

NCHRP

REPORT 483

**NATIONAL
COOPERATIVE
HIGHWAY
RESEARCH
PROGRAM**

Bridge Life-Cycle Cost Analysis

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP REPORT 483

**Bridge Life-Cycle
Cost Analysis**

HUGH HAWK

National Engineering Technology Corporation
Arlington Heights, IL

SUBJECT AREAS

Bridges, Other Structures, and Hydraulics and Hydrology

Research Sponsored by the American Association of State Highway and Transportation Officials
in Cooperation with the Federal Highway Administration

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation Officials, or the Federal Highway Administration, U.S. Department of Transportation.

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Hugh R. Hawk, Chief Bridge Engineer, Delcan Corporation, was the principal investigator. The other authors of this report are Dr. Andy Lemer of the Matrix Group and Dr. Kumares Sinha, Professor of Civil Engineering, Purdue University. The bulk of the soft-

ware programming was conducted by Nimira Kurji, Delcan Corporation. Assistance in the testing of the software was provided by Stepanka Elias, a former employee of Delcan and now a research assistant at the University of Toronto. The bulk of the work was done under the direct supervision of Hugh Hawk. Background material was coordinated by Dr. Sinha, and the State-of-the-Art Study was conducted by Dr. Lemer.

FOREWORD

*By David B. Beal
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This report contains the findings of a study to develop a methodology for bridge life-cycle cost analysis (BLCCA) for use by transportation agencies. The report describes the research effort leading to the recommended methodology and includes a guidance manual for carrying out BLCCA and software that automates the methodology. The material in this report will be of immediate interest to engineers concerned with the life-cycle cost analysis of major bridges.

Transportation officials consider life-cycle cost analysis an important technique for assisting with investment decisions. Several recent legislative and regulatory initiatives recognize the potential benefits of life-cycle cost analysis and call for consideration of such analyses for infrastructure investments, including investments in highway bridge programs. Because a commonly accepted, comprehensive methodology for bridge life-cycle cost analysis (BLCCA) did not exist, NCHRP Project 12-43 was initiated.

Under NCHRP Project 12-43, National Engineering Technology Corporation developed a comprehensive procedure for life-cycle cost analysis. Of particular note is the explicit introduction of vulnerability and uncertainty in the analysis. Consideration of vulnerability and uncertainty results in a more realistic estimate of life-cycle cost. Although default values are provided for cost parameters, users will benefit from the development and use of parameters specific to the structure and environment in question.

The proposed methodology is fully described in the Guidance Manual (Part II of the report). The methodology is implemented in software contained on a CD bound with the report (*CRP-CD-26*). The report appendixes, the Guidance Manual, and a User's Manual are accessible from the software. The User's Manual presents four examples of the application of the methodology.

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BRIDGE LIFE-CYCLE COST ANALYSIS

SUMMARY

NCHRP Project 12-43, “Life-Cycle Cost Analysis for Bridges,” has resulted in *NCHRP Report 483* and *CRP-CD-26*, which can be used by professionals to undertake life-cycle costing analysis for bridges. The report has two parts. Part I (the Report) establishes guidelines and standardizes procedures for conducting life-cycle costing. Part II (the Guidance Manual) is useful to all professionals engaged in life-cycle cost analysis either for the repair of existing structures or for the evaluation of new bridge alternatives. The Guidance Manual outlines the concept of life-cycle costing, identifies sources for data, and explains the methodology by which life-cycle costing can be conducted.

CRP-CD-26 contains the appendixes to the Report (Appendixes A, B, D, and E; Appendix C is the Guidance Manual); the User’s Manual and Guidance Manual both as Word documents and in portable document format (pdf); and the bridge life-cycle cost analysis (BLCCA) software. The BLCCA software provides a tool for professionals to apply the life-cycle cost-analysis concepts and methodologies to the analysis of bridges. The software considers agency and user costs and enables the user to consider both vulnerability and uncertainty in the analysis.

In combination, the Report, Guidance Manual, and software are a powerful tool that can be applied to the decision-making process for the repair or selection of cost-effective alternatives for the preservation of bridge assets for short-term and long-term planning horizons. *NCHRP Report 483* and *CRP-CD-26* are companions to the network-based Bridge Management Systems.
