TECHSUMMARY August 2016

SIO No. DOTLT1000041 / LTRC Project No. 15-1ST

Development of Wave and Surge Atlas for the Design and Protection of Coastal Bridges in South Louisiana – Phase 2

INTRODUCTION

The first phase of this project, documented in LTRC Final Report 528, developed meteorological/oceanographic (met/ocean) data for the 100-year storm return period in south Louisiana and presented the data in a GIS platform known as the Wave and Surge Atlas.

This report documents the second phase of the project that developed met/ocean data for the 5-, 10-, 25-, and 50-year storm return periods in south Louisiana, extracting the maximum met/ocean data occurring when hindcasting 50 of the most severe tropical storms/hurricanes that affected Louisiana over the past 160 years, and hindcasting alternative paths for a select number of those storms for a total of 124 hindcasts. This information has been added to the previously developed Wave and Surge Atlas.

Phase 2 also developed a calculator for solving the wave force equations from AASHTO's *Guide Specifications for Bridges Vulnerable to Coastal Storms* and evaluated all spans of the bridges identified as potentially vulnerable during Phase 1.

OBJECTIVE

This research extended the previously developed Wave and Surge Atlas for the design and evaluation of coastal bridges in south Louisiana.

SCOPE

Phase 1 of this study developed a GIS platform for presenting the results of hindcasted storm events with a 100-year return period. Using the same methodology, Phase 2 added results of hindcasted storm events with 5-, 10-, 25-, and 50-year return periods. Maximum values of storm-induced water elevation, wave height, and wave period were determined for actual and path-shifted storm events.

A wave load calculation program was developed based on AASHTO's *Guide Specifications for Bridges Vulnerable to Coastal Storms*. The program allows designers to input met/ocean parameters from the Wave and Surge Atlas to obtain wave loads and to evaluate vulnerability of individual bridge spans, based on superstructure information for the bridge.

LTRC Report 568

Read online summary or final report:
www.ltrc.lsu.edu/publications.html

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METHODOLOGY

The Wave and Surge Atlas developed during Phase 1 of this project incorporated 100-year wave and surge conditions that originated from extreme value analyses on actual or synthetic (path-shifted) data. The methodology started with hindcasting actual major storms that affected the study area over the last 160 years. Accuracy of extreme value analyses increases as data sets become larger, so paths of an actual storm were shifted to the left and to the right in order to produce two additional data sets.

Development of the Wave and Surge Atlas involved extracting water level and wave information for node locations within the model domain for each hindcasted storm return period, adding tide data, determining maximum and associated parameters for each node location within the study boundary, and populating the GIS database.

A wave force calculator was developed using equations from AASHTO's *Guide Specifications for Bridges Vulnerable to Coastal Storms.* A Visual Basic interface is used to compile input data and access the calculator for determination of the critical wave/surge forces.

Compared with the conservative approach for evaluating bridge vulnerability that was used in Phase 1, a more detailed approach that evaluates individual bridge spans and met/ocean conditions at each span location was used for Phase 2.

CONCLUSIONS

While 100-year met/ocean conditions are used for most designs, there are many situations encountered by engineers where met/ocean information for more frequent storms (e.g., 5-, 10-, 25-, 50-year return periods) are more appropriate. For instance, engineers may design a temporary detour bridge based on a 5-year storm return period. Results from this study provide a much greater amount of wave/surge data for bridge designs throughout south Louisiana.

The amount of detailed modeling effort used during design of a bridge must be commensurate with the bridge's vulnerability to closure. When applying the Wave and Surge Atlas for design, good engineering practice dictates performing a sensitivity analysis to evaluate the effects of storm surge level/wave height variations.

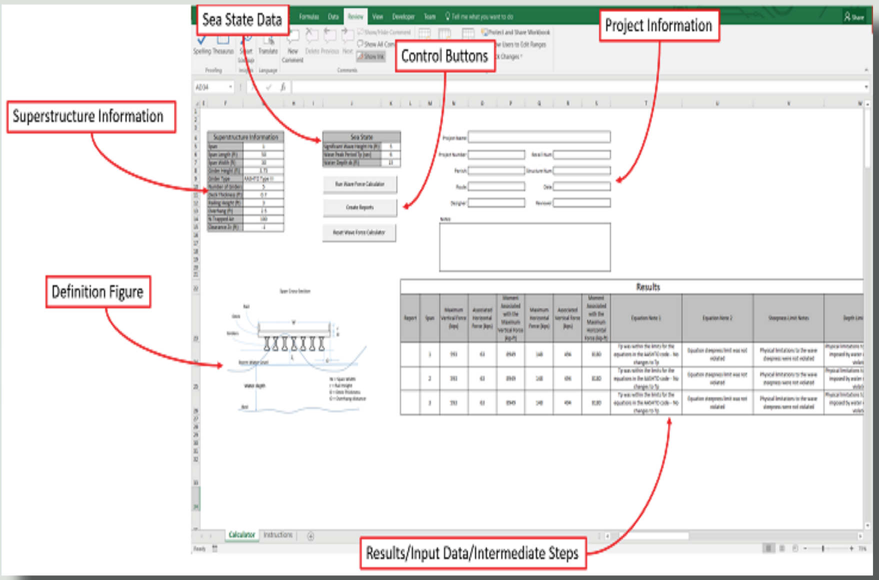

Figure 1
Wave force calculator interface