



RESEARCH PROJECT CAPSULE [10-4ST]

May 2011

TECHNOLOGY TRANSFER PROGRAM

Development of Wave and Surge Atlases for the Design and Protection of Coastal Bridges in South Louisiana

JUST THE FACTS:

Start Date:
May 2, 2011

Duration:
29 months

End Date:
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Funding:
State: TT-Reg

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POINTS OF INTEREST:

*Problem Addressed / Objective of
Research / Methodology Used
Implementation Potential*

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PROBLEM

The failures of highway bridges on the Gulf Coast seen in the aftermath of Hurricane Katrina in 2005 were unprecedented. In the past four decades, wind waves accompanied by high surges from hurricanes have damaged a number of coastal bridges along the north coast of the Gulf of Mexico. Hurricane Camille in 1969 caused damage to bridges across Bay St. Louis and the Biloxi Bay in Mississippi. The same bridges rebuilt after Camille were damaged again by Katrina. Hurricane Frederic in 1979 destroyed the bridge connecting the mainland to Dauphin Island, a barrier island near the entrance of Mobile Bay, Alabama. In the 2004 hurricane season, the bridge on Interstate 1-10 (I-10) over Escambia Bay in Florida was destroyed by Hurricane Ivan. In addition to the I-10 Bridge over Lake Pontchartrain and the two on US-90 over St. Louis and Biloxi Bays, mentioned above, Hurricane Katrina also damaged several other bridges, including the ram between US-98 and I-10 over Mobile Bay in Alabama. A more comprehensive listing of bridges damaged by Katrina can be found in ASCETCLEE (2006) and Padgett et al. (2008) Although all bridges damaged by hurricanes mentioned above are situated in bays or estuaries sheltered from the impact of typical ocean storm surge by barrier islands, the major cause of those bridge failures is the impact of locally generated waves on bridges' superstructures (e.g., Douglass et al., 2006; Chen et al., 2009)

OBJECTIVE

The objectives of this proposed research are to:

1. Develop a 100-year design.
 - a. maximum water surface elevation and associated wave height
 - b. maximum wave height and associated water elevation atlases for South Louisiana coastal waters
2. Obtain the surge/wave loading on the Louisiana Department of Transportation and Development (LADOTD) coastal bridges and assess their vulnerability to this type of loading using the information obtained in objective 1 and bridge information provided by LADOTD.

When these objectives are met, the LADOTD will know which of their coastal bridges are vulnerable to design storm surge and wave conditions. The amount the design surge/wave load that exceeds the resistive forces (span dead weight, tie-down strength, etc.) will be known for each span on each bridge determined to be vulnerable. The storm surge and wave atlas developed in this study will provide the met/ocean information needed for analyzing storm surge and wave loading on future LADOTD coastal bridges, roadways and other structures.

METHODOLOGY

The study will be performed within the guidelines of the following tasks:

1. Perform a literature search.
2. Conduct a bridge selection and screening procedure.
3. Conduct bridge vulnerability screening.

4. Submit and present an interim summary report.
5. Compile and purchase data.
6. Develop storm surge (ADCIRC) and Wave (WAM and SWAN) Model Mesh.
7. Run developed models.
8. Extract information from solution files and perform extreme value analyses.
9. Construct storm surge and wave atlas.
10. Compute surge/wave forces and moments.
11. Determine and analyze vulnerable bridges.
12. Write and submit final report.
13. Present findings, conclusions, and recommendations.
14. Provide a one-day workshop for training.

IMPLEMENTATION POTENTIAL

A major portion of the results of this study are for specific existing bridges in the coastal waters of South Louisiana and in a format for immediate use by LADOTD engineers and their consultants. Both the surge/wave loading and the approximate resistive forces will be presented for all bridge spans determined to be vulnerable to these types of loads. This information can be used directly in decisions regarding retrofitting as well as in the design of retrofits.

The storm surge and wave atlas that will initially contain design water elevations and wave parameter can be used immediately for analyzing the vulnerability of existing and new coastal bridges and roadways to elevated water levels and the associated wave.

The proposed workshop for LADOTD engineers and their consultants will ensure that the study results and their potential use are understood. The workshop will cover how the information was obtained but stress how the information can be used through detailed example problems.



I-10 bridges over Lake Pontchartrain in New Orleans, LA