Balconies – How Do They Impact Wall Performance?

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This case study presents an analysis of the impacts of balconies on the overall effective wall performance of spandrel panels. With increasing focus on passive design measures and improving the performance of building envelopes, especially under the Toronto Green Standard, understanding the role balconies play in our envelopes is important. In this modelled study three key terms will be used:

Nominal R-Value - Thermal performance of the elements that make up the envelope assembly without any thermal bridging accounting.

Clear Wall Effective R-Value - Thermal performance accounting for thermal bridges from major structural elements that penetrate through the insulation layer as part of the wall assembly. This includes items such as steel studs and spandrel backpans.

Overall Effective R-Value - Thermal performance accounting for all thermal bridges within the building envelope. This includes items such as steel studs, spandrel backpans, balconies, window transitions, slab edges, demising walls, parapets, and more. This value is typically the fairest representation of real-world performance. A decrease in R-value represents an increase in thermal loss.

For the purposes of this study, an archetypal multi-unit residential building elevation has been used. Key assumptions include:

- 40% Window to wall ratio
- Typical cantilevered concrete slab balconies penetrating through the building envelope
- Moderate thermal performance from BC Hydro Building Envelope Thermal Bridging Guide (BETBG) for all thermal bridges[1]. Details are available in 'Additional Notes' at the end of this report.
- Balcony perimeter varies from 0-100% of the floor plate

A spandrel assembly has been considered for the basis of the opaque envelope in this study. Assemblies have been assumed based on past project experience and represent typical design for a MURB in the GTA. Three theoretical clear wall effective R-values have been demonstrated: R-16 (U-0.063), R-10 (U-0.100), and R-8 (U-0.125). The overall effective thermal performance for each condition was determined through a modelling exercise of a theoretical floorplate, using ASHRAE Fundamentals and spreadsheet calculations.

A summary of the impacts of thermal performance with changing balcony areas can be found in Figure 1.

[1] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/business/programs/BETB-Building-Envelope-Thermal-Bridging-Guide-v1-4.pdf

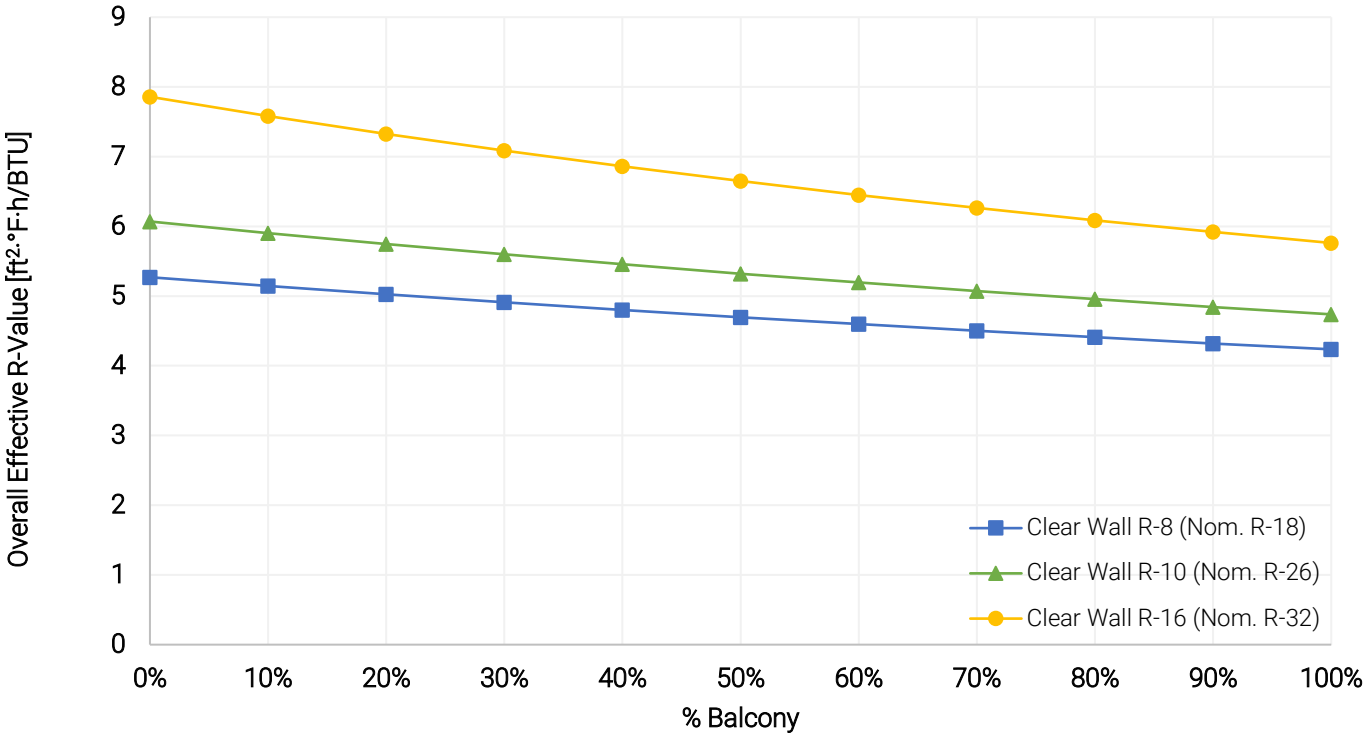


Figure 1 – Relation between balconies and the overall effective wall U-value of spandrel

As the proportion of balcony penetrations increase, thermal losses from the building envelope increase. In the clear wall R-10 scenario, with the inclusion of thermal bridging and no balconies, the overall effective wall performance is R-6.07. When 100% of the floorplate perimeter is balcony, the overall effective wall R-value decreases to R-4.74, equivalent to a 22% decrease in R-value compared to the 0% balcony scenario.

The impact of balcony penetrations becomes proportionally higher for clear walls with higher R-values. In the R-18 clear wall scenario, at 100% balconies, the overall effective R-value is R-5.76, compared to R-7.86 for a design with no balconies. This represents a 27% decrease in R-value from the addition of balconies. By having a higher percentage of balconies, the benefits of a well-designed, high performance wall are not fully realized.

Figure 2 in 'Additional Notes' at the end of this study shows the impact on assumed nominal performance from thermal bridging from structural elements, as well as from the increase from 0% to 100% balconies.

Key Findings

- Balconies should be thoughtfully designed to mitigate losses on investment made into clear wall insulation due to thermal bridging. This involves minimizing balconies to reduce the proportion of slab edge that they contribute to.

- Envelopes with a higher clear wall performance are more impacted by thermal bridging elements, such as balconies. As stricter energy targets are pursued, attention to detailing and thermal bridges, especially balconies, become increasingly important.

Additional Considerations

- This study has assumed that all balconies are cantilevered. When considering inset balconies, additional corners created by balconies will have a further negative effect on thermal performance.

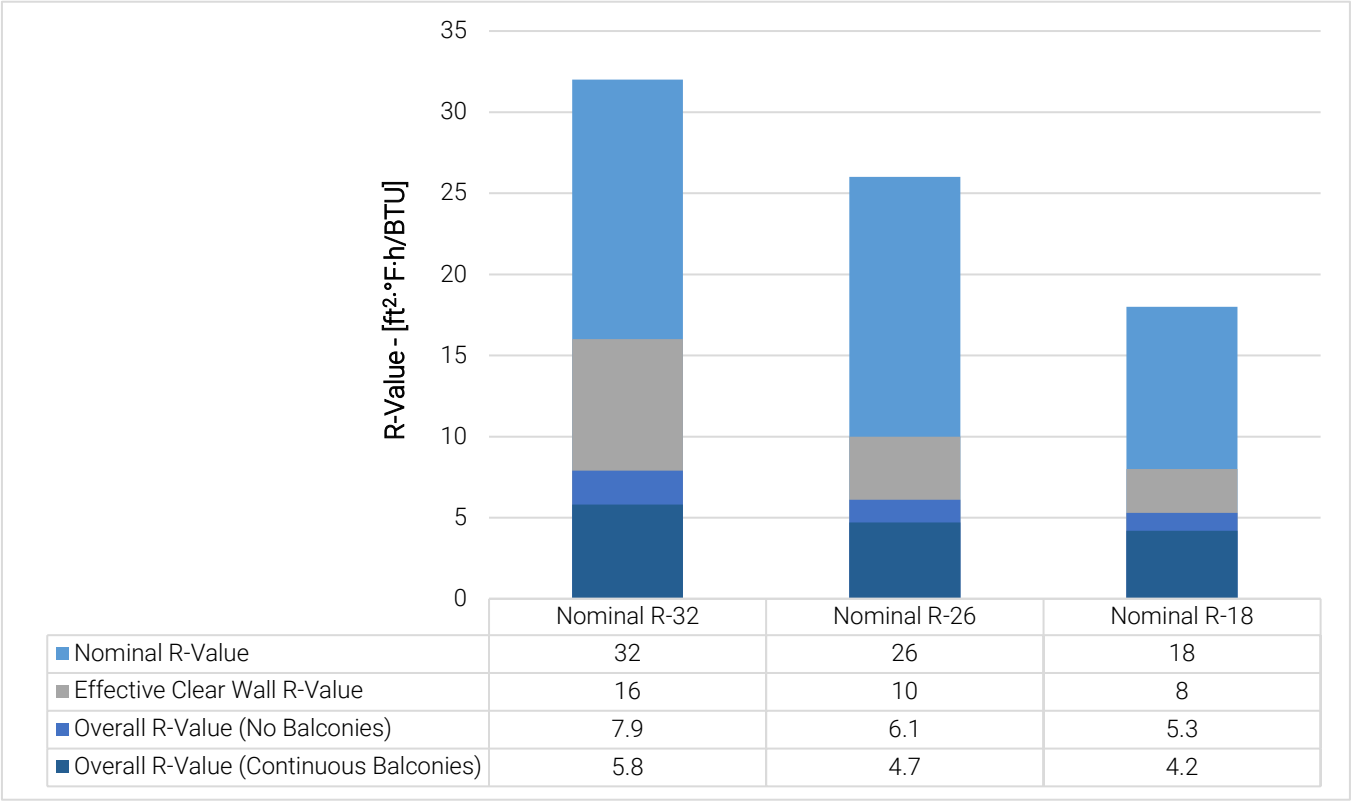
- While balcony penetrations negatively effect the thermal performance of the opaque wall, there are benefits to be found with the shading they provide.

- Thermally broken balconies are one measure that can be used to improve balcony performance but are not yet common in the Canadian marketplace and have not been considered in this study. Additional measures to consider include externally supported balconies or point load balconies that minimize penetrations through the envelope.

Additional Notes

Thermal Bridging Assumptions:

	BETBG v1.4 Detail	Performance (Btu/(h·ft²·°F))
Balcony	9.1.6	0.645
Slab Edge	1.2.5-B	0.379



	Nominal R-32	Nominal R-26	Nominal R-18
Nominal R-Value	32	26	18
Effective Clear Wall R-Value	16	10	8
Overall R-Value (No Balconies)	7.9	6.1	5.3
Overall R-Value (Continuous Balconies)	5.8	4.7	4.2

Figure 2 – Breakdown of opaque wall thermal performance