1. Center Identifying Number
   99 RU6676

2. Project Title
   Monitoring of Construction Doremus Avenue Bridge Structure

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5. Project Objective
   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 sea port area. The main objective of the overall four-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 measure 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.
   The main objective of this proposal is to evaluate the behavior of the Doremus Avenue Bridge. The proposed study identifies the procedure(s) and parameters, used in bridge instrumentation. The identification process will be implemented in two phases: 1) development of a detailed Finite element Model
(FEM) that incorporates parameters from super- and sub-structure (such as temperature and differential expansion between steel and concrete) and the nonlinear behavior of concrete material, and 2) the planning and optimization of instrumentation schemes and sensor location. The end result is to provide a methodology that will enable New Jersey Department of Transportation (NJDOT) to successfully select the appropriate instrumentation modification and construction guidelines.

The main objectives of this project are as follows:

1. Continue with the collection of data from the installed instrumentation to collect long term data on the bridge’s design parameters.
2. Compare the actual strains and deflections with those predicted from the code.
3. Evaluate the data from the subsurface investigation and instrumented piles.
4. Estimate the dynamic soil properties for use in LRFD code.

6. 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 starting from January 2000. The LRFD-AASHTO (or 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, it is believed that there is a need to validate these new design procedures and models as well as to validate the integrity of LRFD designed bridge structures.

Scale models and laboratory-based testing that was done with the development of the LRFD Specifications alone can not reveal the actual as well as realistic behavior of bridge structures. Moreover, the effort to prioritize and schedule repair and rehabilitation of bridge structure requires an accurate as well as systematic assessment and non-destructive monitoring of bridge conditions. This proposal, for the instrumentation and monitoring of the Doremus Avenue bridge structure, will provide the engineering community at large with vital feedback on the short and long-term performance of bridges that are designed according to the new AASHTO LRFD Bridge Design Specifications. The...
instrumentation plan will achieve the short-term goal of identifying the causes of
deck cracking during construction and identifying a concrete pouring sequence
to reduce this occurrence and the long term goal of reducing maintenance and
life-cycle rehabilitation costs.

7. Task Descriptions
   Task 0: Literature Search and Technical Specification Development
   Task 1: Continue Finite Element Model Development (Substructure &
   Superstructure)
   Task 2: Develop Instrumentation Plan and Install Sensors
   Task 3: Develop a Plan for the Parametric Study
   Task 4: Perform Parametric Study and Perform Monitoring
   Task 5: Perform Monitoring and Data Collection
   Task 6: Comparison of Analytical and Experimental Results
   Task 7: Prepare Recommendations to Modify AASHTO and NJDOT’s
   Procedures
   Task 8 & 9: Quarterly Progress and Final Reports

8. Milestones/Dates

9. Yearly and Total Budget

   Year One
   NJDOT Sponsorship (1/1/2001-12/31/2001) $150,097.00

   Year Two
   NJDOT Sponsorship (1/1/2002-12/31/2002) $147,858.00

   Year Three
   NJDOT Sponsorship (1/1/2003-12/31/2003) $110,946.00

   Year Four
   NJDOT Sponsorship (1/1/2004-12/31/2004) $58,781.00

   Total
   NJDOT Sponsorship (1/1/2001-12/31/2004) $467,682.00

10. Student Involvement
    3 Graduate Student Researchers
11. Relationship to Other Research Projects
None To Date

12. Technology Transfer Activities
The recommendations and specifications for the design of bridges in New Jersey and the experimental data generated related to bridge performance will be documented and presented in a form of technical reports. The work will be carried out in close cooperation with NJDOT and intermediate results will be presented in papers submitted to professional journals and conferences. The materials will be distributed to the members of the Center for Advanced Infrastructure & Transportation (CAIT). The recommended details and specifications of this research will be presented in format consistent with the NJDOT design and detailing procedures. The NJDOT and the principal investigators of this research project will coordinate efforts for a consistent and successful implementation of the recommended design procedures and details by consultants and contractors. The most important results will be submitted to AASHTO Subcommittee on Bridges for consideration to sue as a basis for changes in the bridge design and construction specifications. The Research Team will present the results, including several design examples, to NJDOT engineers in a workshop to be coordinated with the Bureau of Structural Design at NJDOT.

The results of the work will be documented and presented in the form of technical papers. The intermediate results will be presented in papers submitted to professional journals and conferences. The work will be carried out in close cooperation with the NJDOT. The materials will be distributed to the members of the Center for Advanced Infrastructure & Transportation (CAIT). The most important results will be submitted to the AASHTO Sub-committee on Bridges for consideration to use as a bases for changes in the bridge design specifications and/or manual of bridge inspection.

13. Potential Benefits of the Project
The anticipated results of this research will be:
1. Experimental verification of the parameters that affect most the behavior of bridges designed by the new LRFD AASHTO Design Specifications.
2. Effect of skew and design flexibility of substructure stiffness on shear stresses in deck slab.
3. Design recommendations for the effect of thermal expansion on the design of steel girder bridges in New Jersey.
4. Recommendations for new design procedures, modifications of the GDF in the AASHTO Specifications for integral bridges especially in the negative moment region over the pier.

14. TRB Keywords
   Evaluation, Bridge Engineering, Monitoring, Instruments for Measuring Loads, Finite Element Analysis, Deflection Measurement

15. TRB Code Words
   Epdbd, Ttkfrb, Dmbm, Gumpp, Gej=, Gumsj