



# **Carli, Inc.**

18 Tanglewood Rd.  
Amherst, MA 01002

TEL: (413) 256-4647  
FAX: (413) 256-4823

home@fenestration.com  
<http://www.fenestration.com>

## **Research Proposal:**

---

### **TREATMENT OF DOUBLE-SASH, SLOPED, SINGLE-GLAZED, AND STRUCTURAL GLAZING FENESTRATION PRODUCTS IN CMA METHODOLOGY**

---

***Proposal submitted to :***

**National Fenestration Rating Council, Inc.**

8484 Georgia Avenue, Suite 320  
Silver Spring, MD 20910

In response to NFRC request for proposals dated April 30, 2007

***Proposal submitted by:***

Dr. Charlie Curcija, President

***Carli, Inc.***

18 Tanglewood Rd.  
Amherst, MA 01002

**May 30, 2007**

## BACKGROUND

The NFRC CMA methodology (NFRC 2004, Curcija 2004) covers a majority of fenestration products. This procedure is being developed with a focus on typical non-residential products with a target implementation date of late 2008. It is believed that this methodology applies equally well to a smaller number of non-standard systems, however this has not been proven yet. It is important that as many fenestration products as possible are covered by this procedure to minimize exceptions and special cases. These systems have been identified by a Technical Issues Task Group as potentially problematic and solutions have been sought. The aim of this project is to investigate if the non standard products proposed in the bid can be satisfactorily handled by current CMA methodology or not.

## OBJECTIVE

The objective of this project is to simulate a selected group of non-standard products (listed below) using both standard THERM/WINDOW and CMA methodologies to confirm that these products can be confidently simulated with the CMA methodology. If the CMA methodology does not produce satisfactory results for some or all of these products, the proposed alternate course(s) of action will be suggested and recommendations for further research to resolve any discrepancies will be provided.

The projects considered through this proposal include:

- Single Glazing
  - This is to take into account products with a low emissivity coating on the interior glazing surface as well as glass / polycarbonate composite products with low conductivity.
- Structural glazing
  - These applications can utilize deep sightlines on the glazing as well as deep structural joints.
- Sloped Glazing (slope of 20° or less)
  - By code, laminated glass is required for single glazing or the interior pane of an IG.
- IG incorporating a laminate layer
  - One or both panes may be laminated due to security/acoustic considerations.
- Double Sash Configuration
  - This must consider installations with IG or single glazed exterior, a wide airspace, and single glazed interior pane (including interior/exterior storms and standard triple glazing). Any of these panes may be laminated/lowE.

## APPROACH

Based on the specific requirements in the RFP, this research project will be divided into the following 4 tasks:

1. Identification of typical fenestration products
2. THERM and WINDOW modeling of typical fenestration products
3. Modeling of typical fenestration products using CMA methodology
4. Conclusions and final report

A more detailed description of the proposed tasks is outlined below.

### **Task 1: Identification of potentially problematic fenestration products**

Typical single glazing, structural glazing, sloped glazing, IG incorporating a laminated layer and double-sash fenestration products will be identified and all necessary information required for simulation will be collected from non-residential manufacturers so that these products can be modeled for their thermal and solar-optical performance. A matrix of glazing and spacer options that will be modeled with these fenestration products will be proposed. The identified products along with the glazing and spacer matrix will be sent to the PMTG and NFRC staff for their review and approval.

### **Task 2: THERM and WINDOW modeling of fenestration products**

Based on the recommendations from the PMTG, the fenestration products will be modeled in THERM and WINDOW (i.e., conventional modeling) with all of the selected configurations, including all glazing options. Simulated thermal and solar optical performance for each product and associated options will be tabulated.

### **Task 3: Modeling of fenestration products using CMA methodology**

After the successful completion of THERM and WINDOW modeling, the THERM models will be modified and modeled using the CMA methodology (i.e., Best/Worst options). The data will be entered into a program that incorporates the CMA methodology FENSIZ. After the CMA based simulations are completed, the values for the same matrix of options and products will be tabulated and the results compared with conventional modeling results obtained in Task 2.

### **Task 4: Conclusions and final report**

Based on the results of this comparison, the level of agreement will be determined and any potential issues will be identified. If there are larger than expected discrepancies (i.e., more than 0.02 Btu/(hr-ft<sup>2</sup>-F)), possible causes will be investigated and further course(s) of action will be recommended, including potential follow-up research projects.

**DELIVERABLES:**

- Progress Reports at the NFRC meetings
- Draft report to the PMTG with identified products and conventional THERM and WINDOW modeling results
- Draft report to the PMTG with the CMA methodology results and comparison with THERM and WINDOW modeling results
- Final report with recommendations delivered at an NFRC Research Subcommittee Meeting. This does not entail a peer-reviewed paper at this time, due to the limited scope of the project.

**MILESTONES:**

- Progress report for Task 1: ..... 1 months from the start of the project
- Progress report for Task 2: ..... 2 months from the start of the project
- Task 3 report: ..... 4 months from the start of the project
- Task 4 report: ..... 6 months from the start of the project
- Bi-monthly conference calls with PMTG, when not coinciding with one of above milestones

## BUDGET

### **Direct Costs:**

#### **A. Personnel:**

- Principal Investigator (1/2 person-month) .....	\$4,000
- Project Engineer/Simulator (1/6 person-year).....	\$10,000
- Secretarial support (1/4 person-month) .....	\$500
<u>Total Personnel</u> .....	<u>\$14,500</u>

**Total Direct** ..... **\$14,500**

### **Indirect Costs:**

- Overhead (1/3 of direct cost).....	\$4,830
--------------------------------------	---------

**Overall Total** ..... **\$19,330**

## FINANCIAL TERMS:

Advance payment at the beginning of the project: .....	20%
Interim payment at the completion of Task 2:.....	40%
<u>Task4/ Final report: .....</u>	<u>40%</u>
<b>Total</b> .....	<b>100%</b>

**REFERENCES:**

- NFRC. 2004. "NFRC 100: Procedure for Determining Fenestration Product U-factors". National Fenestration Rating Council. 2004.
- NFRC. 2004. "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence". National Fenestration Rating Council. 2004.
- LBNL. 2003. "THERM5 - A PC Program for Analyzing Window Thermal Performance of Fenestration Products", Berkeley CA: Windows and Daylighting Group, Lawrence Berkeley Laboratory, 2003.
- LBNL 2003, "WINDOW5 - A PC Program for Analyzing Window Thermal Performance of Fenestration Products", Berkeley CA: Windows and Daylighting Group, Lawrence Berkeley Laboratory, 2003.
- Curcija, D.C.; Manteghi, M.; Bhandari, M.S.; and Shah, B.V. 2004. "Component Modeling Methodology for Predicting Thermal Performance of Non-Residential Fenestration Systems". *Thermal Performance of Building Envelopes IX Conference*. Clearwater Beach, FL. December 2004.
- DBS. 2006. "FENSIZ: A Windows Based PC Program for Rapid Calculation of Thermal Performance of Fenestration Products in Accordance with Component Modeling Procedure". *User's Manual and Program Description*. DesignBuilder Software. 2006.
- NFRC. 2004. "NFRC 100, Section 5.6: 5.6 Non Residential and High Rise Residential Building Fenestration Products". *National Fenestration Rating Council*. 2004.