Numerical Simulation of Hydrodynamic Interference Effects on Coastal Twin Bridge Decks under Hurricane Waves

Guoji Xu S.M. ASCE¹, C.S. Cai, Ph. D., P.E., F.ASCE ²

¹ Dept. of Civil and Environmental Engineering, Louisiana State Univ., Baton Rouge, LA 70803. E-mail: gxu2@lsu.edu
² Edwin B. and Norma S. McNeil Distinguished Professor, Dept. of Civil and Environmental Engineering, Louisiana State Univ., Baton Rouge, LA 70803 (corresponding author). E-mail: cscai@lsu.edu

Abstract: The wave forces on the typical coastal twin bridge decks under Stokes 2nd order waves have been investigated using the Escambia Bay Bridge as the prototype one. The Shear Stress Transport (SST) $k-\omega$ model is adopted as the turbulence closure for the RANS equations. Different still water depths with various structure elevations for prescribed gaps between the twin bridge decks (seaward bridge deck and landward bridge deck) are considered to represent different scenarios in field. Both the horizontal and vertical forces under the prescribed conditions are analyzed in details. The results show that at most times the wave forces on the landward bridge deck are relatively smaller than those on the seaward bridge deck. However, the comparisons of the wave forces between the single bridge deck and the twin bridge decks show that much larger wave forces (based on those on the single bridge deck) will be induced on the seaward bridge deck due to the hydrodynamic interference effects caused by the landward bridge deck. As such, it is extremely important to recalibrate the prediction equations proposed by the AASHTO code since these equations are based on the data acquired through the laboratory study regarding the wave forces on one single bridge model.

Key words: Wave forces; SST $k-\omega$ model; Stokes wave; Twin bridge decks; Structure elevations.