RESEARCH
PROJECT CAPSULE [15-1ST]
March 2015
TECHNOLOGY TRANSFER PROGRAM

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

JUST THE FACTS:

Start Date:
February 12, 2015

Duration:
15 months

End Date:
May 11, 2016

Funding:
SPR: TT-Fed/TT-Reg

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Sponsored jointly by the Louisiana Department of Transportation and Development and Louisiana State University

POINTS OF INTEREST:

Problem Addressed / Objective of Research / Methodology Used Implementation Potential

PROBLEM

The recently completed Louisiana Department of Transportation and Development (DOTD) Storm Surge and Wave Atlas contains significant hydraulic information that will be useful in analyzing storm surge and wave forces on existing and new coastal bridges.

The current Atlas contains surge and wave information for storms with a 1% chance of occurrence each year (100-year return interval). This information is useful for computing wave loads on bridge superstructures. However, many issues encountered by DOTD engineers require other frequency meteorological/oceanographic information (e.g., 5-, 10-, 25-, 50-year return intervals). For instance, engineers may design a temporary facility (a detour bridge) based on a 5-year return interval (20% chance of occurrence each year). Bridges whose service life is approaching their design life may undergo retrofitting based on a return interval different from the 100-year return interval. The information needed for these designs exists in the Level III analysis solution files developed in the recently completed Wave and Surge Atlas (Phase I) project.

Because of the size of the study area and the amount of information available in the recently completed Surge/Wave Atlas (GIS database) for the 100-year return interval, it is prudent to provide a separate GIS database for each of the other desired return intervals. Therefore, this work will produce a separate GIS database for a 50-year return interval (2% chance of occurrence each year), a 25-year return interval (4% chance of occurrence each year), a 10-year return interval (10% chance of occurrence each year), and a 5-year return interval (20% chance of occurrence each year).

OBJECTIVE

This research intends to develop and extend the previously completed wave and surge atlas for the design and evaluation of coastal bridges in south Louisiana.

METHODOLOGY

Accomplishing the work includes the following tasks:

- Develop Surge/Wave Atlas for 50-year, 25-year, 10-year, and 5-year return intervals;
- Develop a Surge/Wave Atlas for maximum values of actual hurricane/tropical storm-induced water elevation, wave height/peak period, and wind speed for the study area over the past 150 years;
- Develop a Surge/Wave Atlas for maximum values of path-shifted hurricane/tropical storm-induced water elevation, wave height/peak period, and wind speed for the study over the past 150-years;

- Develop a Visual Basic wave load calculation program based on the AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms, allowing designers to input bridge superstructure information and meteorological/oceanographic parameters from the Surge/Wave Atlas, then simply click a "compute button" to obtain all wave loads;
- Provide a training session so that DOTD will be able to update or modify the program as needed for future code changes;
- Complete any additional work needed in the Surge/Wave Atlas developed in Phase I for the 100-year return interval; and
- Prepare a final report documenting the entire research effort, including guidelines for application and discussion about limitations of the Surge/Wave Atlas.

IMPLEMENTATION POTENTIAL

The hurricane/tropical storm-induced damage experienced on large, expensive bridges in the Gulf Coast states during the past decade led to the creation of the AASHTO Guide Specifications for Bridges Vulnerable to Coastal Storms. This document provides guide specifications for calculating hurricane/tropical storm-generated wave and storm surge loads on bridge superstructures for both evaluation of existing bridges and design of new bridges. Phase I, conducted in the previous study, applied the AASHTO specifications to evaluate DOTD's existing coastal bridges to assess their vulnerability to this type of loading. The study identified 18 bridges as potentially vulnerable. The second phase conducted under this study will create additional wave/surge atlases and estimates wave loads on all spans of previously-identified vulnerable bridges. The atlases provide a GIS interface to present and access the data. This tool will allow DOTD to rapidly identify wave and storm surge conditions along most of Louisiana's coastal waterways enabling evaluation of existing bridges or design of new bridges. The data will aid DOTD engineers in the design of temporary facilities and implementation of countermeasures and retrofits.

Training sessions and other meetings will help ensure that DOTD engineers understand the study results and the accompanying wave load calculation program. The sessions/meetings will discuss the AASHTO specifications and use of the Visual Basic program.