TECHNICAL SUMMARY

Load Testing for Assessment and Rating of Highway Bridges

Phase I: Review of Current and Experimental Technologies and Practices

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This study reviewed some of the current and experimental technologies and practices used in the instrumentation (field testing) of highway bridges. In addition, 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. Several other state DoTs recently have implemented bridge testing programs and although they don't have specific cost savings, all agree the that long-term cost savings clearly justify the cost to develop, implement and conduct a bridge testing program. The study concluded that the SCDoT should continue their development of a bridge testing program. The next phase would focus on the development of a test methodology and equipment needed to conduct bridge tests and conduct a limited number of bridge tests to evaluate and improve the bridge testing program.

Results

Bridges are being subjected to higher loads than ever. The bridge infrastructure is aging and in need of across-the-board evaluation. The need for bridge tests arises from the necessity of knowing the response spectra for any given bridge. It is believed that this information cannot be adequately obtained by visually inspecting or conducting typical analyses on these bridges. Bridge instrumentation using modern testing devices has proven to be a reasonably effective means of developing the response spectra of a bridge to a known load case. This information will be crucial to determining the actual capacity of bridges and assessing bridge conditions prior to repair or replacement decisions being made. The South Carolina bridge inventory has a large number of bridges that are categorized as deficient. While many of these bridges may be truly deficient, many may not be deficient and can be shown to be adequate with additional tools such as load testing to provide more accurate assessment of the bridge capacity. Currently, these deficient bridges can be easily identified using the FHWA database for bridge networks.

Various problems have arisen in the past during instrumentation, especially regarding tests of concrete bridges. It has always been challenging to instrument concrete bridge members due the difficulty in obtaining accurate strain measurements on the surface of the concrete. This has typically resulted in the instrumentation of the reinforcing bars, which required substantial preparation time to expose the reinforcing. Recent advances in bridge instrumentation technology have produced more reliable surface-mounted gages in the form of strain transducers. These transducers utilize a longer gage length to average the strain value, thus countering the problems posed by tensile surface cracking in the concrete. The time required to instrument and test other bridge types has also dropped significantly in recent years. Companies are now producing complete testing systems for instrumentation, data collection, and data analysis. This will greatly reduce the time required for testing each bridge if the testing equipment is mastered by the user. These testing systems do require a substantial initial investment, but the time and effort saved more than cover the cost of the equipment.

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 State of Connecticut has already realized substantial benefit from testing as discussed previously. Although the testing procedures discussed and suggested by this investigation are not the most technical and state-of-the-art, they are sufficient for their intended purpose of the investigation, which is to develop response spectra for existing bridges for the purpose of posting evaluation. Changes to the base system can be implemented on an as-needed basis in the future to capture dynamic response and other items not addressed by this investigation.

The conclusions of this investigation clearly indicate that the SCDoT should move forward and implement a bridge testing program. Other state DoT's have benefited from initiating bridge testing programs and while not being able to specifically quantify the cost savings are clearly convinced that their bridge testing program is a very effective tool to reduce bridge retrofit and replacement costs. Given the number of bridges in the State of South Carolina that have been posted as well as the potentially larger number of bridges that may be posted in the next decade, a substantial return on the investment to develop, implement and execute a bridge testing program will be realized by the SCDoT.

Researchers—This study was conducted under research contract 588-SCDoT by Scott D. Schiff (faculty) and Terrance W. Philbrick, Jr. (graduate student) within the Civil Engineering Department; Clemson University; Lowry Hall - Box 340911; Clemson, SC 29634-0911. Contact information: 864.656.0456 (voice); 864.656.2670 (fax); scott.schiff@ces.clemson.edu.

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