PREDICTING PEAK WIND PRESSURES ON A LOW-RISE STRUCTURE FROM UPSTREAM TERRAIN CONDITIONS

Pedro L Fernández-Cabán*[1], Forrest J. Masters[2], Brian M. Phillips[1]

[1]University of Maryland at College Park, College Park, MD 20742, USA; [2]University of Florida, Gainesville, FL 32611, USA

*plferndz@umd.edu

This study presents an analytical approach for predicting the distribution of peak pressure coefficients on a low-rise structure based on upwind terrain conditions. A comprehensive dataset of aerodynamic pressure tests conducted in a large boundary layer wind tunnel (BLWT) was used to train, validate, and test an artificial neural network (ANN) designed to predict mean, RMS, and peak pressures from turbulent characteristics of the freestream. The aerodynamic dataset includes measurements from three geometrically scaled (1:20, 1:30, and 1:50) pressured tapped models of the Wind Engineering Research Field Laboratory (WERFL). The models were immersed in 33 unique boundary layer flows. Three wind directions (parallel and perpendicular to the ridgeline and cornering) were tested for each model and terrain, which equates to nearly 300 independent experiments. Simulation of the upstream terrain in the BLWT was achieved through the Terraformer, an automated roughness element grid that rapidly reconfigures the height and orientation of 1116 roughness elements in a 62 × 18 grid to produce desired upwind terrain conditions along an 18.3 m fetch. The 33 upwind terrains considered in this study simulate upwind terrain conditions spanning from marine (i.e., smooth) to dense suburban exposures. The aerodynamic dataset is publicly accessible through the Natural Hazard Engineering Research Infrastructure (NHERI) DesignSafe cyberinfrastructure web-based research platform. BLWT experiments were conducted at the University of Florida (UF) NHERI Experimental Facility.