Research Project

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C a p s u l e

Technology Transfer Program

LTRC

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Feasibility of Tubular Fender Units for Pier Protection against Vessel Collision

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LTRC

Louisiana Transportation Research Center

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

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Problem

Vessel collisions with bridges are increasing at an alarming rate, as more vessels are making more frequent trips under bridges. Given the high number of bridge structures over navigable waterways in Louisiana, bridge pier protection is a concern for DOTD. Where bridge piers and abutments are not able to fully withstand expected impact loads, a protection system should be specified to prevent, redirect, or reduce such loads. An efficient protection system must be designed to protect the bridge structure, as well as the vessel and the environment.

Fender systems currently installed around bridge piers are generally rigid, relatively brittle barriers. These barriers often exhibit high levels of damage or even total destruction, requiring major repairs after a collision. Ideally, such fenders can be modeled as linear elastic systems under the effects of impacting forces. To absorb energy without damaging the system, the elastic limit of the fenders should not be exceeded. That is, the impacting force should be low enough so that the fender will deflect under the effect of the force, but return to its original position after impact. In general, fender systems can adequately absorb the collision energy and forces associated with small to medium vessels at low impact speeds and oblique angles. This

A typical Louisiana pier fender

project will also assess these fender systems under catastrophic impacts like a head-on collision.

Since fenders are first to get damaged in collisions—minor or major—it is important to develop systems that can protect the bridge without sustaining much damage themselves. This would alleviate costly, time-consuming repairs. Energy-absorbing fenders have been identified as systems with potential to provide protection for bridges with minimal post-collision maintenance requirements.

Objectives

The goal of this project is to identify existing protective systems and propose new systems that can be used to mitigate the effects of bridge-vessel collisions. The researchers will identify or propose fender systems that are 1) modular, 2) easily installed, 3) suitable for retrofitting existing bridges or for use in new construction, 4) crashworthy, and 5) durable, with low life-cycle costs.

Description

After a literature review, the researchers will prepare an interim report that will identify existing protective systems and propose new ones. The report will also include a detailed explanation for the theory and computational procedures that will be used for the remainder of the project.

Next, the investigators will determine the range of energy absorption and load resistance requirements for barge and ship collisions. The analysis will be applied to the fender configurations identified during the literature review. The researchers will determine if these fender systems will be capable of meeting the demands imposed by vessels commonly used in Louisiana.

A life cycle cost analysis will also be performed to identify the most cost-effective alternative. The analysis will account for agency costs, including environmental cleanup, and user costs, including accident and delay costs for collisions that cause vessel damage.

Design aids will be developed to assist in choice of dimensions and characteristics for a proposed fender system. Finally, preliminary plans, specifications, and performance data will be prepared for selected units.

Implementation Potential

This research will provide a reliable means of assessing tubular fender systems for pier protection against vessel collision in a cost-effective manner.