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Research Title:
Accelerated Construction Decision-Making Threshold Levels

Research Authors:
Sam Salem; University of Cincinnati
Richard Miller; University of Cincinnati

Website:
http://www.mrutc.org/research/0504/index.htm

Contact Information:
University of Cincinnati
Department of Civil and Environmental Engineering
PO BOX 210071
Cincinnati, OH 45221

MRUTC Contact Information:
Greg Waidley
1415 Engineering Drive, Rm 2205
Madison, WI 53706
(608) 262-2013
gwaidley@engr.wisc.edu

Research Summary Series

A series to disseminate results of research being conducted by the Midwest Regional University Transportation Center, Federal Highway Administration, and Wisconsin Department of Transportation

Accelerated Construction Decision-Making Threshold Levels

Project 05-04

Research results in a quick and easy-to-read format

Background

The National Bridge Inventory shows that more than 480,000 bridges that serve the U.S highways are of a median age of more than 42 years and a design life of 50 years. According to statistics reported by the Federal Highway Administration (FHWA), approximately 14 and 16 percent of the bridge inventory falls into the functional and structural deficient categories, respectively. More than half of the known bridge deficiencies are structural deficiencies. If the defects are not rectified in time, the expenses required to rectify the structural defects could increase substantially.

Project Overview

In 1997, nationwide bridge expenditures related to system preservation and construction of new highway bridges were US$61 billion and US$10 billion, respectively. Because the need for upgrades and repair usually exceeds the funds available, decision makers must determine the best use of limited funds available. In a mature infrastructure system, upgrade, repair, or replacement requires either restriction or closure of those parts of the system. The Ohio DOT has started several initiatives aimed at reducing problems associated with reconstruction of roadways. Some important findings of the initiatives identify bridges as a significant source of delays in the reconstruction process of roadways. Studies have also revealed that some of the barriers to minimizing down time are not technological and include: business, safety, political, environmental and personal factors. Implementation of accelerated construction initiatives should change from the traditional planning and construction approach to a systems approach that considers all possible impacts and contributing factors during the planning stage.

Task Descriptions

I. Determining the non-technical factors affection accelerated bridge construction
   a. Literature search and communication with special task forces
   b. DOT interviews
   c. Survey of 50 DOTs
   d. Observe Ohio DOT construction projects

II. Develop the Decision Model
   a. Preliminary model which will provide a decision guideline

III. Validate decision model
   a. Interview key bridge experts
   b. Apply model to one or two Ohio bridge projects
   c. Recommend policy changes and write final report

Analytical Hierarchy Process

The accelerated construction decision making model in this report is based on the Analytical Hierarchy Process (AHP). The Analytical Hierarchy process, being used in more than 57 countries (as of 1995) all over the world, was developed by Prof. Thomas Saaty at the Wharton School of Business. This process allows the decision makers to model complex problems into a hierarchical structure showing the relationship between the ultimate goal, the objectives (factors), sub-objectives (sub-factors) and alternatives. In allowing the decision makers to derive ratio scale properties (opposed to arbitrarily assigning them), AHP not only supports decision makers by enabling them to structure complexity and exercise judgment, but also allows them to incorporate both objective and subjective considerations in the decision process. This method is a compensatory decision methodology as alternatives that are deficient with respect to one or more objectives (factors) can compensate by their performance with respect to other objectives. AHP is composed of several previously existing but unassociated concepts and techniques such as hierarchical structuring of complexity, pairwise comparisons, redundant judgments, eigenvector method for deriving weights, consistency considerations, etc. which have been combined to form a process which is far superior to its individual constituents.

Conclusion

The decision making process for identifying an optimum strategy for construction of bridges, shown in Figure 1, involves careful evaluation of a number of factors. In the surveys of state DOTs conducted as a part of this study, it was found that all the DOTs evaluate these factors during the decision making process in a qualitative and quantitative way. It was also found that factors such as impact of construction on local communities, local economy, impact on traffic flow have a significant impact on the eventual selection of a bridge construction plan. The safety of motorists, construction workers, pedestrians, reduced impact on surrounding communities and businesses on account of accelerated construction can’t be quantitatively evaluated.The decision makers can choose which factors will be addressed using the system and assign priorities to these factors and derive the weights using mathematical sound method.