

**Work Plan**  
**The Wisconsin Highway Research Program**

**Monitoring and Load Distribution Study for the Land Bridge**

**Agency:**

The Board of Regents of The University Of Wisconsin System  
University of Wisconsin-Milwaukee  
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## **Problem Statement**

With funding provided through the USDOT's Innovative Bridge Research and Construction Program (IBRC), a study was conducted at the University of Wisconsin-Milwaukee that was entitled, "Fatigue Resistance and Monitoring of HPS Bridge Members" in the Land Bridge. The bridge is located in the Vernon County, Wisconsin and is constructed of a 270-foot long simple span curved double-tub girders made of high-performance steel (HPS) flanges. The project is identified as WISDOT Project ID # 1000-02-02 and it had a performance duration from June 2000 to August 2005. This study was completed in two phases. The Phase I study included a series of laboratory cyclic load tests of full size hybrid steel girders made of high-performance steel flanges and more commonly used weathering steel webs to establish their fatigue resistance and suitability for use in the Land Bridge. The Phase II study consisted of installation of various sensing devices (strain gages, LVDT's, vibration gages, and temperature gages) in the bridge and remote monitoring of the bridge elements responses due to loads from traffic and temperature fluctuations.

As a result of the Phase II study, the investigators were able to obtain results to document the response of the bridge girders during a full year cycle (from April 2004 to March 2005). It was found that thermal load cycles played a dominant role in causing stresses up to 8.0 ksi in the girders. The live stresses caused from the effect of routine traffic were not as severe.

The current documented bridge response is only for a period of one year and it might not offer a true representation based on the normal service conditions. Since all relevant sensing devices and supporting instrumentation are already installed at the bridge, it is desirable to extend the monitoring period for the Land Bridge for a longer period of time to obtain a more reliable representation of the bridge behavior. Also, the presence of the current instrumentation in the bridge would be suitable for expanding the scope of the project to include an effort to better understand and document the distribution of truck wheel loads on the deck based on the specific structural configuration of the Land Bridge.

## **Objectives**

The objectives of this work are to extend the monitoring period of the Land bridge for an additional two years and to document the response of the bridge over a longer period than was possible in the original study, and to study the truck wheel load distribution on the deck and the tub girders through tests performed at the bridge using WISDOT trucks with known axle loads as well as performing numerical analysis.

## **Implementation Work Plan**

The proposed work will be completed within the scope of the following tasks:

Task A: Assessment of the Conditions of Existing Sensing Devices and Instrumentation in the Land Bridge. A field trip will be made to the Land Bridge site to assess the conditions of all existing gages and data recording/transmission devices. Gages or components that require repair or replacement will be identified and appropriate action will be taken to have all components operational. In addition, it will be determined if there will be a need for additional gages to be installed in order to facilitate the completion of the wheel load distribution study in a later stage. Additional gages will be installed as required.

Task B: Remote Monitoring of the Land Bridge. The Land Bridge structural components (tub girders) will be monitored through measuring strain, displacement, and temperature variables on a continuous basis for a period of two years from the starting date of this study. The results will be analyzed, interpreted and presented in the form of graphs that are easy to understand. The results will provide a

meaningful insight into the behavior of the structure and will provide a basis for estimation of the life of the steel girders in the bridge.

Task C: Review of Available Literature on Wheel Load Distribution. Numerous investigations have been conducted during the last 40 years regarding the wheel load distribution in various bridge types. AASHTO specifications have adopted some of the findings from these studies to recommend load distribution factors for bridge analysis and design. Still, questions remain regarding true load distribution based on specific conditions in a bridge structure. In particular, the relative stiffness of girders, deck, and diaphragms play a major role in the wheel load distribution. In addition, the span length as well as the bridge width are contributing factors here. A review of the available literature will be performed to synthesize the current knowledge relevant to bridge construction type similar to that at the Land Bridge. The review will include both analytical and experimental studies involving controlled load testing.

Task D: Numerical Analysis for Wheel Load Distribution in the Land Bridge. Based on the results of the literature review and consultation with the WisDOT personnel, a program of numerical analysis of the structural components of the Land Bridge will be developed and implemented. Appropriate finite element analysis will be used to model and analyze the bridge. The results of the finite element analysis will be used as a basis for comparison with the field test data that will be obtained later in the study.

Task E: Field Testing for Wheel Load Distribution in the Land Bridge. A program of field testing will be designed and implemented in consultation with the WisDOT personnel to determine wheel load distribution in the girders of the Land Bridge through measuring strains and displacements. Controlled loaded trucks with known axle loads will be provided by WisDOT for this stage of the study. The field test data will be correlated to those from the numerical analysis. Attempts will be made to develop a design guide for determining the load distribution factor for this bridge type.

Task F: Final Report. At the completion of the study, a final report will be prepared and submitted to the WisDOT for review and approval. The report will include the details of the monitoring and field testing programs for the Land Bridge. The results of the monitoring program will be presented in the form of graphs and charts that are manageable and easy to understand and use. Analysis and interpretation of the results will be provided in order to aid the reader to utilize them for bridge management or life calculation purposes. The results of the field testing and numerical analysis for load distribution factor determination will be presented in the report. If appropriate, a design guide will be developed and presented in the report to aid the reader as a basis for a more accurate calculation of distribution load factor in bridges similar to Land Bridge.

### ***Work Time Schedule***

A period of 2 years is proposed for completion of all tasks in this project. The project starting date is anticipated to be October 1, 2006.