

# PROS AND CONS OF VARIOUS THERMAL CLIPS IN BUILDING ENVELOPE REMEDIATIONS USING CONTINUOUS EXTERIOR INSULATION

By Guillaume Vadeboncoeur, PEng, LEED AP

With an increased focus on careful stewardship of resources and rapidly rising energy costs, it is now mandatory for new and remediated buildings to be more energy efficient. For buildings under remediation, this is often easier said than done. There are a number of challenges that a design team must address during the design and construction phases of such a project.

One of the main challenges the building envelope industry currently faces is the design of exterior wall assemblies that address thermal bridging, with lower-conductivity components ideally located outboard of the sheathing. Standards and building code requirements are trending in this direction. To meet the requirements of ASHRAE 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*, using the prescriptive method (required by some building codes), one can either demonstrate low overall heat loss for an assembly, or incorporate a continuous layer of insulation in the exterior wall design (Figure 1).

Recently, several thermal clips have been introduced to the construction industry to facilitate the construction of

exterior walls with insulation located outboard of the wall sheathing (Figures 2 and 3). Several types of thermal clips are available; however, they are not all created equal. Each clip has its advantages and disadvantages, ranging from thermal properties to the user-friendly aspects of its installation.

WSP Canada has been involved in projects in which these thermal clips have been used. Three case studies with three different thermal clips will be presented while

some of the advantages and disadvantages of each clip, such as thermal effectiveness, adjustability, cost, and design considerations, will be discussed.

Even with these new thermal clips, exterior insulated wall designs can be quite challenging during building envelope remediation projects, as existing buildings are often constructed using the traditional method of insulating between the wall studs. During these types of projects, it is crucial to properly design the new wall assemblies so that the air barriers and vapor retarders are at the correct locations to prevent potential condensation problems.

Besides exterior insulated finish systems (EIFS)—wall assemblies that are adhered to the wall sheathing and structure—most exterior walls have framing components that can bridge the insulation layer. The impact of these components on the thermal performance of the exterior walls is significant. There are numerous strategies and wall-cladding assemblies available to reduce thermal bridging through an exterior insulation layer.

As previously mentioned, there are significant design and construction challenges with exterior insulated wall assemblies. These challenges should not be taken lightly,

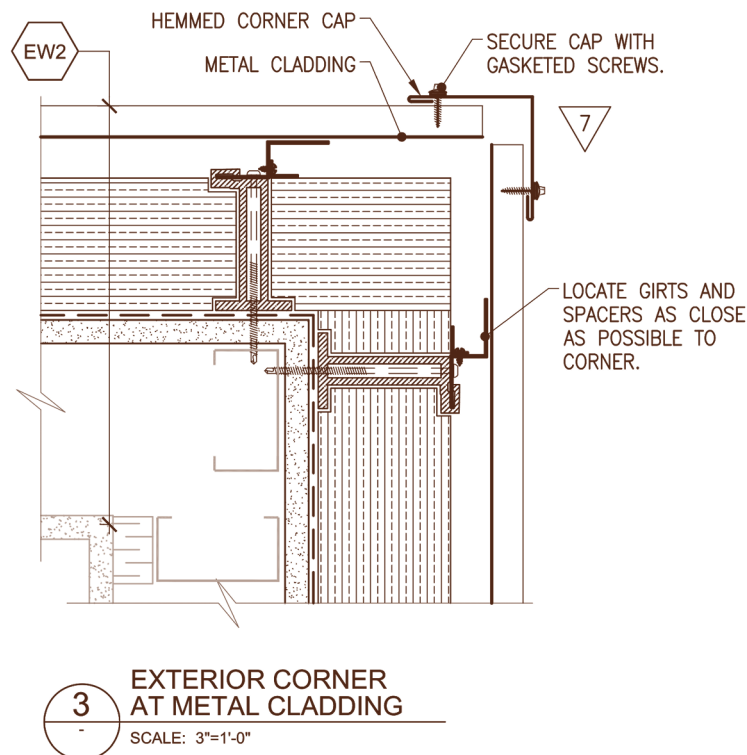
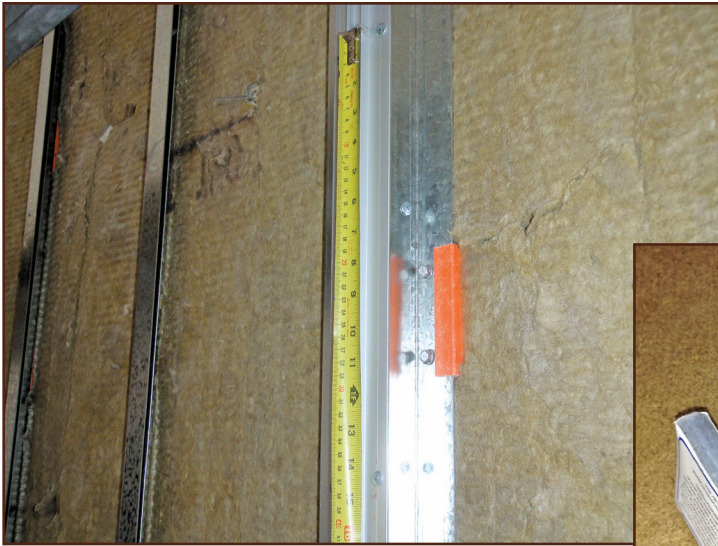
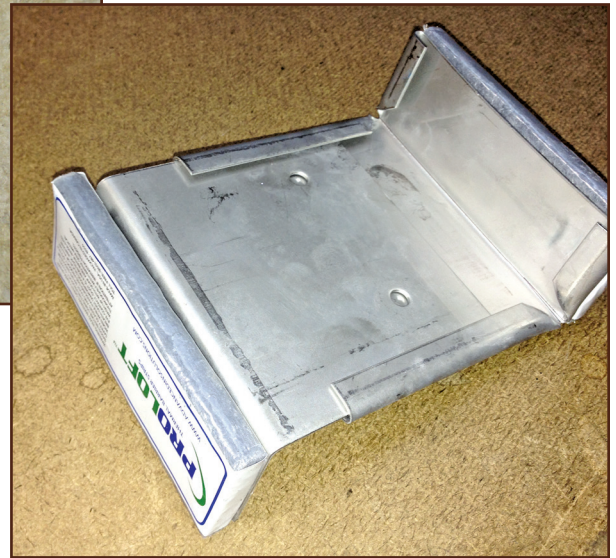


Figure 1 – Plan view of an exterior insulated wall assembly.

as they could become problematic and, in some cases, possibly catastrophic. Design solutions for these assemblies need to perform thermally, but also in accordance with good moisture management practices. Moisture management should be considered in all exterior wall designs,



Figures 2 and 3 – Examples of thermal clips used for exterior insulated wall assemblies.



but it is of primary importance in the coastal climate of British Columbia, where the author of this article practices engineering. Current versions of ASHRAE 90.1 do not explicitly state its importance (as earlier versions did), but the standard's primary focus is energy-efficient design. As insulation levels increase and walls become more airtight, it becomes increasingly difficult for the assembly to dry out, which makes it even more important to make sure the assembly doesn't get wet in the first place. So reduced heat loss is important, as is proper management of wind-driven rain, air leakage, capillary action (pressure), and water-vapor diffusion. A wall or roof design that doesn't

consider or account for these can be subject to potential leaks or condensation within the assemblies.

These exterior wall assemblies must also perform structurally and economically; in other words, they need to be relatively cost-effective and not overly difficult to construct.

Following are some case studies using these thermal clips.

#### CASE STUDY ONE

Recently, our engineering design team was faced with a challenging building envelope remediation project in a healthcare facility. This structure had a history of building envelope

failures due to air and water leakage. It was originally constructed with insulation between the steel framing. To increase the thermal performance of the exterior walls and to enhance the airtightness of the building, the design team decided to have the air barrier/vapor retarder (also the weather barrier layer) and the insulation layer outside of the sheathing.

During the demolition phase, it was recognized that the deterioration to the existing steel framing and the interior components



Figure 4 – A layer of exterior insulation behind the Z-girts was secured to the fiberglass thermal clips of the building in Case Study One.



Figure 5 – The new wall claddings after completion of Case Study One.



Figure 6 – Installation of the thermal clip used in Case Study Two over self-adhered membrane.



Figures 7 – Clip used in Case Study Three with aerogel insulation.

was worse than expected. Due to the extent of deterioration to the existing sheathing, studs, and interior wall components, it was necessary to remove all wall components down to the framing. Another challenge was to properly scaffold and weather-protect the building during demolition, as this is a hospital setting. Since the building was required to remain operational during construction, it was necessary that strict infection-control procedures be established to safeguard patients and staff. The exterior walls and scaffolding area were fully enclosed, and the interior of the building was pressurized to prevent any contamination of the occupied space. The pressure was monitored at all times, and air quality testing was performed before, during, and after construction.

The new wall design incorporated specialized engineered wall cladding assemblies to allow for drying and drainage, while reducing thermal

bridging with fiberglass clips to reduce heat transfer. The new wall assembly consisted of a fiberglass-faced gypsum sheathing installed over the steel framing, a new self-adhered air barrier/vapor retarder (also the weather barrier layer) membrane installed onto the sheathing, and new fiberglass thermal clips connecting the cladding to the sheathing to reduce thermal bridging through the semi-rigid insulation layer. The cladding types utilized for this remediation project were fiber-cement panels and horizontal corrugated metal panels (Figures 4 and 5).

Challenges during the design and construction included providing proper structural support at all the joints in the new fiber-cement panels, and at transitions between wall cladding types. This required careful planning prior to installation of the fiberglass thermal clips and Z-girts. One of the disadvantages of this particular thermal clip is the lack of possible adjustment both laterally (side to side) and front to back, to allow for construction tolerances. Therefore, the clip must be shimmed if the exterior wall sheathing is not plumb.

#### CASE STUDY TWO

WSP Canada is also currently involved in a project that is using galvanized steel clips with a “thermal break” incorporated at the back of the clip (Figure 6). This project is the construction of a new healthcare building. The exterior wall construction is similar to Case Study One, with a self-adhered air barrier/vapor retarder (also the weather barrier layer) outside of the sheathing and semi-rigid exterior insulation. Some advantages were noted with regards to the design of these clips, the first being that they have a slot to allow for the installation of horizontal and vertical girts outboard of the clip. This allows the girt to be easily adjusted if the substrate is out of plane. It allows for the installation of both vertical and horizontal girts, if needed.

A couple of disadvantages were noted as well. Due to the material and its design, this clip doesn't provide the thermal effectiveness that other clips can provide. The design team may want to model the clip using a thermal transfer software and/or use thermal transfer equations to determine and confirm its thermal effectiveness. Several factors can influence the thermal effectiveness of the clip and exterior wall assembly. A small change in the exterior wall assembly's effective R-value could have a significant impact on the building energy model. While other clips come in multiple sizes, the "T-Clip" used on this project is only available in a depth of 4 inches.

### CASE STUDY THREE

Our team is also currently using a third type of thermal clip on a project on Vancouver Island. These particular clips are made of stainless steel and are paired with an aerogel product that can be placed on either end or both ends of each clip (*Figure 7*). Each aerogel layer has an R-4 value, and multiple layers can be used.

An advantage with this clip (similar to


the previously discussed thermal clip in Case Study Two) is the fact that it is adjustable. This gives installers the ability to adjust the clip to account for imperfections in the walls. These imperfections are common in renovated buildings with concrete, brick, and steel studs that are non-parallel or inconsistent with one another.

One of the disadvantages of this clip is its cost, as the materials used are fairly expensive.

### CONCLUSION

As stated, there are a variety of thermal clips from which to choose, but they are not necessarily created equal. It is up to the design and project team to research, test, and model the various types to determine which thermal clip is best for its upcoming project.

These types of wall assemblies, whether in new construction or building envelope remediation projects, will become more prevalent as the industry moves towards more energy-efficient buildings. These projects are challenging, but with careful planning, design, and proper review during

the construction processes, can be accomplished with great success. 



Guillaume Vadeboncoeur, PEng, LEED® AP

*Guillaume Vadeboncoeur, PEng, LEED AP, is a professional engineer with over 11 years of experience in the field. He is the building science group leader for the Fraser Valley and Southern Interior in British Columbia, Canada, for WSP Canada Ltd. He has managed several building science projects that include building envelope remediations, condition assessments, roof replacement projects, and wall monitoring. Vadeboncoeur attended Laval University and graduated with a diploma in mechanical engineering. He is president of the Western Canada RCI Chapter and the vice-chair of the ACECBC Building Engineering Committee.*

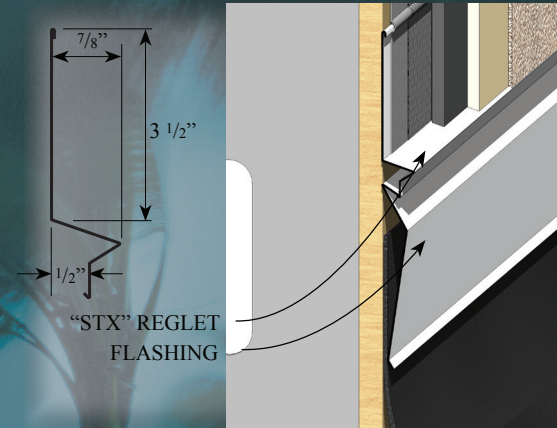
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