JBED

Journal of Building Enclosure Design

An official publication of the National Institute of Building Sciences
Building Enclosure Technology and Environment Council (BETEC)

*National Institute of Building Sciences: An Authoritative Source of Innovative Solutions for the Built Environment*

Winter 2013

# Thermal Bridging: It Can Be Done Better

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JBED

**Published For:**
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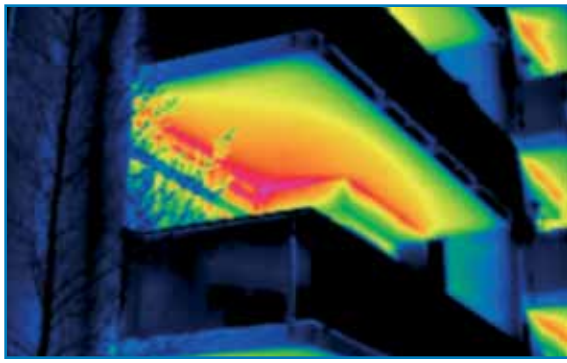




**On the cover:** The Centre for Interactive Research on Sustainability (CIRS), located at the University of British Columbia, is one of the greenest buildings on earth… and provides a great example of thermal bridging done right.

# The Truth is Out There:

## Efficiency and Iconic Architecture Can Co-Exist

**By Joseph Lstiburek, PhD, P.Eng., ASHRAE Fellow**

IT IS A BEAUTIFUL BUILDING. QUITE stunning actually. It is an embodiment of everything that is right and wrong with architecture. An orgy of glass and concrete. It is a thermodynamic obscenity while it takes your breath away. An 82 story heat-exchanger in the heart of Chicago **(FIGURE 1, FIGURE 2 AND FIGURE 3)**.

Could it have been constructed differently without the thermal bridges and without changing the appearance? Sure. It could have been an example of efficiency, not just iconic architecture. And that would have been a beautiful thing. And it could have been done with off the shelf stuff, no less. How about a true R-5 curtain wall between thermally broken cantilevered slabs? Check out **FIGURE 4** and **FIGURE 5**. These are available right here in the good 'ole US of A. They're also apparently available in Serbia **(FIGURE 6)** and pretty much anywhere folks want them. Triple-glazed gas-filled curtain walls have been around for a while. The thermal breaks have also been around for a while; mostly in Europe and in Canada.

The Aqua Building is not an exception. Most buildings are like this; thermal bridges galore. It is a big deal. The good news is folks are beginning to get it (ASHRAE 90.1) and great work is being done on the research side.[1] The bad news is that although we know this stuff, it is not getting used. It seems to me that folks are just not serious about energy. This is an architectural problem. This is an architectural detailing problem. This is an architectural detailing problem that involves structural engineering. To deal with this is going to require collaboration between architects and structural engineers. Serious collaboration.

Too often, structural decisions are made in isolation from the energy impacts. It is not that the structural engineer does not care. It's just that no one asks—but it's time to ask. It's time to get great things from your structural engineer.

Balconies are a big deal and everyone knows that. But relieving angles can be an even bigger deal. They go completely around a building and sometimes occur at every floor. Balconies rarely do, previous exception noted. The good news is that we know how to deal with relieving angles. The bad news is that we often do not. Sound familiar?

The best way to deal with relieving angles is to hang them off of the building with a "stand-off" **(FIGURE 7)** and then spread them out every second or third floor. This

*Figure 1. Extended finned-surface, made of concrete.*

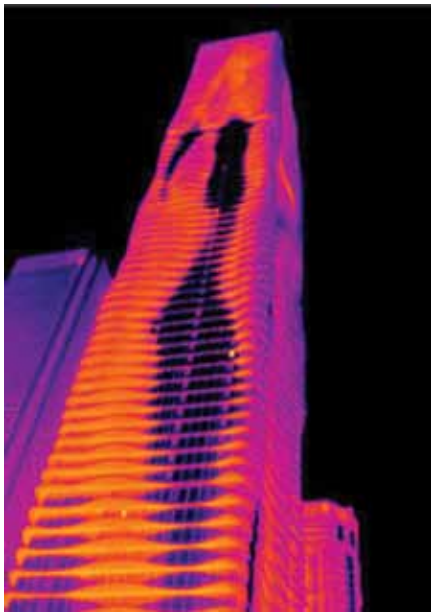

*Figure 2. An infra-red of the Aqua Tower.*

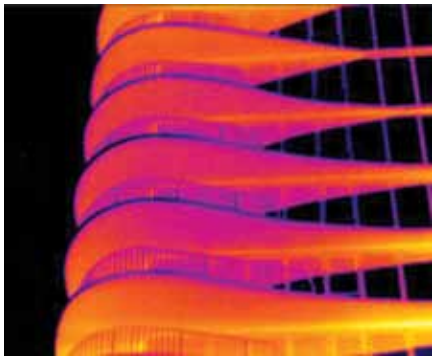

*Figure 3. An infra-red of an Aqua Tower balcony.*

Dave Robley and Michael Stuart, Fluke Corp.

allows your insulation to run past the angle. Presto, continuous insulation **(FIGURE 8)**. The stand-offs can be welded to plates cast into slabs or welded to structural steel supports **(FIGURE 9)**. Amazing as it seems to civilians and other mere mortals, the architect obsesses over the location of the relieving angle. It can't be just anywhere. It has to look good wherever it is. Sometimes it has to line up over the heads of windows for reasons that escape me, a mere mortal, so we have to ask the structural engineer to be clever **(FIGURE 10)**. See, all you have to do is ask.

What if I do not like brick? Great, no relieving angles. How do I do panels? And, how do I do panels "conservatively" if I don't buy into all that other stuff you have talked about? Ok, ok, ok. Check out **FIGURE 11**. Although the structural design required for thin stainless angles and long galvanized L-rails is simple, engineers normally are designing for loads of thousands of pounds (kips) and the hundred pound loads involved here are unfamiliar and sometimes scary.

We also have to deal with the thermal bridges associated with windows. For reasons that are unclear to me, where windows are concerned, we don't call it a thermal bridge, we call it "flanking" losses. Flanking losses are losses around the window often through the buck or through the structure components the wall is installed in. The bottom line is that you need to line up the thermal control layer in the window unit (a.k.a. "thermal break") with the continuous insulation you are now required to install on the exterior of the wall. That often means pushing your window outboard and hanging it in mid-air, sort of. Gotta talk to the structural engineer again. Magic will happen again.

**FIGURE 12** has everything, including relieving angles on stand-offs and bumped out windows. Nice. I wonder if there are any Leadership in Energy and Environmental Design® (LEED) points for this? Yeah, probably not.

The best thing to do is to take your structural engineer out to lunch and discuss relieving angles, window attachment and balcony thermal breaks.

Enjoy a nice moment with your engineer… ■

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*Joseph Lstiburek, PhD, P.Eng., ASHRAE Fellow, is principal of Building Science Corporation.*

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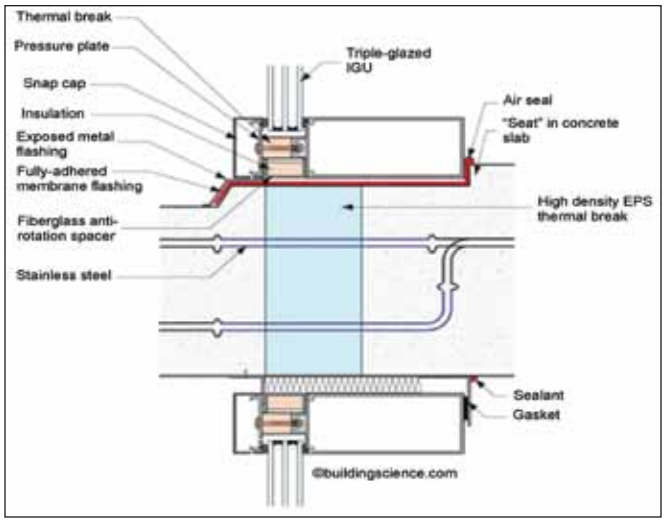
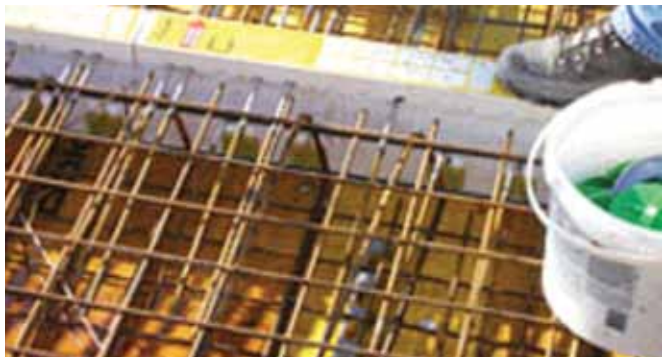



*Figure 4. Section at balcony glazing interface. Take a high-performance curtainwall and couple it with a high-density expanded polystyrene thermal break and some basic slab water control and you have a beautiful thing.*



Schoeck Canada, Inc.

*Figure 5. Pre-manufactured thermal break. High-density graphite-enhanced expanded polystyrene. Note the reinforcing rods penetrating the foam are stainless steel, not carbon steel. Stainless steel has less than half the thermal conductivity of carbon steel.*

Beodom, Inc., Belgrade, Serbia

*Figure 6. The product shown here, which is being used on a building in Serbia, prevents thermal bridges on balconies.*

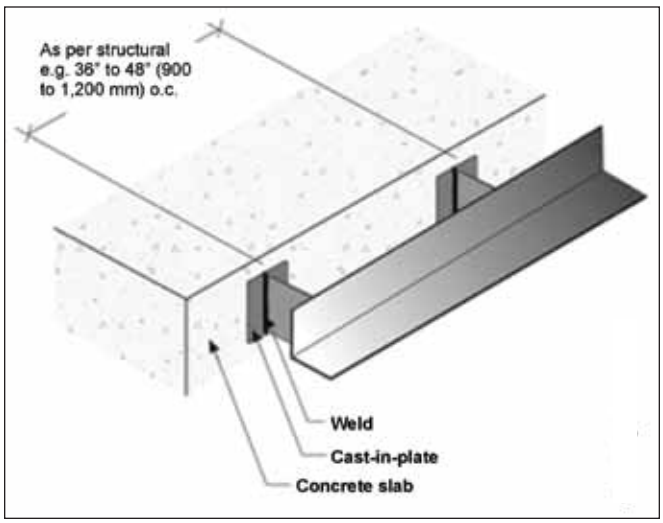



*Figure 7. Relieving angles. Hang them off of the building with a "stand-off." This allows your insulation to run past the angle.*

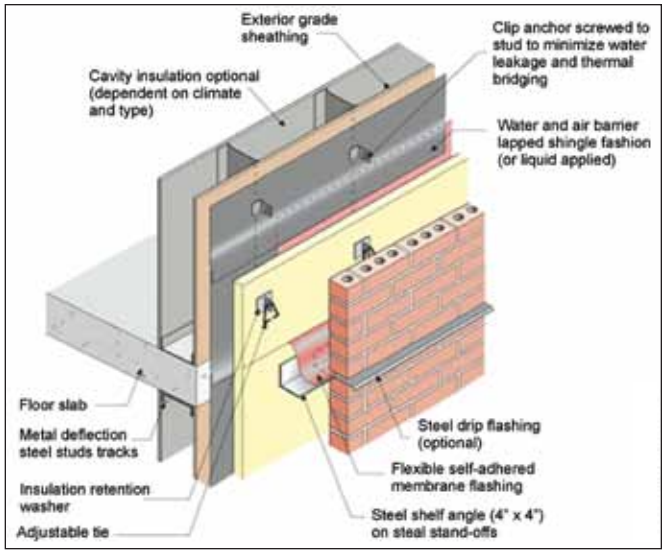



*Figure 8. Continuous insulation. If you are serious about energy, this becomes standard practice.*

*Figure 9. Stand-off. This can be welded to plates cast into slabs or welded to structural.*

*Figure 10. Relieving angle line up. Notice how the relieving angle lines up with the top of the window.*

**MORE IMAGES RELATING TO THIS ARTICLE ARE AVAILABLE AT WWW.BUILDINGSCIENCE.COM/DOCUMENTS/INSIGHTS/BSI062-THERMAL-BRIDGES-REDUX**

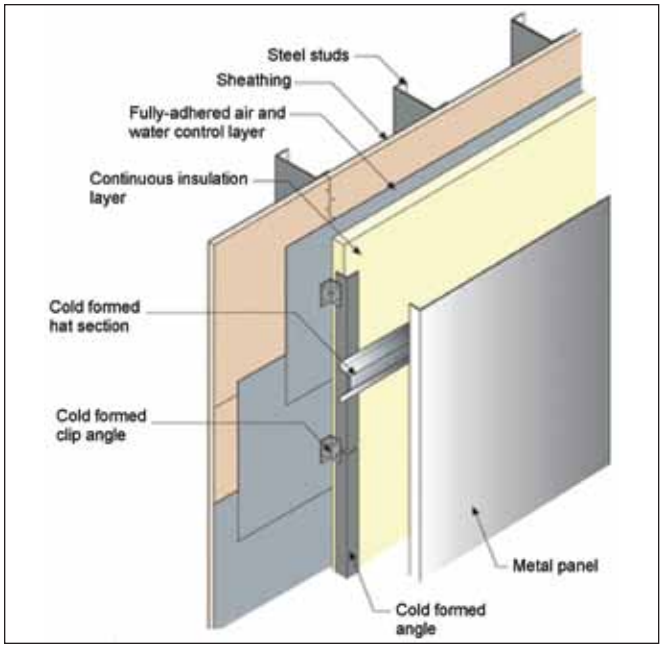



*Figure 11. Clip and rail minimum thermal bridging to support metal panels, fiber cement panels and composite panels.*

*Figure 12. A little bit of everything…relieving angles on stand-offs and bumped-out windows.*

**FOOTNOTE**

1. ASHRAE Report No. 5085243.01, *Thermal Performance of Building Envelope Details for Mid- and High-Rise Buildings* (1365-RP), addresses thermal bridges. The report was done July 2011, for Technical Committee 4.4, Building Materials and Building Envelope Performance. *www.morrisonhershfield.com/.../MH_1365RP_Final_%20small.pdf.*

## Complete Resources for the Construction Industry

When people in the building industry have questions about design, management, operations and maintenance they go to the National Institute of Building Sciences **WBDG Whole Building Design Guide® at www.wbdg.org.**

**WBDG** is one of the largest, most comprehensive online resources in the building construction industry. This web-based portal contains design, construction and facility management information and criteria required by U.S. military and other federal agencies.

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