October 2024

# Thermal Bridging at Balconies and Doors Guide

This guide outlines how to utilize data in the ThermalEnvelope.ca database that separates the impact of the door and spandrel sill interface at concrete curbs, and related thermal bridging, from the thermal transmittance for the balcony.

This is an enhanced methodology that has evolved from combined transmittances for door and balcony details. The methodology for evaluating doors and balconies has evolved to:

1. Encourage mitigating the impact of the door-to-curb interface,
2. Avoid discounting how much mitigation is provided by balcony thermal breaks, and
3. Facilitate the data being directly applicable to more project specific scenarios.

When applicable, both the door or spandrel sill linear transmittance and balcony transmittances need to be included in calculations for the overall opaque thermal transmittance.  This guide provides example calculations that show how to utlize the data in overall thermal transmittance calculations.



# Background

Balcony details from the Building Envelope Thermal Bridging (BETB) Guide combined the impact of thermal bridging at the door-to-curb, deflection head, and balcony into an aggregate transmittance. This was done to simplify the calculations, increase understanding of the overall impact, and support market transformation from common practice that largely overlooked thermal bridging.

Refer to “Detailing with Floor to Ceiling Glazing” on page 16 of the BETB Guide V1.6 and watch the video under Module 2 available at ThermalEnvelope.ca/help for additional insight and background on dealing with doors and balconies.

Calculations are simplified with a combined transmittance because users can simply take off the length of balconies and do not need to worry about the intricacies of construction details. However, this method has limitations for an industry that has shifted focus from simply understanding the impact of thermal bridging to mitigating thermal bridging.

Separating the individual impacts as shown in Figure 1 reduces the quantity of details that are needed in the BETB database and allows users to determine how to best mitigate thermal bridging. For example, designers can explore the value of mitigating the impact of the door sill interface, a balcony thermal break, or doing both.

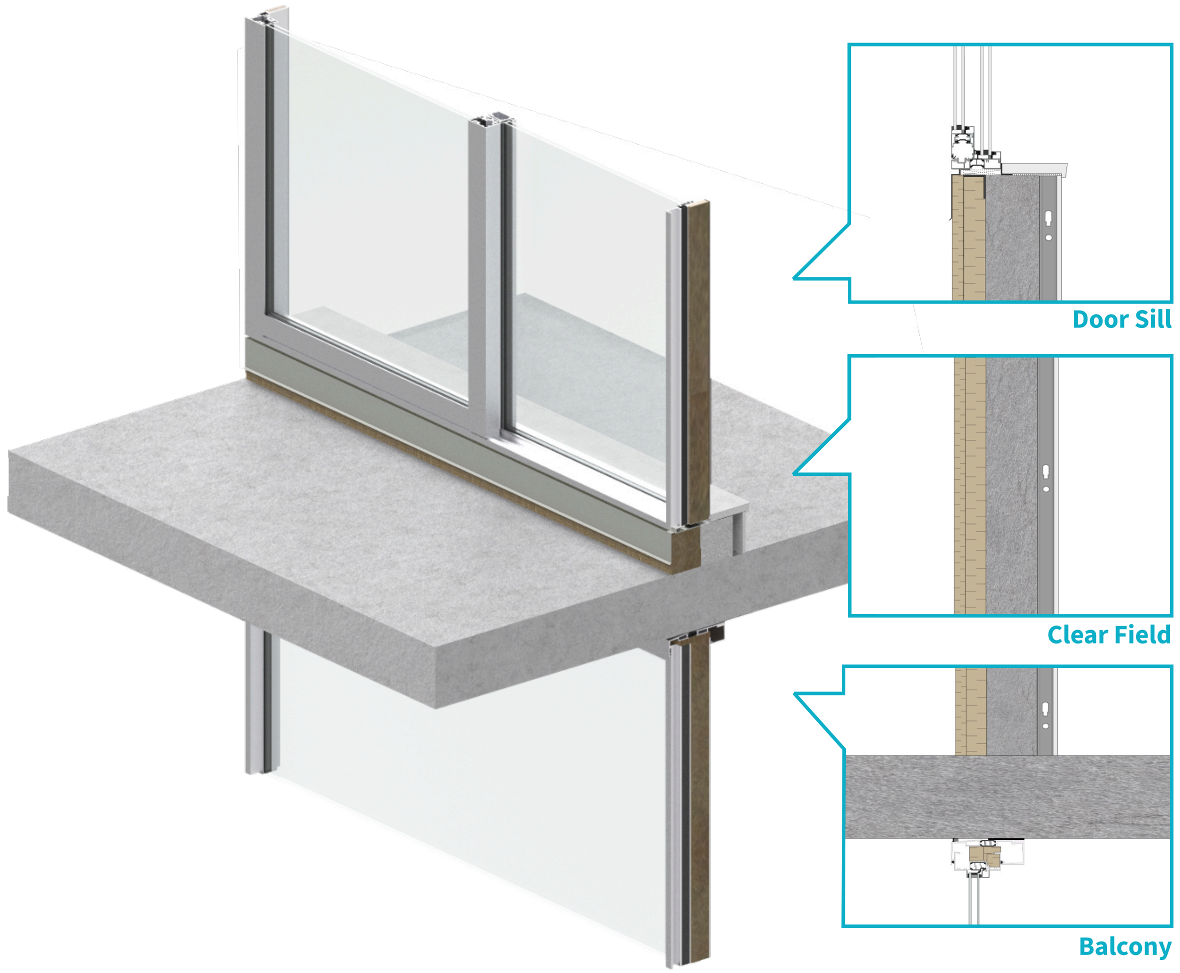



**Figure 1.** 3D render showing overall balcony and door section, and the approach using separated details for an insulated concrete curb

## Example 1: Sliding Door and Window-Wall Spandrel on 6-inch Curb

The doors and opaque walls are part of a window-wall system that are interrupted by a cantilevered concrete balcony as shown in Figure 2. The 6-inch (152 mm) concrete curb runs the entire length of the balcony and is exterior insulated with 3-inches (76 mm) of mineral wool insulation.

This example goes through the steps of determining the overall thermal transmittance for the façade area presented in Figure 2.

### Step 1: Determine Approach

The first step in determining the overall thermal transmittance, or effective R-value, for the opaque facade is to determine the approach. This example uses the enhanced methodology because there is an insulated concrte curb and there is data available to determine the relative impact of the details.

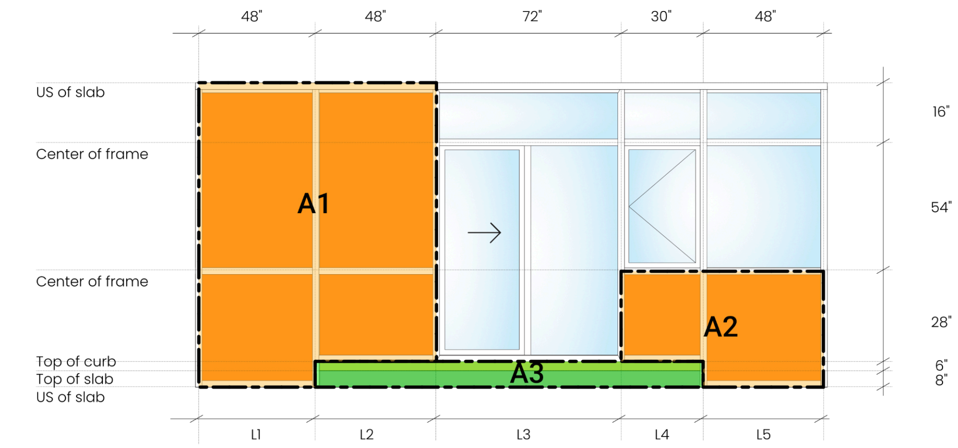



Figure 2.Quantity Takeoff for Example 1

### Step 3: Area and Linear Quantity Takeoff

The quantity takeoffs follow from step 2 and as outlined in Figure 2.

**Table 1.** Example 1 Quantity Takeoff and Thermal Performance

| Transmittance Type | Description | Applicable Clear Field Assembly | Source | Quantity | Transmittance | Percent Heat Flow |
|---|---|---|---|---|---|---|
| Clear Field Assembly | Window-wall Full Height Glass Spandrel | Not Applicable | BETB 1.1.8 V1.8 | A1 = 6.50 m² | 0.474 W/m² K | 33% |
| | Window-wall Upstand Glass Spandrel | | BETB 1.1.5 V1.8 | A2 = 1.84 m² | 0.487 W/m² K | 10% |
| | Concrete Curb with 3" Mineral wool | | BETB 9.2.1 V1.9 | A3 = 1.35 m² | 0.375 W/m² K | 6% |
| Linear Interface | Full Height Spandrel Bypass | Window-wall Full Height Glass Spandrel | BETB 1.2.11 V1.8 | L1 = 1.22 m | 0.138 W/m K | 2% |
| | Upstand Spandrel Bypass | Window-wall Upstand Glass Spandrel | BETB 1.2.14 V1.8 | L5 = 1.22 m | 0.196 W/m K | 3% |
| | Spandrel-to-Curb | Concrete Curb with 3" Mineral wool | BETB 9.3.7 V1.9 | L2 + L4 = 1.98 m | 0.044 W/m K | 1% |
| | Door-to-Curb | | BETB 9.3.2 V1.9 | L3 = 1.83 m | 0.266 W/m K | 5% |
| | Balcony with Spandrel at Underside | | BETB 9.2.2 V1.9 | L2 = 1.22 m | 0.981 W/m K | 13% |
| | Balcony with Vision Glazing at Underside | | BETB 9.2.1 V1.9 | L3 + L4 = 2.59 m | 0.986 W/m K | 28% |

### Step 2: Determine Assemblies and Details

The next step is to identify the clear field assemblies and interface details. Identifying the details that will be utilized is critical to establishing a clear direction for quantify takeoffs.

### Step 4: Determine Transmittances

Determine the clear field and linear transmittances. This can be done while doing steps 2 and 3. However, getting stuck on details that might not have a big impact can be avoided if done afterwards.

### Step 5: Determine Relative Impact of Details and Overall Performance

The relative impact of the details and overall transmittance, or effective R-value, is determined using the thermal calculator available at ThermalEnvelope.ca and using the values outlined in steps 3 and 4.

**Total opaque Area:** 9.70 m²

**Overall Performance:** R-6.0 (1.05 RSI)

## Example 2: Sliding Door on a Recessed Concrete Slab without a Curb

The doors and opaque walls are part of a window-wall system similar to example 1, but there is no curb at the sliding door.

This example goes through the steps of determining the overall thermal transmittance for the façade area presented in Figure 3. The enhanced methodology is utilized for the spandrel areas on the curbs and the combined transmittance is used for the balcony section at the door.

### Step 1: Recognize that the spandrel areas require a different approach than the doors.

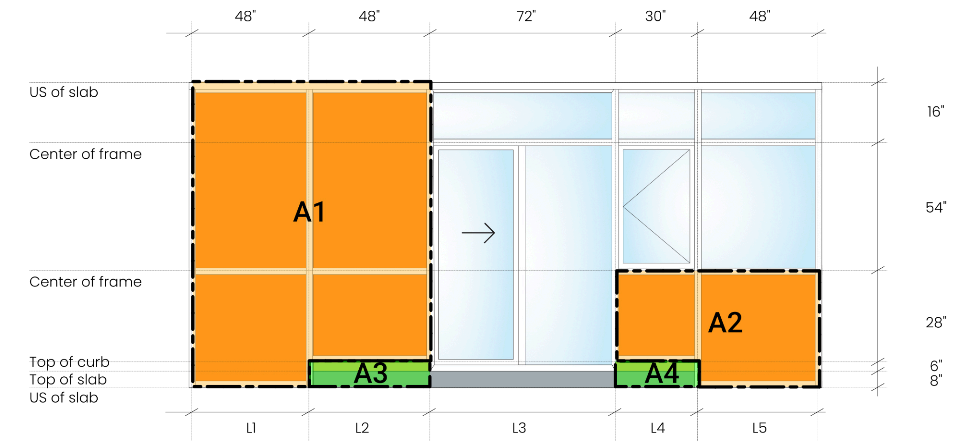



Figure 3. Quantity Takeoff for Example 2

### Step 3: Area and Linear Quantity Takeoff per Figure 3

**Table 2.** Example 2 Quantity Takeoff and Thermal Performance

| Transmittance Type | Description | Applicable Clear Field Assembly | Source | Quantity | Transmittance | Percent Heat Flow |
|---|---|---|---|---|---|---|
| Clear Field Assembly | Window-wall Full Height Glass Spandrel | Not Applicable | BETB 1.1.8 V1.8 | A1 = 6.50 m² | 0.474 W/m² K | 33% |
| | Window-wall Upstand Glass Spandrel | | BETB 1.1.5 V1.8 | A2 = 1.84 m² | 0.487 W/m² K | 10% |
| | Concrete Curb with 3" Mineral wool | | BETB 9.2.1 V1.9 | A3+A4 = 0.70 m² | 0.375 W/m² K | 3% |
| Linear Interface | Full Height Spandrel Bypass | Window-wall Full Height Glass Spandrel | BETB 1.2.11 V1.8 | L1 = 1.22 m | 0.138 W/m K | 2% |
| | Upstand Spandrel Bypass | Window-wall Upstand Glass Spandrel | BETB 1.2.14 V1.8 | L5 = 1.22 m | 0.196 W/m K | 3% |
| | Spandrel-to-Curb | Concrete Curb with 3" Mineral wool | BETB 9.3.7 V1.9 | L2 + L4 = 1.98 m | 0.044 W/m K | 1% |
| | Balcony with Spandrel at Underside | | BETB 9.2.2 V1.9 | L2 = 1.22 m | 0.981 W/m K | 13% |
| | Balcony with Vision Glazing at Underside | | BETB 9.2.1 V1.9 | L4 = 0.76 m | 0.986 W/m K | 8% |
| | Door-to-Balcony | none | BETB 9.1.27 V1.9 | L3 = 1.83 m | 1.24 W/m K | 25% |

### Step 2: Determine Assemblies and Details

Recognize how the approach affects the quantity takeoffs for the clear field area and linear quantity takeoff.

### Step 4: Determine Transmittances

Provide the transmittances that match the approach and takeoff.

### Step 5: Determine Relative Impact of Details and Overall Performance

**Total opaque Area:** 9.41 m²

**Overall Performance:** R-6.0 (1.05 RSI)

# Combining Balcony Transmittances

The linear transmittances that separate the door or spandrel sill from the balcony can be combined to compare aggregate transmittances using equation 1. This is useful when comparing early versions of the BETB Guide or to calculations that utilize aggregate balcony transmittances.

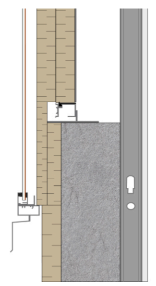
The following examples outline how to determine the aggregate transmittance for the spandrel area and at the door for the example facade outlined in Figure 1.

$$U_T = U_o + \frac{\sum \psi \cdot L}{A_T} \qquad \text{(equation 1)}$$

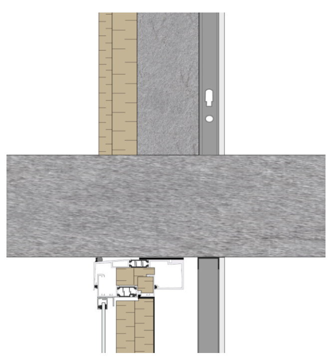
Where:

- $U_T$ = overall transmittance at the balcony including the impact of the door sill, spandrel sill, curb, balcony, and deflection head interface
- $U_o$ = clear field transmittance of the curb or adjacent wall assembly above the balcony
- $A_T$ = opaque area of the balcony and curb
- $\Psi$ = linear transmittances for the door, spandrel, and balcony
- L = Length of linear transmittance

## Detail 1: Combined Balcony Transmittance for Full height Spandrel



Spandrel-to-curb interface



Balcony interface

The full height spandrel-to-balcony interface contains two interfaces and one clear field assembly as follows.

1. Spandrel-to-curb ($\psi_1$) for spandrel glass scenario from BETB 9.3.7 V1.9.
2. Balcony interface ($\psi_2$) for spandrel glass scenario from BETB 9.2.2 V1.9.
3. Concrete curb clear field assembly ($U_0$) from BETB 9.2.2 V1.9.

The combined transmittance for the balcony and curb area is calculated as follows.

$$U_T = U_o + \frac{\sum \psi \cdot L}{A_T} = U_o + \frac{(\psi_1 + \psi_2) \cdot L}{L \cdot (H_{curb} + H_{balcony})}$$

$$U_T = 0.375 + \frac{(0.044 + 0.981)}{(0.152 + 0.203)} = 3.257 \text{ W}/m^2\text{K}$$

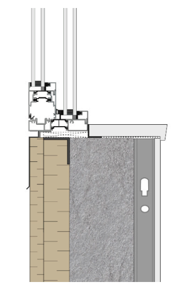
The combined linear transmittance for the balcony and curb related to the full height spandrel clear field, from BETB 1.1.8 V1.8, is calculated by rearranging equation 1 as follows.

$$\psi = \frac{(U_T - U_o) \cdot A_T}{L} = \frac{(U_T - U_o) \cdot L \cdot (H_{curb} + H_{balcony})}{L}$$

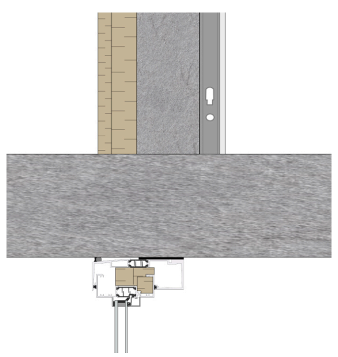
$$\psi = (3.257 - 0.474) \cdot (0.152 + 0.203) = 0.99 \quad W/mK$$

This value can be directly compared to detail 9.1.9 V1.6, which has a linear transmittance of 1.13 W/m K.

## Detail 2: Combined Balcony Transmittance for a Door Interface



Door-to-curb interface



Balcony interface

The door-to-balcony interface contains two interfaces and one clear field assembly as follows.

1. Door-to-curb ($\psi_4$) for the steel angle scenario from BETB 9.3.1 V1.9.
2. Balcony interface ($\psi_3$) from detail BETB 9.2.1 V1.9.
3. Concrete curb clear field assembly ($U_o$) from BETB 9.2.1 V1.9.

The combined transmittance for the balcony and curb area is calculated as follows.

$$U_T = U_o + \frac{\sum \psi \cdot L}{A_T} = U_{o,3} + \frac{(\psi_3 + \psi_4) \cdot L}{L \cdot (H_{curb} + H_{balcony})}$$

$$U_T = 0.375 + \frac{(0.247 + 0.986)}{(0.152 + 0.203)} = 3.84 \quad W/m^2K$$

The combined linear transmittance for the door and balcony does not relate to any clear field as it is floor to ceiling glazing. Refer to Part 1 of the BETB Guide in the section called "Detailing with Floor-to-Ceiling Glazing" for more information.

The combined transmittance is calculated by rearranging equation 1 as follows, where $U_0 = 0$.

$$\psi = \frac{(U_T - U_o) \cdot A_T}{L} = \frac{(U_T - U_o) \cdot L \cdot (H_{curb} + H_{balcony})}{L}$$

$$\psi = (3.842 - 0) \cdot (0.152 + 0.203) = 1.37 \quad W/mK$$

This value can be directly compared to detail 9.1.4 V1.6, which has a linear transmittance of 1.84 W/m K.

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