The AASHTO Manual for Bridge Element Inspection

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The need of bridge owners to effectively assess the condition of their bridge assets in order to efficiently manage their preservation, repair, rehabilitation, and replacement has been ever present. With the introduction of the 2013 *AASHTO Manual for Bridge Element Inspection* (AASHTO MBEI), 1st Edition, the American Association of State Highway and Transportation Officials (AASHTO) has developed a state-of-the-art tool for assessment of the nation's bridges.

Background

In the early 1990s the Federal Highway Administration (FHWA)—working collaboratively with several states—introduced the concept of more accurately assessing individual components or elements of bridges and how they deteriorate. This information is essential to bridge management.

Subsequently, AASHTO created the concept of bridge elements with the *AASHTO Guide for Commonly Recognized (CoRe) Structural Elements*, First Edition (1998). This inspection approach improves upon that required by the National Bridge Inspection Standards (NBIS) in that individual bridge elements are quantified and their condition assessed. For example, individual components of a concrete arch bridge—such as beams or stringers, floor beams, spandrel columns, arches, their concrete protective coatings, and concrete reinforcing steel protective systems—are quantified and their conditions are assessed rather than simply giving one condition assessment to the entire superstructure of an arch-type bridge as would be done with the NBIS.

A worker inspects under the State Highway 3 Bridge over Childs Creek in northern Idaho. All Photos: Idaho Department of Transportation

As the use of element-level inspection techniques proliferated, the need for improvements became identified. In 2011, AASHTO created the *AASHTO Guide Manual for Bridge Element Inspection* (GMBEI), 1st Edition. This manual contained many improvements and enhancements, such as:

- changes in the measurement units of decks and slabs,
- development of the wearing surface element,
- standardization of the number of element states,
- development of the protective coating element, and
- incorporation of expanded element smart flags.

The goal of the AASHTO GMBEI was to completely capture the condition of bridges in a simple way that could be standardized across the nation while providing the flexibility to be adapted to both large and small agency settings. Michael B. Johnson of the California Department of Transportation and Paul Jensen (retired) of the Montana Department of Transportation were fundamental to the development of the GMBEI.

After the introduction of the AASHTO GMBEI, bridge inspectors and bridge asset managers from bridge owner agencies, the FHWA, consultant inspection firms, and training instructors suggested improvements. The result is now presented as the 2013 AASHTO MBEI.

AASHTO MBEI

The AASHTO MBEI comprises 245 pages and has been divided into three sections and five appendices. Section 1, Background, discusses the philosophy behind element level condition assessment and multiple distress paths within the defined condition states. The multi-path distress language provides the means to fully incorporate all possible defects within the overall condition assessment of the element. The overall condition of the element can be utilized in this aggregate form, or broken down into specific defects as desired by the agency for bridge management system (BMS) use.

In Sections 2 and 3, the AASHTO MBEI provides a comprehensive set of bridge elements that are designed to satisfy the needs of all agencies. The element set presented includes two element types identified as national bridge elements (NBEs) and bridge management elements (BMEs). Also a framework for agency developed elements has been created to provide an agency with the ability to define custom sub-elements in accordance with the NBEs or BMEs or for agency elements not defined in the AASHTO MBEI. All elements are assigned a standard number representing one of four condition states: good, fair, poor, and severe.

NBEs represent the primary structural components of bridges necessary to determine the overall condition and safety of the primary load carrying members. NBEs are a refinement of the deck, superstructure, substructure, and culvert condition ratings defined in the FHWA's *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges*. Additional elements included in this section are bridge rail and bearings. NBEs are designed to remain consistent from

An under-bridge inspection truck is used at the site of State Highway 78 over Rabbit Creek in southwest Idaho.

Acronyms

Many acronyms are used in this article. Their definitions are provided below:

BME = bridge management element

BMS = bridge management system

GMBEI = Guide Manual for Bridge Element Inspection

MBEI = Manual for Bridge Element Inspection

NBE = national bridge element

NBIS = National Bridge Inspection Standards

agency to agency across the country, to facilitate and standardize the capture of bridge element conditions at the national level. In order to capture the diversity of new element design types and materials, many elements in this category have an "other" type element defined.

BMEs include components of bridges such as joints, wearing surfaces, and protective coating systems and deck/slab protection systems that are typically managed by agencies utilizing a BMS. BMEs are defined with a recommended set of condition assessment language that can be modified to suit the agencies needs as these elements are not intended to be utilized for the purposes of national policy making. BMEs defined within the AASHTO MBEI were purposefully left fairly general in nature to provide the flexibility to develop agency specific elements that best suit the local bridge management practices. Agencies may choose to develop additional BMEs as necessary following the agency-developed element conventions discussed in appendix A of AASHTO MBEI. When considering additional elements, the agency should consider such factors as element performance, deterioration rates, feasible actions, and preservation costs, as well as the practical considerations of training and inspection costs.

The elements presented in the AASHTO MBEI provide the flexibility for an agency to define custom elements in accordance with the defined element framework that may be sub-elements of NBEs or BMEs, or may be agency defined elements without ties to the elements defined in this manual. By defining a comprehensive set of bridge elements necessary for robust bridge management and the minimum set of elements necessary to assess the condition of primary components of bridges, the AASHTO MBEI provides a flexible element set that can be tailored to the needs of all agencies.

The new elements contained within the AASHTO MBEI have been introduced into AASHTOWare™ Bridge Management software BrM (formerly Pontis), as well as other bridge management systems. The new elements and the AASHTO MBEI as a whole are foreseen to provide greatly improved tools to bridge owners and will enable them to more effectively manage their bridge assets.