TECHNICAL SUMMARY

Load Testing for Assessment and Rating of Highway Bridges

Phase III: Technology Transfer to the SCDOT

U.S. Department of Transportation
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Phase I of this study reviewed some of the current and experimental technologies and practices used in the instrumentation (field testing) of highway bridges. The potential benefit that the South Carolina Department of Transportation could derive from the development of a bridge testing program to assess and rate highway bridges in their existing inventory was investigated. The conclusions of Phase I indicated the SCDoT would benefit from having the capability to field test bridges and use the data to assess and rate bridge structures in their inventory. It was recommended and funding subsequently approved for this project to move into Phase II activity.

Phase II started in October 2001, and the main goal of this stage of the project was to develop the procedures to field load test and analyze a typical highway bridge. This phase began with the identification and purchase of the necessary equipment to complete a successful bridge test. After all the equipment was obtained, preliminary procedures were developed to follow during the first round of bridge tests. In an attempt to show that the procedures that had been developed worked for different types of bridges, multiple bridges were tested during the first round of tests. Following the field tests, the procedures were refined and the results were presented in the Phase II final report. This report included a set of user manuals that were to be followed for model creation, load testing and data analysis. At the completion of Phase II the project moved forward to the final phase, Phase III, with the approval of the SCDoT.

The original goal of Phase III of this project was to be the refinement of the user manuals, as well as training of SCDoT personnel to carry-out the various activities of this bridge assessment and rating program to rate other highway bridges in their inventory. However, in a joint decision between the SCDoT and Clemson University, it was decided that Clemson would retain control of the testing equipment and would be contracted to load test and analyze the bridges for the SCDoT on a contractual basis. After the change of scope for the project, the training of the SCDoT staff was terminated, but the streamlining of the testing procedures and the refinement of the user manuals continued as planned.

Results

The computer modeling techniques developed in Phase II were overhauled to allow for quicker model development and adjustment. These models will still be calibrated using measured field data from the bridge test as the previous procedures called for. The use of SAP2000 for the models proved to be cumbersome to develop and calibrate. As a result, the Structural Modeling program was created to model only a single girder line of the bridge. It was decided that only the critical girder lines would be analyzed to reduce the time spent modeling and analyzing each structure, which would in turn allow for more bridges to be tested each year. This program used the same input parameters of rotational stiffness and continuity of connections, loads applied to the structure, and material properties that were used in the SAP2000 models. These models are then adjusted based on data collected from the field testing.

Modifications were also completed on the Data Analysis and Conversion program to allow for quicker data conversion. A reduction in the time spent converting and analyzing the data means less time spent in the field and a reduction in the cost of each bridge test. Overall, this reduction in cost, may allow the same staff to complete more bridge tests per year.

Based upon the rating procedures discussed in Phase II of this project, an Excel spreadsheet was created to calculate the load rating for a candidate bridge. The program required some basic information to be input, and then quickly calculated a load rating for the bridge based on the bending moment being the controlling load effect. Had shear or end bearing been the controlling load effect, the program would need modifications to incorporate those considerations.

Using the new Load Rating program, a candidate bridge (S-1021 in Anderson, SC) was rated. The rating included analyses utilizing strict AASHTO requirements based on a non-composite section. The load rating was developed based on the AASHTO HS-20 design truck to obtain a total load, in tons, for the rating of the candidate bridge. The performance of the S-1021 Bridge indicated possible load rating capacities higher than catalogued by the SCDoT.

The SCDoT is faced with a decision on how to proceed with field testing bridges. There are many bridges in the State inventory that are listed as deficient, many of these affecting some major highways. Better understanding the behavior of these bridges could lead to changes in the anticipated load capacity of many bridges. This may in turn prevent unnecessary bridge replacement or repairs. The possible savings to the SCDoT in the short term are significant. The cost of a single bridge repair could and likely would exceed the cost of all phases of this investigation. The conclusions of this investigation clearly indicate that the SCDoT should move forward and implement a bridge testing program.

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