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## **2.2 CONDITION EVALUATION PROCEDURES**

### **2.2.1 Introduction**

The biggest challenge in any bridge inspection program is to relate the material distress found on a bridge to its effect on the structure's strength and safety. Another challenge is to create uniformity between all bridge inspectors for rating the structural condition of a bridge.

It is expected that all qualified bridge inspectors have a basic understanding of bridge mechanics and of how deterioration of a certain bridge component will affect (or will not affect) the bridge's performance and public safety. So that all bridge inspectors will more or less come to the same conclusions regarding the structural condition of a bridge and causes for its distress, two standard inspection methods are currently used in Wisconsin: Element Level inspections and National Bridge Inventory (NBI) inspections. Both are currently used for all inspections.

### **2.2.2 Element Level Inspection**

Element Level bridge inspections have been used since the early-1990s. This inspection method developed because of the need for bridge owners to manage and allocate the limited funds available for maintenance, repair, and rehabilitation of their structures. It identifies problems at particular components of a structure and recommends measures to be taken to ensure the longevity of a bridge. The intent of Element Level inspections is to capture all major bridge components in an effective simple way while providing agencies with an appropriate amount of flexibility. The Element Level inspection method breaks the bridge down into several elements, such as the railing, deck, girders, diaphragms, abutments, pier columns, etc. Each element is inspected for defects. The defects are assigned a Condition State based upon its state of deterioration. The various defects quantified on an element then determine the Condition State of the element as a whole. Condition States are numeric ratings that reflect the state of deterioration of an element. Every element has the same possible number of condition states, four which are comprised of the following overall rating: Condition State 1 – Good, Condition State 2 – Fair, Condition State 3 – Poor and Condition State 4 – Severe. Each defect condition state uses standard phrases to describe the deterioration. The standard phrases increase uniformity and consistency of bridge inspection reports. Many elements, depending on their unit of measure, can be split into several different defects and assigned different Condition States to reflect the differing categories and differing rates of deterioration that often exist on any one bridge element.

One of the end results of performing Element Level inspections is the generation of a database for the bridge management system computer software. By developing a database over time, bridge deterioration rates based upon material, geographic location, age, usage, type of crossing, prior rehabilitation or preventive actions, etc. can be estimated. The software modeling capabilities allows comparisons between the effectiveness of preventive and corrective actions, predictions of estimated future deterioration, and life cycle costs. In this way, informed decisions can be made regarding prioritizing funds, when (or when not) to take action, and what type of action to take for the maximum benefit of money spent.

Per the Federal Highway Administration, all State and Federal agencies, were required to collect element level data for every NHS Bridge by October 1, 2014 and submitting this data



to the FHWA by April 1, 2015. Wisconsin has been performing element level inspections since the early 1990's.

The American Association of State Highway Transportation (AASHTO) has released an updated version of its element level inspection manual titled, *Manual for Bridge Element Inspection, 1<sup>st</sup> Edition*. Elements are broken down into three categories: National Bridge Elements (NBEs), Bridge Maintenance Elements (BMEs) and Agency Defined Elements (ADEs).

- National Bridge Elements (NBEs) are the primary structural components which determine the general overall condition and safety of members carrying the primary load. These are to remain unchanged from one agency to another across the nation in attempt to facilitate and standardize bridge element condition descriptions.
- Bridge Maintenance Elements (BMEs) are more generic and can be modified by an agency as needed. They are defined with modifiable recommended condition assessment language and are purposefully fairly general in order to allow flexibility for the agency to develop specific local bridge preservation practices and standards. Additional BMEs can also be created by the agency as needed. These added elements should take into account such factors as element performance, deterioration rates, feasible actions, preservation costs, and also the practicality of said elements.
- Agency Developed Elements (ADEs) are elements an agency can create for added flexibility. These may be sub-elements of NBEs or BMEs or may be elements independent of national standards and recommendations.
- All elements have associated material defects. Those elements comprised of the same material share the same defect. Defects are a refinement to the element level inspection process to further break down and more accurately reference element deterioration. WisDOT has the opportunity to create its own defects if the Department has a deficiency it would like to capture.

#### 2.2.3 National Bridge Inventory (NBI) Inspection

The Federal Highway Administration (FHWA) *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges (Coding Guide)* is the basis for the NBI inspection condition ratings. It has been used as the basis for bridge inspections since 1971, and its primary objective is to monitor the safety of the nation's bridges. The *Coding Guide* provides guidance for rating the condition of a bridge's deck, superstructure, substructure, and channel (if it exists). It also provides condition rating guidance for culverts. By using standard phrases related to each rating code, increased uniformity and consistency can be achieved. Aside from establishing a component's physical condition, rating data is used in a variety of analyses and decisions performed by Wisconsin Department of Transportation (WisDOT) and the FHWA. The data helps in determining the sufficiency of a bridge to remain in service, rehabilitation and replacement eligibility, etc. Based on this inspection method, funding for maintenance, repair, and rehabilitation is determined on an individual bridge basis.



In contrast to the Element Level inspection, NBI inspection results rate as a whole only major bridge components (deck, superstructure, and substructure) without being specific as to where, how much or what type of deterioration exists. Each bridge component is assigned a numeric rating code ranging from 9 to 0, with 9 being “excellent condition” and 0 being “failed condition”. The ratings represent the overall physical condition of the component as compared to the day it was built. It is purely an evaluation of the bridge component’s material and its state of deterioration and not an evaluation of its ability to carry current legal loads. Sound engineering judgment is required in order to provide the most accurate condition of the primary structural components.

#### **2.2.4 Agency Submittal Requirements**

Both NBI Condition Ratings and Element Level Condition States of NBEs are required to be reported to FHWA. Wisconsin has been cataloging data from both inspection methods for several years.



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