Research Project

00-6SS

Capsule

Technology Transfer Program

LTRC

September 2001

Fatigue and Shear Behavior of HPC Bulb-Tee Girders

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Duration: *2 years*

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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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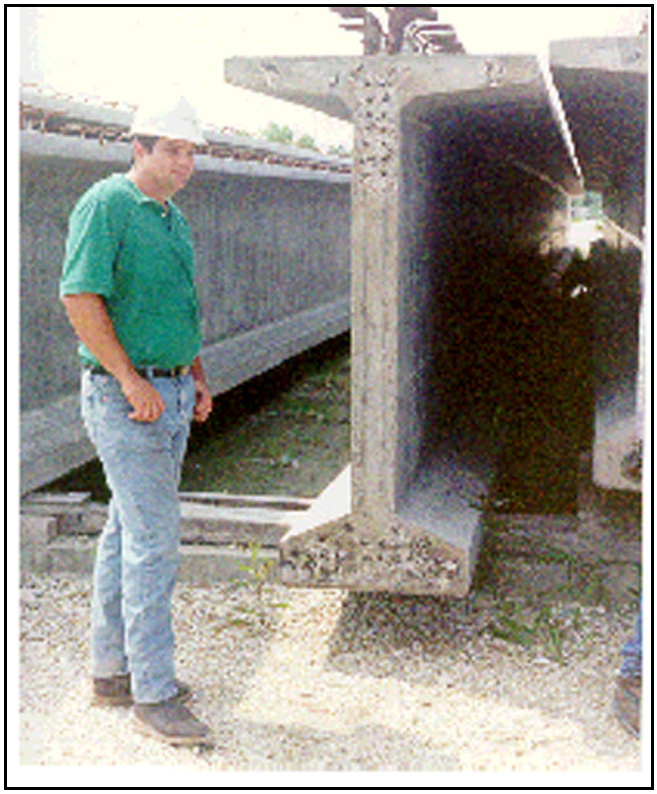
Problem

The Louisiana Transportation Research Center (LTRC) has sponsored research work to address design and construction issues related to high performance concrete.The Louisiana Department of Transportation and Development (DOTD) has gradually introduced high performance concrete (HPC) into its bridge construction program. DOTD is now considering the use of 72-inch (1.83m) deep bulb-tee girders for a future bridge project. The girders are expected to require concrete with a specified compressive strength of 10,000 psi (69 MPa) and prestressing strands with a diameter of 0.6 in. (15.2 mm). To ensure that the girders will perform satisfactorily, it is necessary to verify design provisions for repeated flexural loading and shear.



Bulb-tee Test Girder

Objectives of Research

Objectives of the proposed research are:

1. Evaluate the flexural fatigue performance of high-strength concrete bulb-tee girders.

2. Evaluate the static shear strength of high-strength concrete bulb-tee girders.

Research Approach

The proposed research will be accomplished through:

Task 1 - Development of a detailed test plan
A detailed test plan describing the girder design, test specimen design, anticipated fabrication procedures for the girder and deck, instrumentation plan, materials testing program, fatigue testing program, and shear testing program will be prepared.

Task 2 - Design of test specimens
Three 72 -inch bulb-tee girders will be designed. The design of the first girder will be based on the AASHTO Standard Specifications, and the other two girders will use the AASHTO LRFD specifications.

Task 3 - Fabrication and instrumentation of test specimens
All three girders will be produced in the same precasting bed at the same time. All girders will have the same number of bonded strands. The instrumentation will include vibrating wire strain gages at the mid-span of each girder, strain gages on the shear reinforcement and non-prestressed longitudinal reinforcement at the ends of each girder, and load cells on selected prestressing strands in the precasting bed.

Task 4 - Material property tests
The compressive strength, modulus of elasticity, modulus of rupture, and coefficient of thermal expansion will be determined. Data will be obtained from testing approximately 50 specimens for concrete used in the girders and 25 specimens for concrete used in the deck.

Task 5 - Fatigue tests
The girders will be tested using a closed-loop, load-controlled servo-hydraulic system. For dynamic loading, the test equipment will be programmed to maintain a forced loading function at a frequency of two cycles per second.

Task 6 - Shear tests
After completion of all fatigue loading sequences, the two ends of each girder will be tested to evaluate static shear strength performance. Each girder will be cut in half and placed on supports, creating a simply supported beam.

Implementation Potential

Appropriate revisions to DOTD design procedures or specifications will be submitted to the Bridge Design Section. Modifying the specifications by using HPC in the new construction of bridges will result in structures that are more economical. The initial economic benefit arises from the ability to use fewer beams, resulting in lower costs in materials, labor, transportation, and construction, while increasing span lengths that require fewer piers. The structural benefits include increased rigidity, because of the increased elastic modulus and increased concrete strengths, which will then increase the allowable design stresses. A long-term economical benefit may be realized because of increased durability and reduced maintenance.

It should be noted that the findings of the study will be used for the design of three additional bridges using HPC concepts.