UAA Professional Development Seminar Series

Thermal Modeling and Testing of Building Envelope Assemblies

Presented by Scott Hamel

Abstract: The large temperature differentials between inside and outside spaces in Alaska (>100^{o}F) has triggered the use of thermal-break details for envelope point protrusions for decades, mostly to prevent condensation on interior structural members. This has been done, however, using engineering judgment, and, prior to this study, no experimental or computational analysis has been conducted on the thermal or structural effectiveness of these details.

This presentation will outline a study conducted on thermal bridges and thermal break details for point penetrations in the building envelopes, such as with steel end-plate moment connections used in canopies or rooftop mechanical units. The details were analyzed with Abaqus in three-dimensional finite-element thermal models that determined heat-flow through the bridge/break detail and their temperature factor, an indicator of condensation potential. The details were then experimentally tested in a "Hot Box" that simulated indoor and outdoor air temperatures and measured heat flow and surface temperatures. The heat flow and temperature factors determined in experimental testing agreed well with the thermal models. It was found that in some configurations with relatively thin break materials, the addition of the thermal-break detail actually increased the heat flow of the detail. However, relatively thick composite thermal breaks were effective at reducing both heat flow and condensation potential. Unfortunately, for softer polymers, such as Neoprene, these were found to be structurally inadequate.

Biography: Dr. Scott Hamel grew up on the seacoast of New Hampshire, and spent his summers in the NH mountains working as a staff member at the Hidden Valley Scout Reservation. After high school, he pursued a degree in Civil Engineering from Worcester Polytechnic Institute in Massachusetts, and worked part-time as a surveyor and draftsman. After earning his B.S. degree in 2000, he began his career as a bridge inspector and roadway designer in Boston, working on contracts from MassHighway, MBTA and the City of Boston. In 2003, he moved to Colorado to pursue a Master's in Civil Engineering with an emphasis in structures at the University of Colorado at Boulder, which he earned in 2005. Dr. Hamel was employed for three years by S.A. Miro in Denver as a Structural Engineer designing multi-story commercial and government buildings, including hospitals, office buildings, and museums, and earned his Professional Engineering (PE) license in 2006. In 2007, returned to school and in 2011 completed his doctorate at the University of Wisconsin-Madison in structural engineering. Dr. Hamel became a faculty member at UAA in 2011 and has since taught structural design and analysis courses, including Steel Design and Structural Analysis. He has conducted research projects in Wood-plastic Composites, High-mast Light Pole anchor nuts, strength or freshwater lake ice, thermal breaks, and Structural Insulated Panels (SIPs). He is a registered Professional Engineer in Alaska and is active in the Anchorage chapter of SEAAK.

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