Rehabilitation to Improve Safety, Reduce Congestion, and Extend Service Life of Highway Bridges

by M. Myint Lwin

There are about 600,000 highway bridges in the United States with state and local governments owning most of them. More specifically, 47 percent are owned by the states and 51 percent owned by local governments, such as counties and municipalities. The remaining 2 percent are federally and privately owned. Concrete, steel, prestressed concrete, and timber are the predominant materials used in bridge construction. Other materials, such as, masonry, cast or wrought iron, aluminum, and composites are used in less than 1 percent of the bridges.

The average age of the highway bridges in the United States is about 45 years. Many are approaching 100! As the aging bridges are used by an increasing number of vehicles and subjected to higher vehicular loads, forces of nature, and corrosive environment, their physical conditions are deteriorating, their load-carrying capacities are reduced, and their roadway widths are becoming inadequate. Over 28 percent of the nation's highway bridges are considered structurally deficient or functionally obsolete.

The U.S. Congress finds and declares that it is in the vital interest of the United States that a highway bridge program be carried out to enable states to improve the condition of their highway bridges over waterways, other topographical barriers, other highways, and railroads. This is to be accomplished by replacement and rehabilitation of bridges that are determined to be structurally deficient or functionally obsolete, and through systematic preventive maintenance of bridges.

Highway Bridge Replacement and Rehabilitation Program

The Surface Transportation Assistance Act of 1978 replaced the Special Bridge Replacement Program (SBRP) with the Highway Bridge Replacement and Rehabilitation Program (HBRRP) extending funding to include rehabilitation to restore the structural integrity of a bridge on any public road, and rehabilitation work necessary to correct major safety defects.

The Surface Transportation Assistance Act of 1982, the Surface Transportation and Uniform Relocation Assistance Act of 1987, and the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) continued the HBRRP. Additionally, ISTEA allowed federal participation in bridge painting, seismic retrofitting, and calcium magnesium acetate applications.

The Transportation Equity Act for the 21st Century (TEA-21) continued HBRRP. It authorized the set-aside of $100 million for each FY1999-2003 for discretionary allocation by the secretary for major bridges with the provision that a maximum of $25 million would be made available for seismic retrofit of bridges, including projects in the New Madrid fault region. It also authorized a set-aside of $25 million for FY1998 for seismic retrofit of the Golden Gate Bridge. TEA-21 changed the HBRRP eligible work activities to include sodium acetate/formate or other environmentally acceptable, minimally corrosive anti-icing and deicing compositions, and installing scour countermeasures.

The Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) of 2005 continued the HBRRP for replacement or rehabilitation of structurally deficient and functionally obsolete highway bridges in the states. Under this legislation, painting, seismic retrofit, systematic preventive maintenance, installation of scour countermeasures, and the application of calcium magnesium acetate, sodium acetate/formate, or other environmentally acceptable, minimally corrosive anti-icing and deicing compositions are eligible for HBRRP funding.

Eligibility for Federal Funds for Rehabilitation

In general, rehabilitation project requirements necessary to perform the major work required to restore the structural integrity of a bridge as well as work necessary to correct major safety defects are eligible for federal-aid funds. Bridges to be rehabilitated shall, as a minimum, conform to the provisions of 23 CFR Part 625, Design Standards for Federal-Aid Highways, for the class of highway on which the bridge is a part.

An AASHTO-approved sufficiency rating formula is used as a basis for establishing eligibility and priority for rehabilitation of bridges. The sufficiency rating formula is a numerical rating system, 0 to 100, based on the bridge's structural adequacy and safety, essentiality for public use, and its serviceability and functional obsolescence. In general, the lower the rating, the higher the priority. A rating of 100 represents an entirely sufficient bridge, which does not require any work. A rating of 80 or less will be eligible for rehabilitation. A rating of less than 50 will be eligible for replacement. A rating of 0 represents an entirely insufficient or deficient bridge. A more detailed description of the sufficiency rating formula may be found in the FHWA Report No. FHWA-PD-96-001 Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges.

Systematic Preventive Maintenance

SAFETEA-LU has a special rule for preventive maintenance, allowing a state to perform seismic retrofit, systematic preventive maintenance, or installation of scour countermeasures for a highway bridge without regard to whether the bridge is eligible for replacement or rehabilitation.

This legislation makes systematic preventive maintenance activities, such as crack sealing, expansion joint repair, controlling deterioration, seismic retrofit, scour countermeasures, and painting, eligible for federal-aid funds. A state may carry out preventive maintenance for a highway bridge without regard to sufficiency rating or deficiency status. Systematic preventive maintenance implies the use of an effective

maintenance strategy or a prioritization and optimization system to gain the most benefit from the investment on preventive maintenance activities.

Systematic preventive maintenance and preservation activities are necessary for assuring proper performance of highway bridges. Experience has shown that preventive maintenance is a cost-effective way for extending the service life of highway bridges and preserving the highway systems.

Integrating Management Systems

As the population of bridges grows in number and age, the management tasks associated with preserving the serviceability and condition of bridges become very complex, time-consuming, and costly. Management and analytical tools are needed to collect and analyze the bridge data for predicting the present and future bridge preservation strategies and related costs. As the transportation agencies are facing limited resources—generally much less than the needs—for maintaining and preserving an efficient network of highways, it becomes ever more important to invest the resources in areas where the benefit-to-cost ratios are the highest. Since the 1980s, transportation agencies are using modern analytical methods, deterioration models, and high-speed computers to develop bridge management, maintenance management, and asset management systems to meet varying needs.

The challenge is the ability to effectively integrate a maintenance management system, bridge management system, and asset management system through a strategic framework to assure timely decisions in committing adequate resources to maintenance and rehabilitation to improve safety, reduce congestion, and extend service life.

The FHWA is committed to perform research, deploy tools, and provide training to assist the states and local governments in implementing and integrating effective management systems for making sound technical and financial decisions on maintaining the structural health and serviceability of a bridge or a network of bridges. For more information, please visit www.tfhrc.gov/structur, www.fhwa.dot.gov/infrastructure, www.fhwa.dot.gov/resourcecenter, and www.nhi.fhwa.dot.gov/training.

Closing Remarks

Congress has given us the technical and financial responsibility and flexibility to carry out the Highway Bridge Program to improve the condition and performance of the highway bridges through systematic preventive maintenance, cost-effective rehabilitation, and timely replacement. The works of a project should be coordinated and integrated to identify and meet the needs of the designers, constructors, inspectors, maintenance personnel, and others—working together to achieve safety, quality, and efficiency.

U.S. Department of Transportation
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