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LTRC

RESEARCH PROJECT CAPSULE

07–4ST

TECHNOLOGY TRANSFER PROGRAM

JUST THE FACTS

Start Date:
September 1, 2007

Duration:
48 months

End Date:
August 31, 2010

Funding:
Federal

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SPECIAL POINTS OF INTEREST:

- Problem Addressed
- Objectives of Research
- Methodology Used
- Implementation Potential

Integral Abutment Bridge For Louisiana's Soft and Stiff Soils

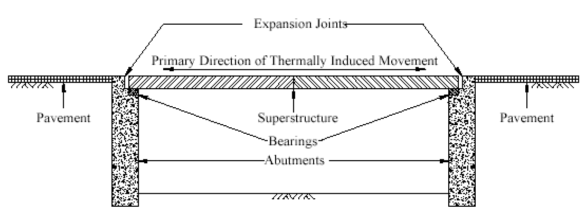
PROBLEM

One of the major maintenance problems for DOTs is caused by bridge joints where the intruding water induces problems at the beam ends, bearings, and supporting substructures. In bridge structures, movements due to thermal strains, creep, and shrinkage are accommodated by such components as expansion joints, roller supports, and expansion bearings. However, the fact that expansion joints and bearings are expensive to install and require continuing maintenance is known. These joints are also prime sites for deterioration of the superstructure and substructure due to cyclic movements and deck leakage. A cost effective alternative becoming increasingly popular among bridge owners is the integral abutment or integral bridge. An integral abutment bridge (IAB) system is constructed without deck joints, particularly at the abutments. The design of IAB in stiff soil has become a well established practice. However, due to our state's unique soft soil condition and the complexity of the pile and soil interaction in the integral abutment bridges, no full integral bridge has ever been explored in Louisiana.

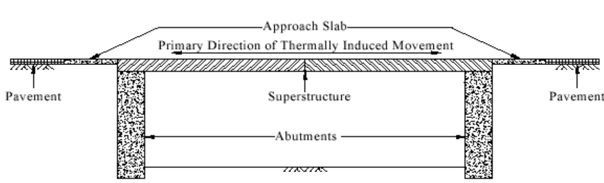
OBJECTIVES

The proposed research will be to field instrument, monitor, and analyze the design and construction of full integral abutment bridges for Louisiana's soft and stiff soil conditions. Comparison of results will be submitted to the Louisiana Department of Transportation and Development (LADOTD) Bridge Design and Geotechnical Sections in the form of guidelines to incorporate in future designs. The objective of the study will address the following:

1. Instrumentation and monitoring of piles, embankment/backfill, abutment, and bridge at two sites representing soft and stiff soil conditions.
2. Behavior of the backfill material and surrounding soil under the cyclic abutment displacement.
3. Behavior of the pavement and approach slab near the abutment.
4. Pile and soil interaction.
5. Abutment wall and soil interaction.



Typical Conventional Abutment Concept (after Horvath, 2000)



Typical Integral Abutment Concept (after Horvath, 2000)

6. Approach slab and soil interaction
7. Effects of temperature and longitudinal movement

The overall performance of the two bridges (one with soft soils in Jefferson parish and the other with stiff soils in Caddo parish) will be monitored. The superstructures will be analyzed for thermal movement. The steel piles, abutment wall, backfill material and soils under approach slab will be instrumented to measure the pile deformation, the soil pressure, and the rotation of the abutment wall due to loads transferred from the superstructures and subsurface deformation.

METHODOLOGY

In order to achieve the proposed objective, the LADOTD has developed a scope of work comprised of the following tasks:

Task 1: Literature Review
The literature review will be comprehensive. A survey of state DOTs in the US will be conducted in an effort to learn about the current practice of the integral bridge abutment and its construction in different soil conditions.

Task 2: Instrumentation and Testing Plan
The extensive instrumentation plan for this project will allow for the monitoring of short and long term performance of IAB components and systems. A conceptual instrumentation plan for the details recommended in Task 1, as well as a conceptual instrumentation plan for a lateral load pile testing on each site, will be submitted for approval. Field monitoring will consist of placing 40 to 50 instruments on each integral abutment bridge. Instruments used for field monitoring will include thermocouples, vibrating wire strain gages, vibrating wire tiltmeters, borehole vibrating wire extensometers, and vibrating wire pressure cells, piezometers, and TDR for moisture variation. Pile load tests will be carried out in accordance with the LADOTD specifications and guidelines. An appropriate data logger and data acquisition system will be installed. Data will be taken by the research team on a monthly basis for a period of six hours during the time frame of two years.

Task 3: Installation of Field Instrumentation and Data Collection System
Field instrumentation and data collection pertaining to the integral abutment and foundation will be performed on both IAB systems in soft and stiff soil conditions.

Task 4 Data Collection
The research team will perform that data collection for a period not less than one year, analyze the data, and train DOTD personnel for the long term monitoring.

Task 5: Evaluation and Recommendations for Design and Construction of IAB System
Design and construction of the integral abutment for this project will be evaluated using collected data, analysis, and modeling. Based on the performance evaluations resulting from extensive monitoring and data collection at two sites with soft and stiff soil conditions, recommendations for future installations will be developed. The results of data collection and analysis will be presented to the PRC at periodic intervals for feedback, which will help in developing recommendations.

Task 6: Final Report
A final report documenting the entire research effort will be prepared. Based on the performance of the installed system, the final report will include guidelines regarding the application and/or limitation of such a system on new and existing structures.

IMPLEMENTATION POTENTIAL

The results of this research will be implemented in the form of design and construction guidelines for IAB in Louisiana. In addition to the written report, a summary sheet will be created, and presentations will be made at appropriate local/regional conferences.

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For more information about LTRC's research program, please visit our Web site. ***www.ltrc.lsu.edu***