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At the Breaking Point

Working with Poured-and-Debridged Thermal Breaks

Before I begin to discuss thermal breaks, I want to dedicate this column to William Brimmer who passed away on May 4. Brimmer was chairperson of the ASTM task group on thermal barriers and was instrumental in the development of the proposed Standard Specification for the Structural Performance of Thermal Barriers in Aluminum Fenestration Products. Brimmer’s committee meetings were well-attended and were infamous for being the most heated and action-packed. Even those who disagreed with Brimmer had to admire his passion and dedication to his work.

Thermal Conductance

One of the biggest disadvantages of aluminum as a window frame material is its high thermal conductance. Aluminum is an excellent conductor of heat. Thus, it can affect the U-rating of a window unit greatly. In extreme climates aluminum windows often become cold enough to condense moisture or frost on the frames. Thermal breaks are utilized to reduce the conductance of heat across the aluminum frame. By splitting the aluminum components and separating the interior and exterior sections with a less conductive material, the U-value and condensation resistance of aluminum windows can be improved greatly.

However, in hot climates solar heat gain is far more problematic than conductive heat transfer, so improving the performance of the glazing material is usually a better investment. One of the reasons for this is the relative instability of some of the thermal break materials at high temperatures and moisture conditions.

Figure 1: Shrinkage of poured-and-debridged thermal break at frame corner.

Poured-and-Debridged Thermal Breaks

The original and most common method of thermal break is called “poured-and-debridged.” This process involves pouring a polyurethane resin into a raceway located within an aluminum extrusion. Once the material cures, the aluminum bridge at the base of the raceway is milled away leaving only the plastic connection between the inner and outer aluminum sections.

A few years ago our company became involved in a project in South Florida that included new casement windows. Within three years of the building's completion water leakage was observed below the windows we were asked to investigate. While selecting a specimen for testing, we noted gaps in the corners of the frames at the thermal breaks. Inspection revealed contraction of the thermal break at approximately 70 percent, of the windows creating gaps of up to ½ inch (see Figure 1). During our review of shop drawings we noted the subcontractor had provided the poured-and-debridged thermally broken windows although they were not specified.

The window manufacturer was very quick to respond and sent mechanics to clean and seal all of the frame corners. At the fixed windows, interior-glazing beads were removed to provide access to the frame corners and in many cases were damaged and replaced with new ones. The failure was attributed to the high heat and humidity in South Florida.

Thermal Break Variations

Due to similar problems associated with this type of thermal break, including shrinking and cracking, variations of the thermal break were developed. One variation is "lancing" or mechanically locking the aluminum to the polyurethane by either staking the aluminum at regular intervals (approximately 11/2 inches) or abrading the interior of the raceway. The stake or abraded sections increase the bond of the polyurethane to the aluminum, which reduces expansion and contraction of the polyurethane and reduces shrinkage.

As an alternative to poured-and-debridged thermal breaks, manufacturers developed a mechanically attached thermal break in which a pair of rigid plastic extrusions (commonly known as Iso-Bars or Insubar) are crimped into slots provided in the aluminum frame members. Testing has shown that Iso-Bars are less susceptible to shrinkage.

In addition, studies have shown that certain types of polyurethane (polyesters) are hydrolytically labile and are not recommended for wet or high-moisture conditions. Polyester poly-urethane not only absorbs water physically but also consumes water chemically through hydrolysis until the polyurethane is destroyed.

In contrast, polyether-based poly-urethane has demonstrated that it is hydrolytically stable (shore A hardness remains above 30 after 28 days aging at 100 C and 96 percent RH), does not absorb water and has increased heat-stability characteristics.

Items to Consider

Before providing a thermally broken window, consider the following:

1. Is a thermal break necessary?
   Eliminate them if possible, especially in hot climates.
2. The Iso-Bar system is less prone to heat shrinkage and is recommended for use in hot climates.
3. For poured-and-debridged thermal breaks, avoid polyester-based polyurethane, which is not recommended for wet/high-moisture conditions. Testing of polyether-based polyurethanes shows they are not affected by moisture and have increased heat stability.

Keep in mind that tens of millions of linear feet of thermally broken material is manufactured each year. Much of it is performing perfectly. However, there is mounting concern over the long-term effects of heat and moisture on the traditional poured-and-debridged thermal break.

Manufacturers are improving the product continually. Independent testing, quality control in manufacturing and physical testing often is enough to create a reliable long-lasting product. However, knowing the limitations of a material or product is critical to its successful use. An improperly specified material creates problems for everyone: the owner, the contractor and the manufacturer.

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