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In this issue:

Selection of hurricane scenarios for combined wind and flood loss estimation **1**

Projection of Future US Design Wind Speeds due to Changes in Hurricane Activity: Storm Frequency and Sea Surface Temperature **2**

Influence of aerodynamic interference on the performance of tall buildings **2**

Request for Nominations **3**

Selection of hurricane scenarios for combined wind and flood loss estimation

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Among all hurricane-related hazards (e.g. windborne debris, rainwater intrusion, wave setup, and etc.), strong wind and surge are often the greatest threats, which may cause devastating losses to coastal areas. This paper presents a new methodology for selecting hazard-consistent hurricane scenarios for regional hurricane loss estimation considering the joint occurrence probability of hurricane wind and surge. A stochastic hurricane simulation program was used to simulate 50,000 years of synthetic hurricanes and the SLOSH (Sea, Lake and Overland Surges from Hurricanes) model was utilized to calculate the corresponding storm surges for Charleston in South Carolina. The study region, Charleston Peninsula, was divided into 18 census tracts. The peak wind speeds and maximum surge heights at the center points of respective census tracts were used to determine the mean recurrence intervals (MRIs) of individual hurricane events. For loss estimation purpose, the MRIs of hurricanes were weighted based on the population of each census tract, and the weighted MRIs (WMRIs) were utilized to select an ensemble of hurricane scenarios with a target WMRI of 200 years considering the data distribution along the given hazard level (Figure 1).

Three hurricane ensembles, selected based on wind speed only, surge height only and joint occurrence of wind and surge, were imported into the FEMA (Federal

Emergency Management Agency) developed HAZUS-MH (Hazards United States Multi-Hazards) program to perform combined wind and flood loss estimation. The results indicate that hurricane selection using only the wind speeds or surge heights may overestimate the regional combined losses. The outcomes of this study can be used to help insurance companies to determine their insurance premiums based on the actual wind and flood damage risk, and assist coastal jurisdictions to conduct regional retrofit planning and hurricane hazard mitigation. The proposed methodology can also be applied to coastal areas, other than Charleston, SC, for regional loss estimation considering the joint occurrence of hurricane wind and surge.

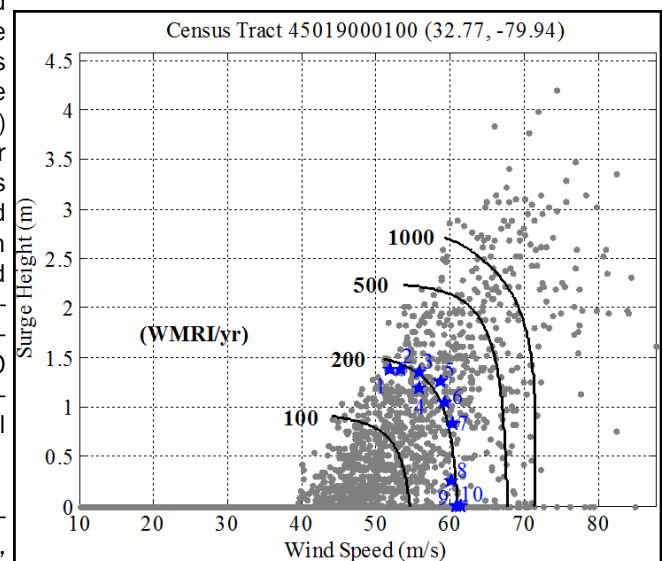


Figure 1: Selected hurricane scenarios (stars) considering joint occurrence of wind and surge (dash line represents effective upper bound)

Projection of Future US Design Wind Speeds due to Changes in Hurricane Activity: Storm Frequency and Sea Surface Temperature

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This study investigates the effects of climate change on tropical cyclone activities in the Atlantic basin and potential change in design wind speeds along the U.S. coastal region. Two climate related changes were investigated, namely changes in sea surface temperature and annual storm frequency. Projections of tropical cyclone activities were made up to year 2100 under three speculated future climate conditions: *I.* low greenhouse gas emission, *II.* high greenhouse gas emission, and *III.* increased annual storm frequency with high greenhouse gas emission. The three climate scenarios are based on the United Nations Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios. In this study, three synthetic hurricane databases, each consists of 49,970 simulation years (526 realizations for years 2006 to 2100), were produced for the three future climate scenarios using a stochastic hurricane simulation procedure based on the Marko Chain approach. Characteristic hurricane parameters (e.g. landfall rate and central pressure) for locations along the U.S. coastline were examined. Compared to current hurricane activities, appreciable decreases in central pressures are observed for scenarios *II* and *III*, while the hurricane intensity remains at around the same level for scenario *I*.

In this preliminary study, the projected future surface wind speeds were evaluated for selected locations and were compared to the design wind speeds in the current structural design code (ASCE 7-10) for mean recurrence intervals (MRIs) of 10, 25, 50, 100, 300, 700 and 1700 years. Figure 1 shows the comparisons between the current design wind speeds and the projected wind speeds for Miami, Florida and Charleston, South Carolina. The most noticeable increases in surface 3-s gust wind speeds were found to be between 10m/s to 15m/s for locations in Florida and along Eastern coast of the United States.

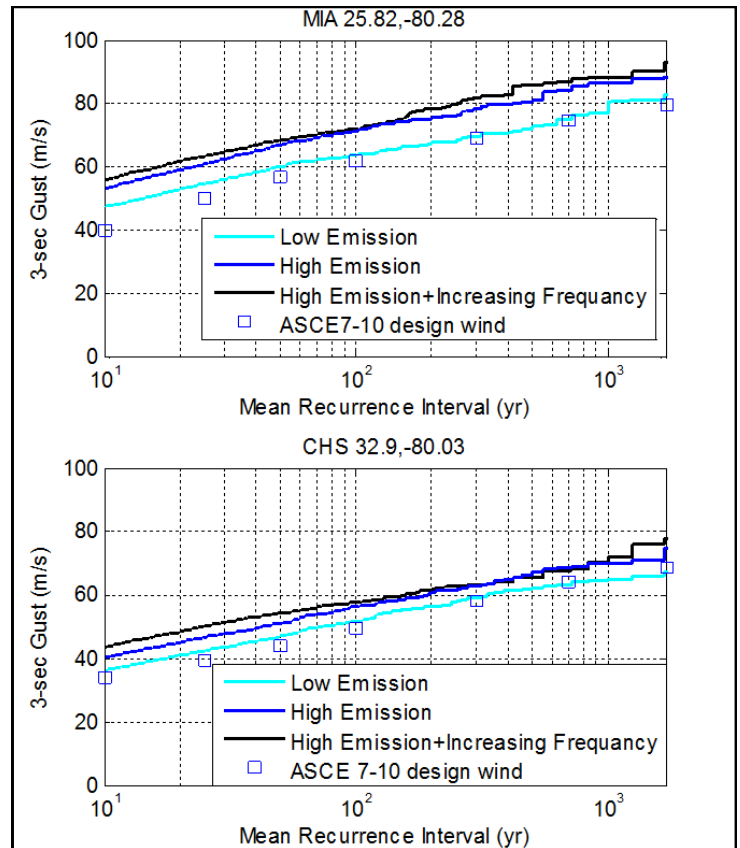


Figure 1: Comparison between the current ASCE 7-10 design wind speeds and projected future design wind speeds under climate change scenarios for Miami, FL and Charleston, SC.

Since the wind pressure exerted on a building envelope is directly proportional to the square of wind speed, the observed levels of wind speed changes might bring significant increase in future hurricane risk.

Influence of aerodynamic interference on the performance of tall buildings

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The wind loading of tall buildings in an urban environment is often greatly affected by aerodynamic interference, which results from the interaction of approaching wind with upstream or adjacent structures. Interference effects are not currently considered in wind loading codes, primarily due to the large number of variables involved, and are often more easily quantified through wind tunnel testing. Nevertheless, advice on building configurations which have the potential to generate problematic interference effects would be useful in

the preliminary design stage. To provide this advice, and interference factor (IF) is used. For this work, the IF is the ratio of the peak response of the test building with the upstream building present to that for the isolated test building. The tests were carried out for three exposures and range of structural properties were considered in the analysis.

Wind tunnel tests were carried out to assess interference

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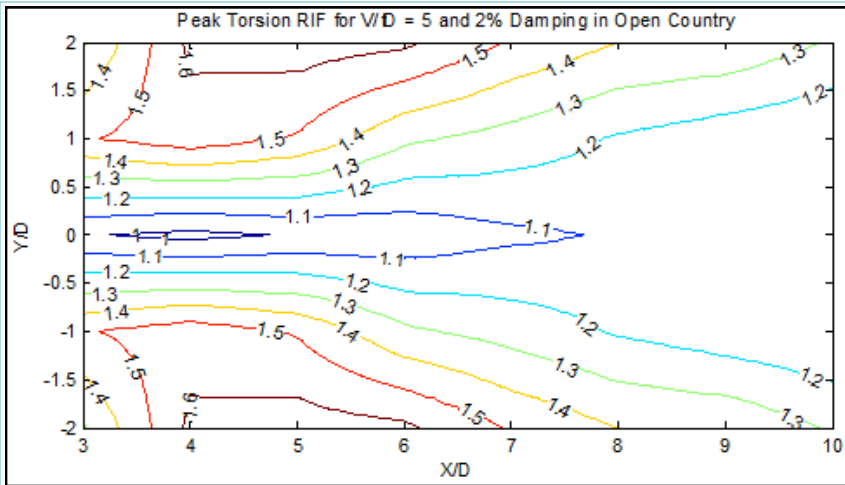


Figure 1: Contour plot of peak torsion IF

(Continued from page 2)

effects resulting from a single upstream building using a grid-based approach. Results are presented as IF contour plots, referenced to the peak response of the isolated test building, and are shown for a range of reduced velocities. An example contour plot of the peak torsion IF is shown in Figure 1 for typical structural properties. The peak along-wind and across-wind IFs are most significantly affected by upstream buildings having an offset spacing, and were found to be most severe for the open country exposure. The peak torsion IF was found to be most influenced by laterally offset buildings as well, although the IFs were much higher (in the order 1.4 to 1.7, depending on exposure and structural properties). While the dynamic wind loading on the test building was found to not be very sensitive to the orientation of the upstream building, the loads and responses significantly changed for different orientations of the test building with the orientation of the upstream building held constant. The latter is illustrated in Figure 2.

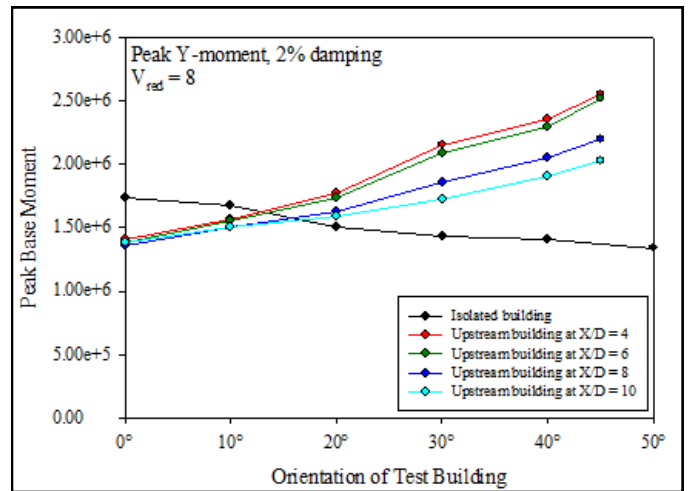


Figure 2: Variation of peak base moment with orientation of test building

REQUEST FOR NOMINATIONS

AAWE Award Nominations

The AAWE Best Paper Award is a recurring annual award. Please consider papers that have been or will be published in 2013 for possible submission for the next opportunity to present this award.

Nominations for the next Best Paper Award are due before January 31, 2014. Please send all nominations to the AAWE Awards Committee Chair, Anne Cope at acope@ibhs.org.

Iawe Award Nominations

The International Association for Wind Engineering awards process has recently changed from a quadrennial nomination, review and award period to an annual process, with nominations due on or before March 31 each year. Please consider nominating fellow AAWE members for these two prestigious Iawe awards:

- Iawe Senior Award (Davenport Medal), which is presented for a record of outstanding achievement, nor-

mally within the previous ten-year period, in at least two out of: i) significant and original contribution to wind engineering research; ii) applications to wind engineering practice; iii) educational contributions in the field of wind engineering; iv) international community involvement.

- Iawe Junior Award, which is presented for a record of outstanding achievement, within the previous five-year period, in at least one of: i) significant and original contribution to wind engineering research; ii) applications to wind engineering practice; iii) educational contributions in the field of wind engineering. Nominations should be under the age of forty years on January 1st of the year.

Nominations for the Iawe awards can be sent directly to the Iawe Secretary General, Shuyang Cao at cao@arch.t-kougei.ac.jp, or for assistance with submission you may contact the AAWE Awards Committee Chair, Anne Cope at acope@ibhs.org.

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