Development of the Simulation Procedure for Garden House Windows Summary page

TITLE: Development of the Simulation Procedure for Garden House Windows (08-102-SP)

Proponent: *Roland Temple, AZS Consulting; D. Charlie Curcija, Carli, Inc.*

Date: *02/04/08*

BACKGROUND:

Garden house windows (GHW) are fenestration products that deeply project to outside and create glazed space on the inside where flowerpots or similar decorative objects can be placed. Currently this class of products can not be simulated for NFRC certification purposes. These products are not very common and so far there was an assumption that the upgrade of simulation models would be prohibitively expensive, requiring in effect 3-D numerical models.

NFRC provides procedure for so called projecting products, where detailed radiation model is believed to contribute to increased accuracy and improved validation with measurements. During the NFRC research project on the convection heat transfer for projecting and highly conducting fenestration products (Carli 2005), a single garden house window was modeled using unique approach with radiation surfaces and presumed convective surface heat transfer coefficient, which greatly simplifies modeling procedure. The agreement between measured results and simulated results was remarkably good (to within 2%). Because the data was available only for a single product, it was considered that this result may be a coincidence and it was not extrapolated to other similar products. If the study was expanded to additional green house windows, new cost-effective modeling approach for these devices could be developed.

OBJECTIVES:

Develop new simulation procedure for garden house windows, utilizing “radiation surface” approach, outlined in Carli (2005). Conduct 3-D convection and radiation numerical modeling and propose new convective surface heat transfer coefficients, based on numerical model. Also, validate the use of 2-D radiation enclosure model in THERM for this class of deeply projecting products. Validate new simulation procedure with measurements in a hot box. Develop guidelines for the future measurement of these products, based on the experiences from this study.

BENEFITS:

Extension of the existing NFRC simulation procedure to the products that are more substantially projecting than skylights or standard windows will provide viable path for the garden house window class of products and any future products that may exhibit higher than usual projection.

SCOPE:

Using the characteristic geometry of the garden house window, developed from the typical garden house windows (GHW), available on the market, develop 3-D numerical model of convection and radiation heat transfer and obtain heat transfer rates and temperature distributions from this model. Validate 3-D numerical models against the careful, research

level measurements, where critical surface temperatures and/or heat fluxes are recorded and compared to the numerical model.

Propose 4-6 actual garden house windows and develop their THERM models using the "Radiation Surface" approach from Carli (2005) and apply newly calculated surface convective heat transfer coefficients.

When making selection of typical garden house windows, use the following guidelines:

- Select 2-3 different frame materials (i.e., Aluminum, PVC, thermally-broken Aluminum)
- Select 1-2 glazing options

The total number of specimens, including glazing options would be up to six. Coordinate this task with the known manufacturers of GHW. Once the selection of the specimens is made, prepare progress report, including the description and drawings for the specimens and submit it to PMTG for approval.

Measure the typical garden house windows in a hot box and record their U-factors, surface temperatures and note any significant issues with the measurement of those products. All measurements shall be fully documented and all raw data provided. In addition to the raw data, standardized results will also be calculated using the existing NFRC 102 procedure (NFRC 2004). Because of the deep projection, it is expected that perpendicular flow direction will provide better choice for the cold side.

After the completion of THERM modeling and hot box measurements, compare results and draw conclusions about the agreement and/or ways to achieve agreement if it was not achieved after the initial modeling.

Provided that the measurements and simulation validate consistently for all of the products, specific language will be developed for inclusion in the future editions of simulation manual and recommendation for the language in NFRC 100 will be provided.

DELIVERABLES:

1) Progress reports at NFRC meetings
2) Final Technical Report at the end of the project
3) Technical Paper for peer review

ESTIMATED COST:

$80k

ESTIMATED DURATION:

12 months

POTENTIAL CO-SPONSORS:

Garden House Windows manufacturers

SOLE SOURCING:

None.

REFERENCES:

Carli, 2005. “Effect of Surface Heat Transfer Coefficients on U-Factors for Projecting and Highly Conducting Fenestration Products.” Technical Report. Carli, Inc. Narch 8, 2005.

NFRC, 2004. NFRC 102-2004, Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems, National Fenestration Rating Council, Silver Spring, MD, 2004