

## **OBSTACLES TO THE DEMOCRATIZATION OF CAE FOR THE FENESTRATION PRODUCTS INDUSTRY**

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### **KEYWORDS**

Democratization, CAE, FEA, nonlinear analysis, fenestration system, accuracy, product certification policy, building code...

### **ABSTRACT**

Being indispensable elements of living space, offering views, ventilation and access to dwellings, fenestration systems are lately desired to meet more stringent regulation to meet energy code and higher structural rating than before. Nonetheless, windows and doors are considered the main source of energy loss and susceptible segments of buildings to devastating natural hazards such as hurricanes and tornadoes. Hence, there is a great need to develop rapid and effective tools to assess the performance of new product design for both thermal and structural aspects of these products.

Building products manufacturers, however, are viewed as one of the most cautious groups in welcoming emerging technology and science. For this reason, FEA/numerical simulation in evaluating their structural performances, i.e. air, water, and structural ratings of the window/door products is used to a limited extent of product development/certification process prior to physical testing. Only thermal simulation for the insulation performance of fenestration systems has been implemented

by NFRC (National Fenestration Rating Council) for its effectiveness and cost-saving opportunity offered by this technology.

This presentation intends to discuss challenges and potential solutions in expanding the horizon for the use of FEA as a rapid assessment tool for both thermal and structural performance and democratization of CAE focusing on this specific industry. For this purpose, a post-yielding behavior of steel/aluminum reinforcement within vinyl frames of an exterior window under the simulated wind load is studied using nonlinear FE analysis to predict the extent of permanent deformation (performance criterion) after loading cycle. Due to the complexity of the problem by the existence of nonlinearity in geometry, material properties, and contact conditions, a solid verification and validation approach to theory, FEA modelling, and testing is crucial to provide the reliable prediction to assist decision making on product design.

A successful demonstration of predictive capability of FEA/simulation for the performance of fenestration systems, the democratization of CAE will speed up through the manufacturers and simulation/test labs and urge code officials of AAMA (American Architectural manufacturers Association) to implement FEA as a standard process to represent many product families based on the prediction of a validation sample.