FIU Wall of Wind
NHERI Experimental Facility

Scope of Work

Codification of wind-induced loads on complex building shapes

Florida Department of Business and Professional Regulation

Florida Building Commission

And

Laboratory for Wind Engineering Research (LWER), Extreme Events Institute (EEI)

Florida International University (FIU)

Project Lead: Ioannis Zisis

1. Introduction

The US is annually impacted by wind hazards including hurricanes, tornado, and thunderstorms events that cause damages to buildings and lifelines (e.g. power, communication, transportation, and water systems). Those damages result in fatalities and injuries and extensive economic losses. Property Claim Services report that U.S. insured catastrophe losses between 1996 and 2015 exceeded $400 billion. About 80% of the losses are caused by hurricanes, tornadoes and other wind events.

Wind engineering research is directly associated to the above mentioned extreme wind events. Wind-structure interaction is a special field of engineering, which has as a scope to study the wind effects on buildings. Several studies were conducted specifically to evaluate the effect of wind action on structures, such as residential buildings and other shared public spaces. The contribution of both wind tunnel experiments and full-scale field monitoring on the development of modern wind standards and building codes of practice is of great significance.

A significant portion of wind engineering research focuses on the wind-induced loading on structures and on the codification of the research findings. A key component, that has not yet been investigated adequately, is the effect of building shape on the local and overall wind-induced load. This issue is directly related to the codification process of wind tunnel experimental work and consequently the improvement of current wind standards and building codes.

Most of the fundamental wind tunnel studies have been carried out on simple rectangular buildings. In these studies, small scale rigid models with a large number or pressure taps have been tested in

various Atmospheric Boundary Layer (ABL) conditions, such Open, Suburban and Urban terrains. The tests generated a very large number or data that has been instrumental in the development of modern wind design specifications. Furthermore, the design procedure described in these standards have been adopted by national and state building codes. The consideration of irregular shaped buildings has not been examined in previously conducted studies. The available references either discuss shape optimization procedures for tall buildings or computational approach for low-rise buildings.

The proposed research will evaluate the wind-induced loads on irregular shaped low-rise buildings. The data collected through physical testing will be analyzed and will generate codified wind design loads that can be directly compared to those in existing wind standards and building codes. Ultimately, the proposed research will contribute to improved building codes and windstorm resilient residential construction.

2. Scope of Work

The proposed research will follow a parametric experimental approach that will allow to quantify the effect of complex, yet realistic, single family home floor plans. The tasks that will comprise the research plan are the following: Task1: Identification of principal building shapes; Task 2: Experimental Investigation on Scaled Models; Task 3: Codification of experimental findings.

Task 1: The scope of this task is to identify the most common home shapes in residential communities. For this purpose, broadly available satellite imagery will be utilized to match actual properties to a finite number of basic target shapes (e.g. L, T, U shape etc.). Major metropolitan areas will be selected for this exercise, such as Miami, Tampa and Orlando. The findings from this task will dictate the experimental protocol for Task 2 that is discussed below.

Task 2: In this Task, small-scale models will be constructed to represent these typical homes and will be tested at the Florida International University (FIU). The models will be instrumented with a large number of pressure taps that will allow to capture the wind-induced pressure on the building envelope. The models will be mounted on a turntable to be able to vary the wind angle of attack and gather data for a large number of wind directions.

Task 3: The large amount of pressure data collected in Task 2 will be analyzed to extract local and area-averaged design pressure coefficients (i.e. Component and Cladding based on ASCE 7 definition). The analysis will follow the codification procedure that generates ASCE 7 format design curves.

3. Staffing

Personnel

PI: Ioannis Zisis, Associate Professor, CEE, Florida International University, USA

Graduate Student: TBD, Florida International University, USA

4. Method of Payment

A purchase order will be issued to the Florida International University. This project shall start on date of execution of the purchase order and end at the midnight on TBD. This purchase order shall not exceed $TBD and shall cover all costs for labor, materials and overhead. Payment will be made for the study after the Program Manager and the Florida Building Commission's Hurricane Research Advisory Committee have approved the final report. Additionally, the Contractor agrees to provide additional documentation requested by the Program Manager to satisfy all payment and audit requirements.

5. Deliverables

a. An interim report shall be prepared and delivered no later than TBD. The interim report shall contain the deliverables of Task 1 and any preliminary findings from Task 2; i.e. a detailed description of the testing protocols and model parameters adopted in the WOW-EF tests. In addition, the interim report shall be formally presented to the Florida Building Commission's Hurricane Research Advisory Committee at a time agreed to by the Contractor and Department's Program Manager. The due date may be extended with the approval of the Department of Business and Professional Regulation's ("Department") Program Manager.

b. A final report shall be prepared and delivered no later than TBD. The final report shall contain deliverables of the first three Tasks as discussed in Section 2. The final report shall be formally presented to the Commission's Hurricane Research Advisory Committee at a time agreed to by the Contractor and Department's Program Manager. The due date may be extended with the approval of the Department of Business and Professional Regulation's ("Department") Program Manager.

6. Financial Consequences

FIU LWER/EEI is solely responsible for the satisfactory performance of the tasks and completion of the deliverables as described in this Scope of Work. Failure to complete the tasks and deliverables in the time and manner specified in Sections 2 and 5, shall result in a non-payment of invoice until corrective action is completed as prescribed by the program or contract manager.

7. Program Manager

The Program Manager for this project is Mo Madani. Mo Madani's email address is Mo.Madani@myfloridalicense.com and his phone number is 850-717-1825.