Project Title: Monitoring of Construction Doremus Avenue Bridge Structure

RFP NUMBER: N/A  
NJDOT RESEARCH PROJECT MANAGER: Nick Vittilo

TASK ORDER NUMBER: 99 / 4-26676  
PRINCIPAL INVESTIGATOR: Hani Nassif

Project Starting Date: 01/01/2001  
Original Project Ending Date: 12/31/2004

Modified Completion Date:  
Period Covered: 1st Quarter 2004

<table>
<thead>
<tr>
<th>Task</th>
<th>% of Total</th>
<th>% of Task this quarter</th>
<th>% of Task to date</th>
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<tr>
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<tr>
<td>1. Finite Element Model Development and verification (Substructure &amp; Superstructure)</td>
<td>5%</td>
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<td>2. Develop Instrumentation Plan and Install Sensors for LMC and Stage II sensors</td>
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<td>3. Parametric Study</td>
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<tr>
<td>4. Perform Testing of LMC layers, Stage I and II before and After LMC, Monitoring and Data Collection</td>
<td>20%</td>
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<td>5. Prepare Recommendations to Modify AASHTO’s, NJDOT’s and LMC Procedures</td>
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<td>6. Comparison of Analytical and Experimental Results including LMC layer</td>
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<td>7. Progress Reports</td>
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**Project Objectives:**

The Doremus Avenue bridge structure, located in Newark, NJ, is New Jersey’s initial LRFD design. The construction project will involve replacement of an existing bridge structure that primarily carries truck traffic into the State’s seaport area. The main objective of the overall five-year study is to instrument, monitor and evaluate the structure during and after construction. The evaluation process aims at assessing the new AASHTO LRFD design procedures and identifying what the New Jersey Department of Transportation (NJDOT) wishes to establish as future bridge design guidelines. The instrumentation schemes will be implemented during the construction phase. This will permit measuring the “undisturbed” behavior of the bridge and establishing the structure’s “finger prints” prior to traffic opening. Both the superstructure and substructure will be instrumented and monitored simultaneously.

**Project Abstract:**

In 2002, the American Association of State Highway Transportation Officials (AASHTO) will adopt the Load and Resistance Factored Design (LRFD) Bridge Design Specifications as the standard by which all future bridge structures will be designed. The use of these Specifications will be mandatory for all States. New Jersey has committed to the adoption of the LRFD Specifications by January 2000. The LRFD Specifications considers the variability in the behavior of structural elements through the use of extensive statistical analyses to ascertain the behavioral variability. The LRFD Specifications continue to be refined and improved. However, many of the
Specifications’ design approaches and methodologies have been adopted with limited or virtually no experimental validation. Therefore, there is a need to validate these new design procedures and models as well as to validate the integrity of LRFD designed bridge structures.

It is anticipated that the bridge will be instrumented to monitor its performance over a period of several years (5 years). It is also envisioned that the Doremus Avenue Bridge will act as a national “test bed” for verifying certain parameters of the AASHTO LRFD Bridge Design Specifications. The following sections describe the objective, scope, and tasks involved in developing analytical models and planning instrumentation schemes and sensor locations prior to the actual construction of the Doremus Ave. Bridge. The presented plan covers the first year of the project only. However, it is expected that the study will continue to allow for instrumentation, field-testing and long term monitoring. The overall project over the five-year period will consist of three Phases as follows:

- Phase I: Bridge Modeling, Instrumentation Planning, and Coordination of Tasks.
- Phase II: Bridge Instrumentation, Testing, and Verification prior to traffic opening.
- Phase III: Bridge Testing and long-term Monitoring after traffic opening.

1. Progress this quarter by task:
   A. Latex Modified Concrete Layer:
      1. Crack observation of LMC Layer, if possible.

   B. WIM System
      1. The WIM bending plate in Lanes 3 and 4 (North bound lanes) are connected and calibrated.
      2. The WIM system is calibrated, however, because of the bump between the approach slab and the roadway there are an increased number of problem readings in the right southbound lane.
      3. WIM system is currently communicating with the fatigue system and it is used as a trigger for the fatigue system.
      4. WIM system data is being downloaded on a regular basis for purposes of truck weights and classification beyond the scope of the fatigue system WIM record. The WIM software can automatically generate truck class and weight reports.

   C. Fatigue System
      1. Fatigues system is being re-programmed to accommodate the full 4 lanes bridges. The connection to the fatigue system from the WIM lanes has been re-designed due to changes in the design of the WIM system. The WIM system model and software originally noted in the Doremus plans has become obsolete and the new software has been installed. The new software required adding new hardware to the fatigue system to accommodate for the text information.
      2. Fatigue system is now programmed to receive WIM triggers from all 4 lanes. The connection to the fatigue system from the WIM lanes has been re-designed due to changes in the design of the WIM system.
      3. The memory capacity of the system was expanded to 2GB with a new RAM Card. This expansion allows for 4 lanes of truck records with up to 1000+ trucks per lane. The previous 128MBx2 configuration would be inadequate for the current traffic. At the present capacity, the system can collect truck data for three weeks before a site visit is required to download the data.
      4. Power difficulties with the Fatigue system have been resolved with changes to the software. Originally, the system was designed to power down when a lower threshold of voltage was reached (to protect the memory cards). The system now has a less sensitive threshold value and is programmed to re-initialize automatically.
      5. Problems with erroneous and empty data sets have been resolved. The remedy was a software setting that would balance the scan rates from two different input sources to read at the same rate.

2. Proposed activities for next quarter by task:
   1. Continue monitoring of the LMC strain profile and measuring its response under field and normal truck traffic conditions.
2. Perform static and dynamic testing of the full bridge (Stages I and II) under normal truck traffic. This will include WIM truck weight data, deflection measurement using LVDT and Laser system, Strain in main girders and secondary members using the STS, and fatigue stress ranges and truck load cycles.

3. Calibrating the fatigue system to capture the truck traffic on the bridge (from WIM system)

4. Correlation of data between WIM bending plate system and other data collection systems on the superstructure.

5. Perform analytical and experimental comparison of FE model and results from test truck as well as WIM-Based truck configurations. Emphasis will be given for multiple presence effects.

6. Develop truckload statistics based on long term Doremus-WIM data and compare with other NJ WIM locations. If needed, the use of portable WIM system will be examined to check data from other locations.

3. List of deliverables provided in this quarter by task (product date):
   N/A

4. Progress on Implementation and Training Activities:
   N/A

5. Problems/Proposed Solutions:
   N/A

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* These are approximate expended amounts for the project; these estimates are for reference only and should not be used for official accounting purposes. For a more accurate project accounting please review the quarterly invoice for this project.