Overview

The nation has a multibillion-dollar investment in its bridges. The protection of that investment through proper design, inspection, repair, and rehabilitation cannot be overstressed. Data from the Federal Highway Administration (FHWA), “1989 Status of the Nation’s Highway and Bridges: Conditions and Performance and Highway Bridge Replacement and Rehabilitation Program,” show that, as of 30 June 1988, 28% of the approximately 275,000 bridges on the federal-aid system are deficient in some manner. Fifty-three percent of the approximately 303,000 bridges off the federal-aid system are also listed as deficient.

Given the condition of the nation’s bridges, the FHWA, the states, and local government agencies are actively developing bridge management systems to establish sound procedures for bridge rehabilitation and replacement. It is estimated that 40% of all bridge deck area on the federal-aid system is between 15 and 35 years old. The majority of these decks have minimum cover for reinforcing steel and are without corrosion protective systems.

ASTM Subcommittee D04.32 on Bridges and Structures and D04.36 on Bridge Deck Protective Systems, subcommittees of ASTM Committee D-4 on Road and Paving Materials, have developed standards and recommended practices associated with bridge materials, inspection techniques, construction and rehabilitation methods, and related definitions in an effort to provide designers and users with the necessary information for extending the life of bridges. These ASTM subcommittees are aware of the activities of the Strategic Highway Research Program (SHRP) and American Association of State Highway and Transportation Officials (AASHTO), groups that have similar interests and responsibilities.

In an effort to provide the latest information, ASTM Subcommittees D04.32 and D04.36, as well as Committee G-1 on Corrosion of Metals, sponsored a December 1989 symposium on “Extending the Life of Bridges” in Lake Buena Vista, Florida. This special technical publication is a compilation of the papers presented at that symposium. The papers represent a good cross section of relevant and current issues related to bridge structures throughout the country. The papers range from the establishment of a bridge ranking system, to detailing specific inspection techniques, to designing relatively new types of bridge decks.

Weissmann et al. describe a procedure developed for the state of Texas that can be used to rank and prioritize bridge projects. Bridge management systems are becoming increasingly popular throughout the country, and this paper can contribute significantly to that effort.

Increasing size and weight of vehicles is of concern since many bridges in service have been designed for lighter loads. Ontario has conducted many load tests on existing bridges and has found that generally the bridges can carry considerably more loads than the theoretically evaluated values. Tharmabala details three examples of these strength evaluations.

All too often structural cracks are discovered in steel bridges, resulting in traffic restrictions and, in many cases, complete closure of the bridge until repairs can be completed. It is not uncommon to see the cracks originate in the weld areas. Pullaro addresses a retrofit repair method used when a crack developed through the web and flange of a girder on a structure in Rhode Island. The problem was traced to a porosity defect at the root of a weld. Postweld
stress relief through a shot-peening process is the subject of a paper by Welsch. The author describes methods currently used to prevent fatigue cracking and explains the advantages of peening.

Neoprene bridge bearing pads have been in common usage in the United States since 1957. The advantages of neoprene pads and their performance record are documented by Burpulis et al. Pads removed from older structures have been tested and results compared with original and current specifications.

Bridge deck durability is a problem of monumental proportions, especially in cold weather states where the routine use of deicing chemicals is a major cause of deterioration. Significant advances in the form of epoxy-coated reinforcing steel, corrosion-inhibiting concrete admixtures, sealers, deck overlay systems, etc., will likely result in increased deck life on new structures or on structures where the deck is replaced. Considerable challenges remain in the rehabilitation of older decks. Several papers deal with deck designs, treatment, repairs, etc.

Bettigole reviews various bridge deck construction methods and discusses how design, construction, and service considerations may impact costs and serviceability. Deck replacement with orthotropic steel plates is a system explained in detail by Stahl. The system consists of removing a section of old deck and replacing it with a prefabricated section of new orthotropic deck. It has a significant advantage when it is imperative that traffic disruption be held to a minimum. Case studies of several large bridges are reviewed.

A common method of prolonging the life of bridge decks is with the application of a concrete overlay. Most overlays consist of either low slump dense concrete or latex-modified concrete. More recently concrete containing microsilica or high-range water reducers has been used for this purpose. The purpose of the overlay is to not only repair the distress in older decks but also to provide protection in the form of additional concrete cover over the reinforcing steel with a concrete of low permeability to chloride ions. Babaei and Hawkins document the performance of twelve latex-modified concrete and low-slump dense concrete overlays in the state of Washington.

Another method of deck protection is with the use of sealers to prevent the intrusion of chloride, thereby minimizing corrosion of the deck steel. Weyers et al. reviewed the performance of a bridge deck in Pennsylvania that was impregnated with a monomer to a depth of 3 to 4 in. and polymerized in situ.

Joints in bridge decks have been of concern for many years. Joints frequently leak and become rough, causing both substructure deterioration and increasing impact loads on the deck. Improvement in joint systems would be very beneficial in improving the life and performance of the structure. Watson describes a joint system utilizing elastomeric concrete and suggests appropriate construction procedures and material properties that may result in enhanced performance.

The papers briefly mentioned here are intended to provide the reader with the latest developments that should serve to provide increased service life on the nation's bridges. The symposium committee acknowledges the contributions of the authors and symposium participants. The efforts of the ASTM staff in the development of this special technical publication is especially appreciated.

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