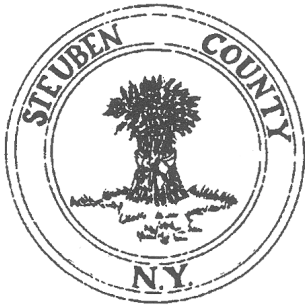


RESEARCH PAYS OFF

Bridge-Testing Technique Receives High Rating in New York



Bridge engineers have been faced in recent years with an increasing need to reevaluate a growing number of older, sometimes deteriorated bridges. These bridges must often carry higher volumes and heavier traffic than they did when they were originally designed. In the evaluation of these bridges, attempts have been made to compensate for uncertainties by using conservative analysis techniques and idealized mathematical models to assess load-carrying capacity. This approach sometimes results in the removal, closing, or conservative load-limit posting of structures that may have excess capacity not accounted for in traditional analyses. Substantial benefits may be realized if appropriate candidate bridges can be evaluated through nondestructive load testing to assess their actual load-carrying capacity. In Steuben County, New York, engineers realized the potential of load testing, applied the methodology to a bridge, and were able to keep the bridge open without a load-limit posting.

Problem

Nondestructive bridge testing is used as a research tool and, to a limited extent, to determine load-carrying capacity. These tests often require costly equipment and expertise normally unavailable to bridge owners. Load-testing methods that can be used reliably by agencies not specialized in physical bridge testing will improve the rating process. Such methods may be used for structures that require load-limit posting based on conventional analyses.

Clear-cut guidelines are needed to determine when load testing is an appropriate method for use in the bridge load rating process. Analysis of the possible benefits, risks, and costs that would be involved to load test a bridge are also required by bridge owners.

Solution

The National Cooperative Highway Research Program (NCHRP) contracted with Raths, Raths and Johnson, Inc., under Project 12-28(13), Nondestructive Load Testing for Bridge Evaluation and Rating, to develop guidelines for nondestructive load testing of highway bridges to augment the analytical rating process. The project resulted in a draft procedure for performing some of the more common nondestructive load tests. In order to allow bridge owners to take advantage of load testing in bridge load rating, however, a detailed procedure for integrating test results into strength evaluations had to be developed.

As a follow-up to Project 12-28(13), NCHRP contracted with A. G. Lichten-

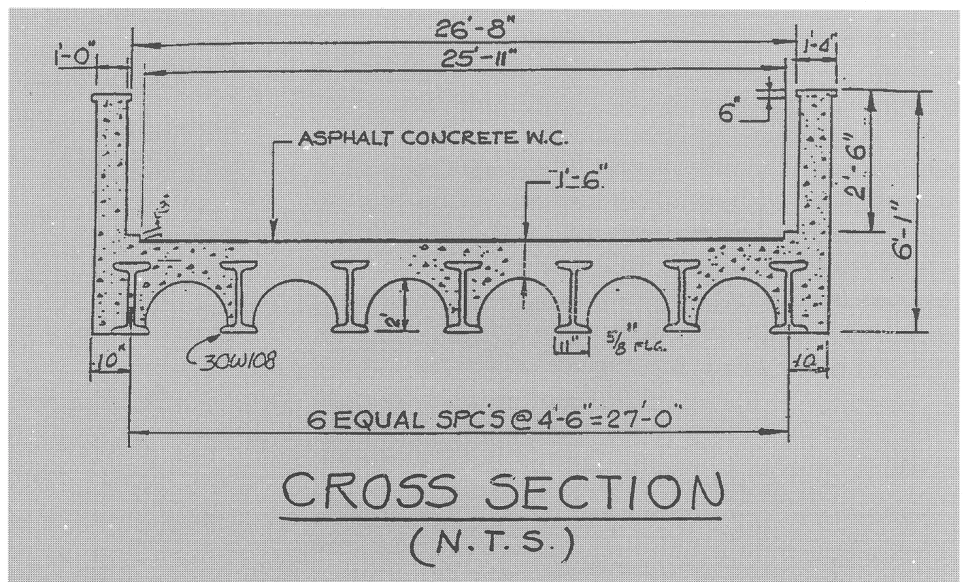


FIGURE 1 Cross-section schematic of bridge on County Route 57, Steuben County, New York.

stein and Associates, Inc., under Project 12-28(13)A, to develop simple nondestructive load-testing and load-rating techniques that could be applied to selected bridges in order to more accurately assess their safe load-carrying capacity. The results of the project are the *Manual for Bridge Rating Through Load Testing*, which may be used as a supplementary document to the American Association of State Highway and Transportation Officials' *Condition Evaluation Manual for Bridges*, and a workshop, with appropriate instructional materials, to assist in teaching the new load-testing and rating procedures to interested parties. The manual includes two testing concepts: (a) diagnostic testing, in which a load is applied to a bridge and its response (e.g., deflection) is measured and compared with that calculated through traditional structural analysis; and (b) proof testing, in which loads are applied incrementally to a bridge and the overall response of the bridge is monitored until a target load (e.g., a desired carrying capacity plus a safety factor) is reached. The workshop materials have been turned over to the Federal Highway Administration for use in potential future course offerings on nondestructive load-testing techniques.

Application

Pilot workshops were held in Irvine, California, and Albany, New York, as part of the workshop development. Stephen C. Catherman, a professional engineer with the Department of Public Works, Steuben County, New York, attended the Albany pilot, which was hosted by the New York State Department of Transportation in May 1993. On leaving the pilot workshop, Catherman considered applications of the new techniques to the bridges in his jurisdiction. One of these bridges was a 1930s multigirder design with a concrete "jack arch" deck carrying County Route 57. The bridge was going to require posting based on traditional analytical load-rating techniques for an H20 truck loading (one of the standard truck-load magnitude and position configurations



Downstream view of bridge on County Route 57 over Carrington Creek, Steuben County, New York.

used in the analysis and design of bridges). The structure was suspected to have additional capacity beyond that calculated. Because of the county's desire to maintain a desirable load rating (i.e., avoid posting) for the bridge, the county engineer turned to the knowledge gained from the pilot workshop and the information from the newly developed manual.

The County Route 57 bridge was judged to be a good candidate for proof load testing, so the county sequentially placed four loaded trucks on the bridge following the methodology described in the manual. The measured deflections for the bridge under the loads were minimal and no distress was noted at the maximum applied load. Using the load-rating formulas listed in the manual, the bridge inventory load rating (i.e., the load the bridge can be expected to carry on a routine basis) and operating load rating (i.e., the maximum allowable load on the bridge) were determined.

Benefits

The nondestructive load testing and associated load rating indicated a safe load-carrying capacity that allowed the county to maintain unrestricted legal loading

(e.g., H20 loading) on the bridge. This kept the bridge and County Route 57 open to a wider variety of truck traffic, resulting in a savings to the traveling public measured in decreased travel times (for trucks that otherwise would have been detoured around the bridge). Steuben County benefitted by being able to allocate limited resources that otherwise might have been directed toward rehabilitation or replacement of the County Route 57 bridge over Carrington Creek, to other bridges with structural or functional deficiencies.

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Suggestions for "Research Pays Off" topics are welcome. Contact G. P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2952).