**Scope of Work**

**Wind-induced loads on ground-mounted equipment**

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

# Introduction

Residential structures need to cater to different climates and occupancy requirements and needs. As a result, a modern home is equipped with valuable and critical mechanical equipment that is mostly related to heating and/or cooling but often extends to solar energy and water harvesting, alternative fuel sources (e.g. gas, propane, power generator) and secondary structure equipment (e.g. pool mechanical equipment). This equipment is placed in the proximity of the house and is exposed to the same – extreme – loads as the main structure itself. Wind related damage has been documented in the past making the repair or replacement of such equipment an additional financial burden for the homeowners. Most importantly, some of this equipment might have a critical role during and after an extreme wind event; for instance, maintaining the power supply through a gas generator to cool the home and provide basic functions.

The latest Florida Building Code (2020) includes an exception clause for the design of such equipment in both sections 1609 and 1620 (HWVZ) and redirect the user to the 2007 version of the FBC:

*Exception: Exposed mechanical equipment or appliances fastened to a roof or installed on the ground in compliance with the code using rated stands, platforms, curbs, slabs, walls, or other means are deemed to comply with the wind resistance requirements of the 2007 Florida Building Code, as amended. Further support or enclosure of such mechanical equipment or appliances is not required by a state or local official having authority to enforce the Florida Building Code.*

The 2007 FBC (Building – 1609.1) subsequently redirects the designer to the American Society of Civil Engineers (ASCE) 7-05, Chapter 6. In that – older – version of ASCE 7, section 6.5.15 deals with the design wind loads on other structures and recommends the use of equation 6-28 in conjunction with Fig. 6-21. Nevertheless, the recommended force coefficients have not been based on scientific research specific to ground-mounted equipment and rather refer to some limited studies that were carried out for rooftop mounted equipment.

Remarkably, the recently released 2022 version of the ASCE 7, has kept almost unaltered the design guidelines for ground-mounted equipment in *Section 29.4 Design Wind Loads: Other Structures*. Equation 29.4-1 now includes the wind directionality factor (Kd) and refers to Fig. 29.4-1 for the selection of the appropriate force coefficient. This figure still provides the same recommended Cf values as in the previous ASCE versions, including the ASCE 7-05. An important addition though, is that there is more background information that has been included in the Commentary chapters and in particular Section C29.4:

*Figures 29.4-1, 29.4-2, and 29.4-3. With the exception of Figure 29.4-3, the pressure and force coefficient values in these tables are unchanged from ANSI A58.1-1972 (ANSI 1972). The coefficients specified in these tables are based on wind tunnel tests conducted under conditions of uniform flow and low turbulence, and their validity in turbulent boundary-layer flows has yet to be completely established. Additional pressure coefficients for conditions not specified herein may be found in two references (SIA 1956, ASCE 1961).*

It is apparent from this clarification that the corresponding design recommendations are completely outdated. In fact, the uniform flow conditions make these recommendations obsolete and require immediate attention and research effort using the necessary scientifically simulated flow conditions that current wind tunnel laboratories can generate.

Taking into consideration the above information, we propose to conduct full-scale testing of representative ground-mounted equipment to generate code-ready design force coefficients that will enhance the Florida Building Code as well as the ASCE 7 Wind Standard. The team will be comprised by wind engineering experts from Florida International University (FIU), Laboratory for Wind Engineering Research (LWER), Extreme Events Institute (EEI) (henceforth FIU LWER/EEI) and from Concordia University’s Building Aerodynamics Laboratory.

# Scope of Work

*Task 1 – Physical Testing Campaign*

TBD

*Task 2 – Data Interpretation and Codification*

TBD

*Task 3 – Evaluation of the FBC related requirements and recommendations for future inclusion*

TBD

# Staffing

*Personnel*

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

Co-PI: Ted Stathopoulos, Professor, BCEE, Concordia University, Canada

Graduate Student: TBD, Florida International University, USA

# 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 June 30, 2023. This purchase order shall not exceed $XXX 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.

# Deliverables

1. An interim report shall be prepared and delivered no later than February 28, 2023. 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.
2. A final report shall be prepared and delivered no later than June 1, 2023. The final report shall contain deliverables of the first three Tasks as discussed in Section 2. This shall include force coefficients in different formats (e.g. function of wind direction, contour plots and area averaged), simplified diagrams suitable for incorporation in building codes and wind standards and recommendations that are necessary to incorporate results of the proposed study into the appropriate sections of the FBC and ASCE. In addition, 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.

# 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.

# Program Manager

The Program Manager for this project is Mo Madani. Mo Madani’s email address is [Mo.Madani@myfloridalicense.com](about:blank) and his phone number is 850-717-1825.