Florida Department of Transportation Research

Statistical Properties of Wave Crest Lengths in Hurricane Generated Seas

BDT63

The loss of a number of major coastal bridges in the last decade due to storm surge and wave action has created a need for a more thorough understanding of water levels, wave heights, and wave crest lengths (i.e., the frequency of wave crests). Equations for predicting horizontal and vertical forces on bridge superstructures are included in AASHTO's *Guide Specification for Bridges Vulnerable to Coastal Storms*. These specifications assume design wave crest lengths are at least as long as the bridge span length, which can range from 20 ft to over 200 ft. However, researchers believe this assumption could be overly conservative for longer bridge span lengths.

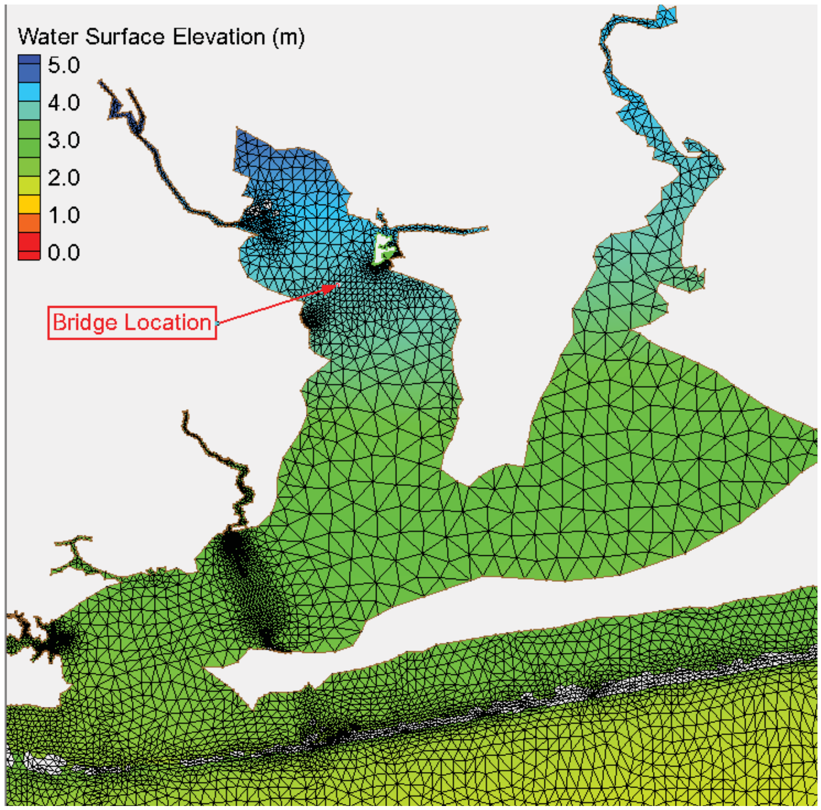

Image of the peak water surface elevations in Escambia Bay, Pensacola Bay, and East Bay during Hurricane Ivan in 2004. Red arrow points to the I-10 bridge, which suffered catastrophic damage during the storm.

FDOT recently contracted with Ocean Engineering and Associates, Inc., to study the statistical properties of wave crest lengths in hurricane-generated seas. The purpose of the research was to investigate wind wave crest lengths in coastal waters during tropical storms and hurricane conditions and to develop a methodology for including wave crest-length effects for the surge/wave load prediction methodology for bridge superstructures.

Wave forces on bridge superstructures are dependent on the variation in design wave-crest height over the length of the bridge span. Researchers wanted to quantify wave crest lengths in enclosed coastal waters under tropical storm and hurricane conditions. Since wave crest heights vary, researchers sought to define a threshold height above the storm water level to establish the crest length. However, researchers were unsuccessful in arriving at a meaningful method to define the threshold height.

Nevertheless, researchers developed a method to account for wave crest variation and to determine the impact of wave forces on bridge spans without defining a threshold value. This method considers both the length of the span and the distance between the storm water and the span low chord elevations. Researchers based their methodologies for obtaining design wave height and length on available meteorology/oceanography (met/ocean) information. Researchers used available directional wave data from recent major storms to obtain more accurate design wave heights and periods. For situations where wave spectra were not available, i.e., wave energy and periods, researchers used conservative values for the spectral parameters, which resulted in conservative wave force estimates.

Researchers determined that for longer bridge span lengths, the methods developed in this study will result in reduced predicted wave loads even when limited met/ocean data is available. Additional research concerning design wave periods in steepness limited cases and slamming forces for both slab and girder bridge superstructures will significantly improve the accuracy of wave loading on bridge superstructure predictions.

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For more information, visit http://www.dot.state.fl.us/research-center.