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To: Research Subcommittee??

From: Dragan Curcija

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CC: Dariush Arasteh, John Hogan

Re: Current Simplifications in Fenestration Computer Models

The following is a list of simplifications built-in in existing computer models of heat transfer in fenestration systems. These simplifications are necessary to enable cost effective simulation of thermal performance of fenestration products by certified simulators. It is believed, and in many cases confirmed that the cumulative effect of these simplifications is not greater than ±10%, which is currently required criteria in order for simulation to validate against experimental results. However, for certain class of products (i.e., projecting products, highly conducting products, etc.) this criteria often can not be satisfied, and therefore more accurate algorithms, with less simplifying assumptions need to be introduced.

This memo will attempt to list all of the simplifying assumptions currently in use, and their effect on overall U-factor. Very often it is difficult to predict quantitatively what is the effect, but nonetheless, it is possible to predict qualitatively. The following is a list of simplifying assumptions categorized by the tendency to under-predict or over-predict U-factor and/or Solar Heat Gain Coefficient. Down pointing arrow means tendency to under-predict, and upward pointing arrow means tendency to over-predict. Left/Right pointing arrow means canceling effect or negligible over or under prediction.

New approved simulation tool THERM 2.0 has a capability to accurately model radiation heat transfer on the boundary and convection and radiation heat transfer in glazing cavities.

Description of simplifying assumption	c	t
• 2-D Heat Transfer Modeling Instead of 3-D Modeling – 2-D Radiation heat transfer effects – 2-D Convection heat transfer effects – 2-D Conduction heat transfer effects	 ⇓ ⇑ ⇑	⇑
• Simplistic Radiation Boundary Condition (I.E., No Detailed Radiation W/ View Factors) – Indoor – Outdoor	 ⇑ ⇑	⇑
• Simplistic Convection Boundary Condition – Indoor – Outdoor	 ⇑ ⇑	⇑
• Simplistic Convection Heat Transfer In Glazing Cavities	⇔	⇔

• Frame cavities
– Convection heat transfer assumptions
  – Largest dimension and grouping
  – Fixed ΔT
  – Jamb sections not treated as vertical cavities
– Radiation heat transfer assumptions
  – Fixed ΔT
  – Infinite parallel plate assumption
	
	⇑
	⇑
	⇓
	
	⇑
	⇑
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• Vented Frame Cavities – Convection heat transfer assumptions – Radiation heat transfer assumptions	 ⇑ ⇑	⇑
• Protruding Hardware and Other Point (Non-Continuous) Thermal Bridges	⇓	⇓
• Ignoring of Contact Resistance	⇑	⇑
• Center of Glass (i.e., 1-D) Solar Heat Gain Applied Everywhere	⇑	⇑
• Ignoring of Specimen Flanking Loss	⇓	⇓
• Glazing Deflection – Inflection – Outflection	 ⇓ ⇑	⇓*

Note: * Usually in this direction