

Use numerical modeling for estimation and improvement test method of measuring the steady thermal transmittance of fenestration systems

The *main idea* is to use numerical 2Dim and 3Dim modeling for reproducing testing procedures for CTS and fenestration specimens given in standards (ASTM C-1199 & NFRC 2002 “Test Procedure ...”) that will allow us to clarify the quantities in experimental procedures that are/or can be source of errors for ideal (numerical) case with dimensions, geometry and thermal and environment properties close to real hotbox and correspondingly for real hotbox.

The numerical modeling gives us not only information about temperature distribution in panels and specimens but also information about heat flux and heat transfer coefficient distributions on all specific surfaces. This information can help us better understand heat transfer features in hotbox and give us answer how to improve measurement accuracy of fenestration products.

For example, it can help us to answer on questions:

What method calculating equivalent temperatures is preferable and under which circumstances – method CTS or area weighted temperatures (ASTM C-1199 & NFRC)?

Need to count surround panel edge heat losses (as in ISO12567) or need not?

Need to place fenestration a flush with inside surface of surround panel (as in ISO12567) or not?

What gives us more accuracy – calculation of surround panel area weighted temperature using the whole panel area or using division of the panel on specific parts and area weighted temperatures of those parts?

Answer on the analogue question about CTS panel we also need to know.

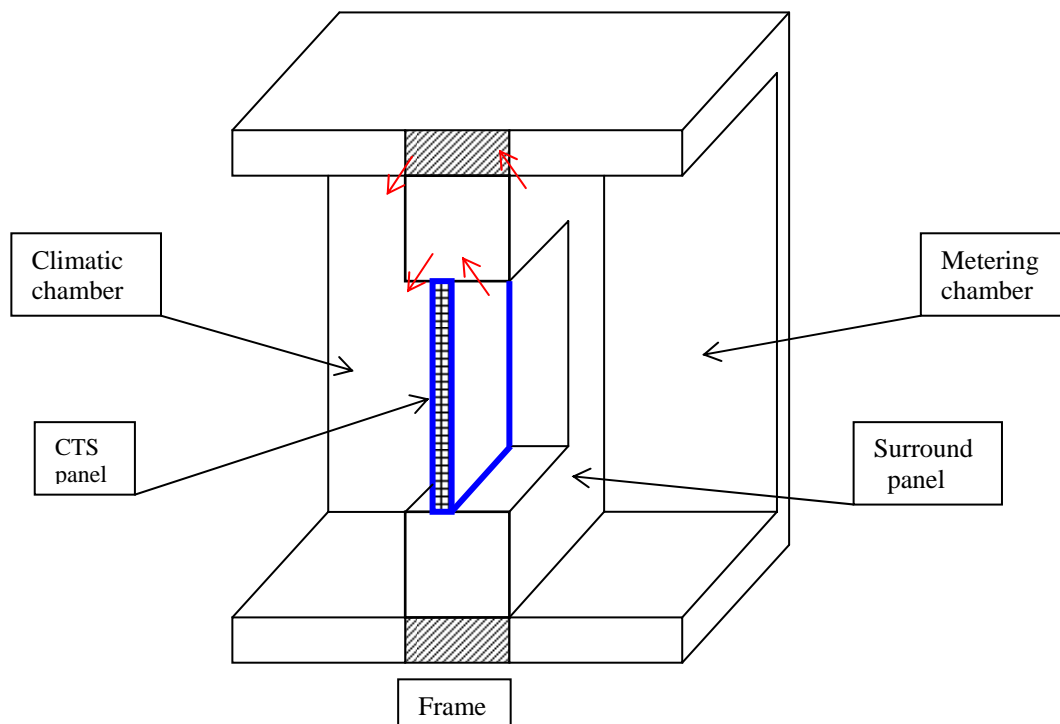


Figure 1. Scheme of 3-Dim conduction model of calibrated hotbox with CTS panel.

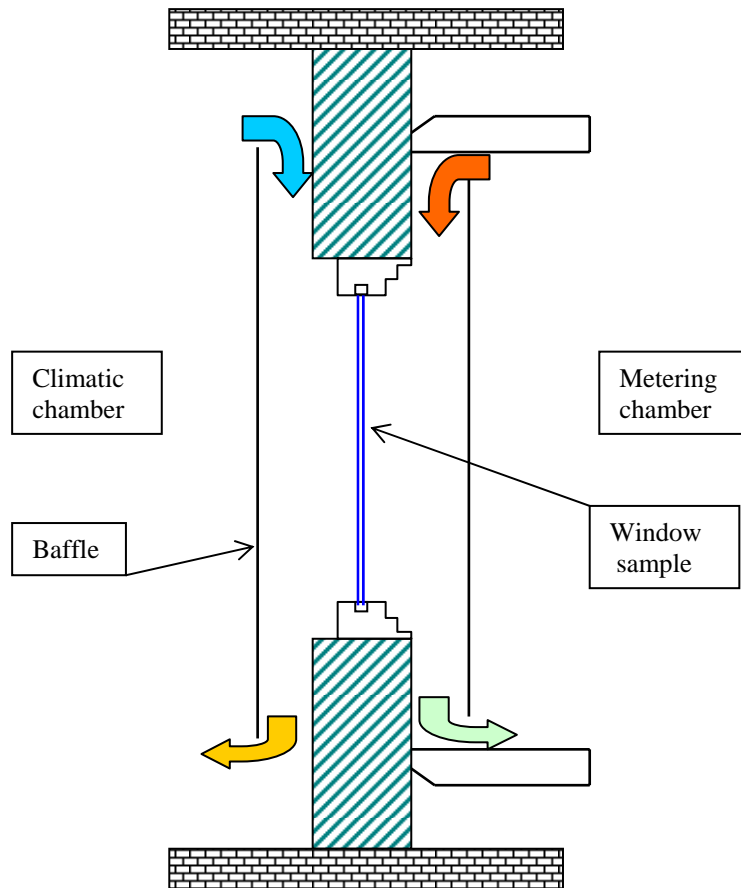


Figure 2. Scheme of 2-Dim convection & radiation model guarded hotbox with fenestration product.

The weak place in hotbox method when it is applied to strongly inhomogeneous products (e.g. fenestrations) is determination of heat transfer coefficients on glazing surfaces using CTS panel as a sample. The comparison between modeling results and direct measurements in hotbox allows us to make decision about using of heat flux meters on specific parts of glazing as alternative approach to measuring thermal properties of fenestrations in hot box.

Needed tools for accomplishing of this work:

Software:

Fluent 6.0, Gambit 2.0, Therm 5.2.

Apparatus:

Heat flux meters, air velocities and temperature sensors with measured apparatus.

Expected results:

The method of creating virtual hotbox (ViTTeF) and getting results for fenestration products.

The suggestions for refinement and improvement of the testing standards.