Breaking the Bridge

The recent and dramatic shift in expectation for significantly higher performance requirements addressing heat flow in roof and wall envelopes for metal buildings has been remarkable. The US is taking bold and necessary steps that will improve energy efficiency of residential, commercial, institutional, and industrial buildings.

The new and more stringent standards, that ultimately become law through adoption by our building codes, mandate that every element of the building envelope be evaluated for its impact on thermal performance and relative cost. Part of this process has been the evolution of "whole building" or "assembly" analysis, whereby each component is now evaluated as part of the whole. This has driven a transition in evaluating the thermal performance of components (R-Value) to that of the entire assembly (U-Factor).

This higher level of scrutiny has placed emphasis on conditions such as "thermal bridging," where highly conductive components (poor thermal insulators) of a roof or wall assembly short circuit the insulation system. Looking at the R-Value of the insulation alone is not enough. The influence of thermal bridging on the overall thermal performance must be considered.

The analysis of thermal bridging has led to the development of "thermal breaks" (a component of an assembly with low thermal conductivity) which mitigate the presence of highly conductive areas of the structure's envelope.

The concept is not new, but has become critically important in achieving the high levels of thermal performance now mandated by code. Thermal breaks are an integral part of tested assemblies that have been developed to be compliant with today's building envelope requirements.

Metal buildings typically have a much larger roof-to-wall ratio than other structures. As such, the thermal performance of the roof has a significantly larger impact on the overall thermal efficiency of the building envelope. Back in the seventies, when thermal blocks first became available for standing seam roofs, both were considered an extravagance because they added cost to the structure and were perceived to offer little return on the investment. Nothing could be further from the truth today. A standing seam roof, in combination with light density fiberglass insulation and thermal blocks, provides cost effective insulation options that comply with stringent codes for non-residential low-rise construction.

The standing seam roof continues to outperform other roofing options when properly insulated with low-density fiberglass and a thermal block, which establishes the required thermal break between the top flange of the purlin and roof panel.

Thermal blocks have evolved over the years and typically consist of a core material that is either expanded or extruded polystyrene. Encapsulated polyisocyanurate is also available. Typical specifications call for the thermal block to have a minimum R-value of 3.0 (ASHRAE 90.1-2013)

Metal buildings provide the highest value for non-residential low-rise structures. Part of this value is that they are easy to insulate with a relatively inexpensive insulation (cost per installed R-Value). Standing seam roofs, with fiberglass insulation and thermal blocks, lead that value proposition and remain the most cost effective method to meet even the most demanding requirements of the new codes.

All single and double layer insulation systems under a standing seam roof today should use a thermal block. The performance/cost difference between one with and without is staggering.

For many buildings in moderate and colder climate zones, it is necessary for the insulation system to fill the purlin cavity. There are two effective ways to accomplish this requirement. One is a Long Tab Banded (LTB) system (filled cavity), where banding is fastened to the bottom flange of the purlin, and the first layer of faced insulation rests upon the banding in between the purlins. A second layer of insulation is rolled out above the 1st layer, perpendicular to the purlins, with a thermal block installed on top of the insulation, directly above the purlins. The other, a Liner System, also fills the cavity, but uses a continuous vapor barrier that covers an entire bay and is supported by banding (and, after installed, can provide fall protection that meets OSHA requirements). Fiberglass insulation and thermal blocks are installed in a similar manner as with the LTB.

Thermal blocks have traditionally been used exclusively in the roof but can now be found in high performing wall assemblies as well. Thermal tape, a closed cell product, has also proven effective in wall applications where fiberglass insulation is present.

Thermal breaks contribute significantly to the capability of the referenced code compliant solutions.

A cross-section of the Skyliner™ Liner System (LS) consisting of a single vapor barrier covering the entire bay, supported by banding at the bottom flange of the purlin. The first layer of fiberglass is installed in between the purlins supported by the vapor barrier. The second layer as with the LTB system is installed over and perpendicular to the purlins with the thermal block above the purlin.

This warehouse uses a two-layer Filled Cavity (FC) system consisting of a first layer of fiberglass laminated to the vapor barrier that is installed from the top between the purlins supported by banding attached to the bottom flange of the purlin. The second layer is unfaced and installed over and perpendicular to the purlins with the thermal block above the purlin.

<u>About the Author</u>

Mike McLain is the General Manager of Bay Insulation Systems Inc., the largest laminator of Metal Building Insulation in the United States. Bay offers a multitude of roof and wall insulation systems (Skyliner™ with OSHA compliant Fall Protection, OptiLiner™ without Fall Protection, and LTB) providing cost effective solutions for present and future code requirements. For more information, visit www.bayinsulation.com or www.skylinersystems.com.