal comfort and indoor air quality problems too. For many of these, undertaking panelized deep energy retrofits (DERs), which consists of overcladding a building with highly thermal resistant prefabricated panels, is the best way to reduce our building sector's GHG emissions. Multi-unit residential buildings (MURBs) are an important typology of the social housing stock in need of retrofit in Quebec, offering an opportunity for social benefits paired with improved energy efficiency.

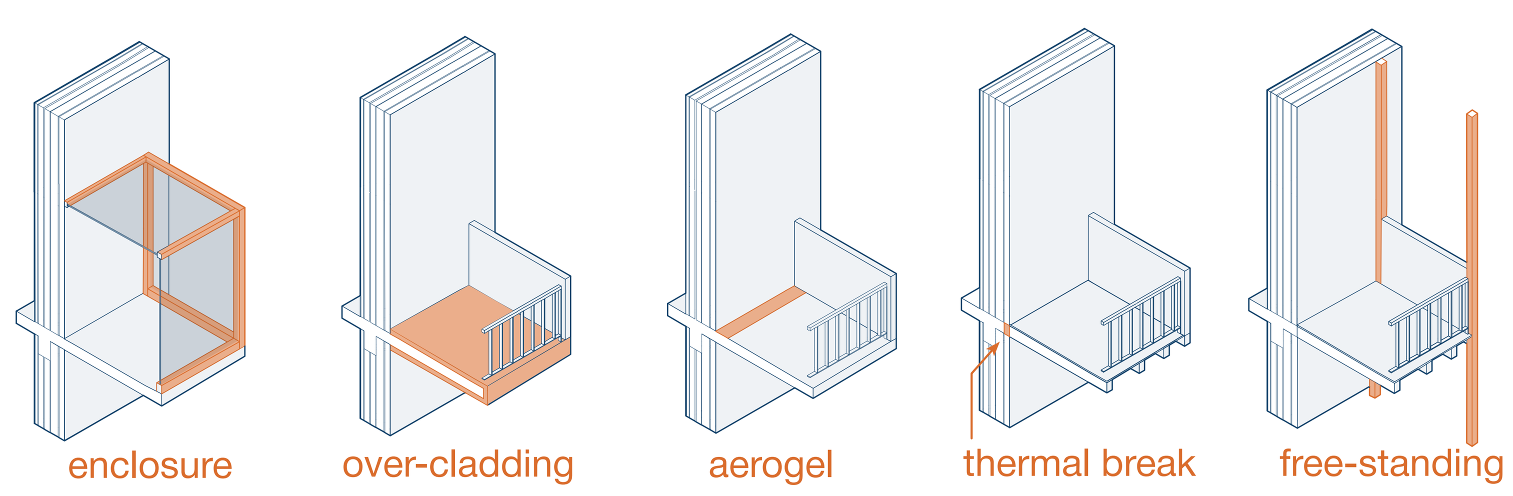
THE BALCONY ISSUE

A major concern when conducting a DER is the mitigation of thermal bridges, which represent a significant source of heat loss. Thermal bridges are caused by an interruption in the building's insulation envelope, often occurring at the junctions of building components. A common source of thermal bridging in MURBs are balconies, as they often protrude from the building envelope. Exposed balcony slabs can represent the second greatest source of heat loss following glazing and openings[2].



EXPLORING SOLUTIONS

Many solutions exist to mitigate such thermal bridges, including balcony enclosure, balcony over-cladding, the use of aerogel technology as insulation, structural thermal breaks, and free-standing balconies. Based on a common MURB typology with exposed concrete floor and balcony slabs, we analyzed five panelized DER and balcony scenarios. The structural thermal break and the free-standing balcony solutions were chosen for their replicability potential, amongst other factors. Thermal analysis was conducted on each detail to compare the interventions' impacts on the RSI (R-value, measure of a material's resistance to the flow of heat, in Système International units) of the building envelope.



COMPARING THERMAL PERFORMANCE OF BALCONY INTERVENTIONS

The following figures depict section drawings of the five retrofit scenarios analyzed. A 2D thermal simulation with the software THERM 7.8 was conducted on each assembly to obtain the overall RSI and surface temperatures of each scenario.

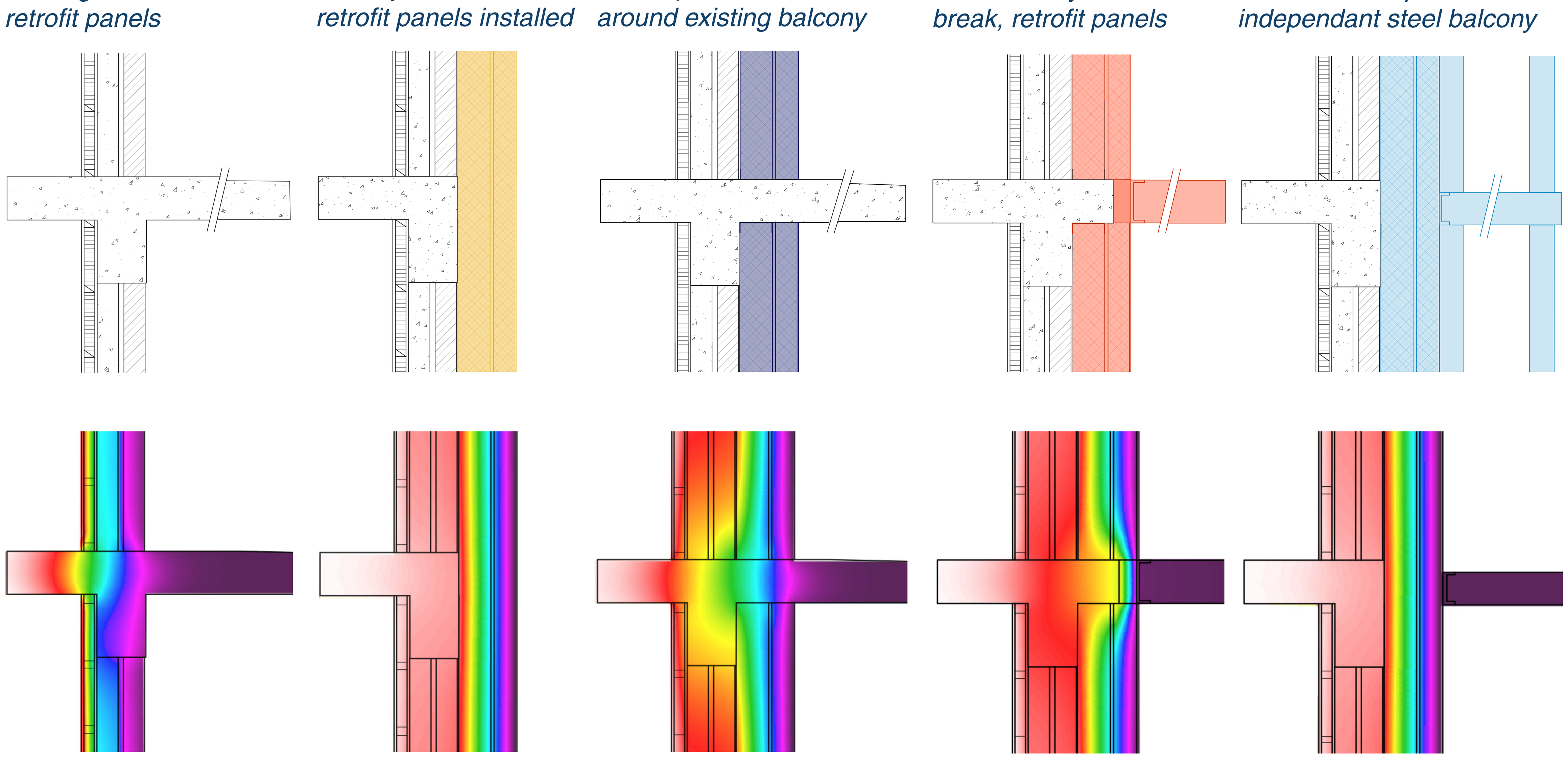
Pre-DER
building "as is" without retrofit panels

DER - No Balcony
balcony removed, retrofit panels installed

DER - Existing Balcony
retrofit panels installed around existing balcony

DER - Thermal Break
steel balcony, thermal break, retrofit panels

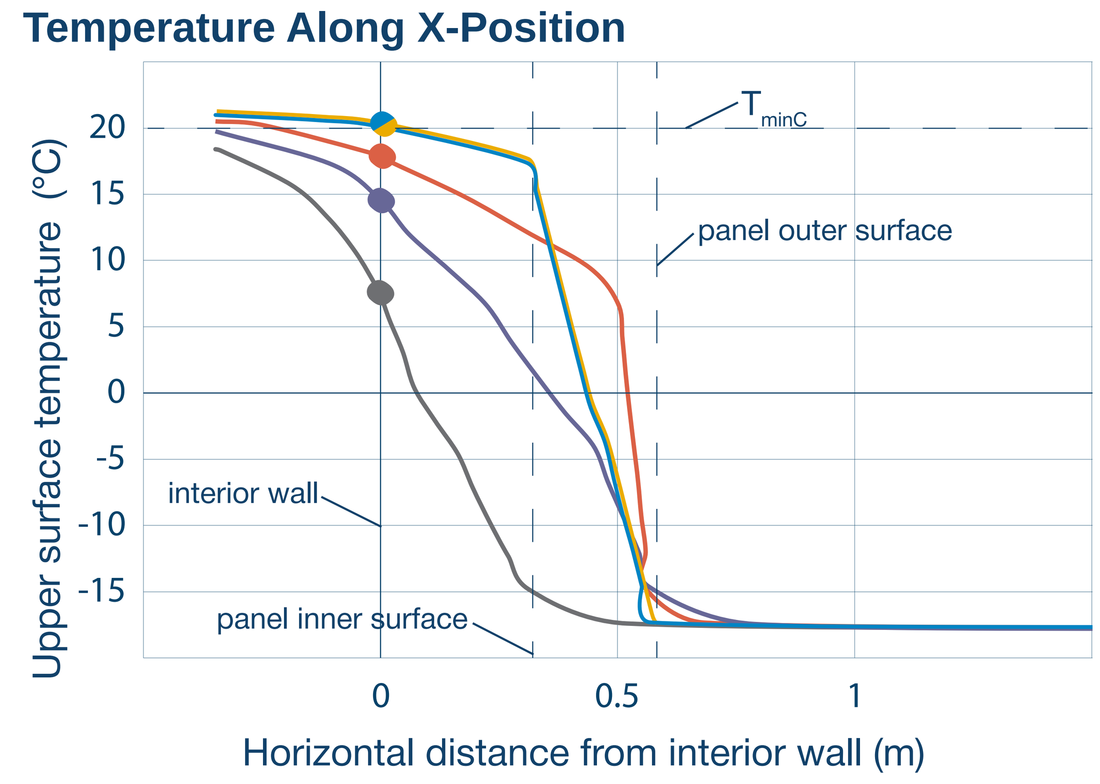
DER - Free-standing Balcony
slab removed, panels installed, independant steel balcony



RSI: 1.0 m^2K/W | **RSI:** 8.6 m^2K/W | **RSI:** 3.6 m^2K/W | **RSI:** 7.0 m^2K/W | **RSI:** 8.6 m^2K/W

Code required RSI[4]: 4.31 m^2K/W *21 °C* *-18 °C*

Temperature Along X-Position



- *Pre-DER*
- *No Balcony**
- *Existing Balcony*
- *Thermal Break*
- *Free-standing*

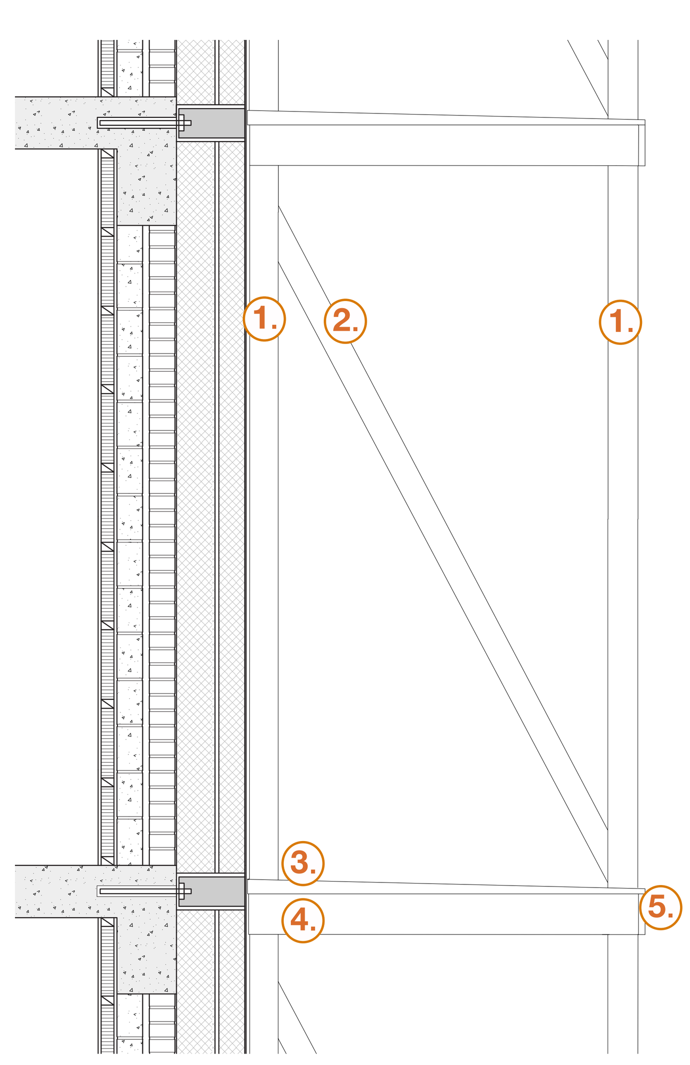
The "free-standing" solution achieves temperature requirement, as does the "no balcony" solution, but with an added cost.

* "No Balcony" curve offset for readability purposes.

T_{minC} : Minimal temperature for thermal comfort[3]

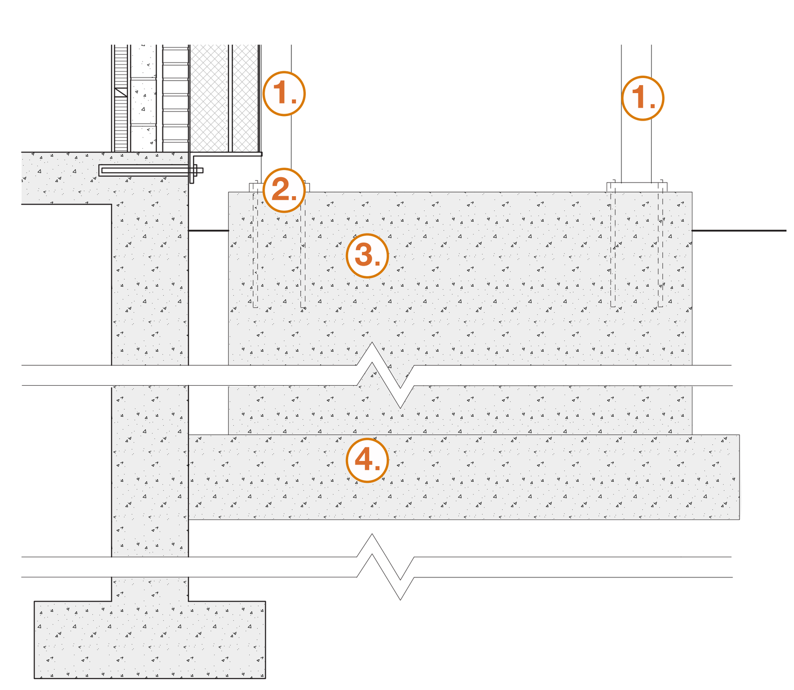
ONGOING: FREE-STANDING BALCONY

As showcased by the thermal analysis, the scenario that is least prone to thermal bridging is the free-standing balcony solution. However, this solution requires further development in terms of design (the detailing of the balcony-door junction and the load handling, for instance). Structural design of free-standing balconies has been started and the following drawings have been detailed with the advice of a structural engineer. Furthermore, free-standing balconies involve a significant amount of resources. Our plan is to further analyze this solution along the other ones. A cost analysis and energy modelling have been undertaken, and we intend to start a life cycle analysis to gain a wholistic understanding of the implications regarding each solution.



1. 100mm x 100mm steel post (HSS4x4x1/2)
2. 100mm x 100mm steel member for bracing (HSS4x4x1/2)
3. 25mm fibreglass deck
4. 150mm steel C-channel (C6x13)
5. 25 mm vinyl fascia

FREE-STANDING BALCONY DETAILED WALL SECTION



FREE-STANDING BALCONY FOUNDATION DETAIL

1. 100mm x 100mm steel post (HSS4x4x1/2)
2. anchor plate
3. reinforced concrete foundation filled with gravel
4. reinforced concrete footing

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