MDOT
Michigan Department of Transportation

BRIDGE ADVISORY
Design Division
Bridge Management Section

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Note: This Bridge Advisory was originally issued on October 15, 2012 as Bridge Advisory 2012-02 (3). It is being re-issued as BA-2012-02 dated October 16, 2012 for cataloging purposes.

SUBJECT: Guidance for the use of "Field Evaluation and Documented Engineering Judgment" Ratings

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"Field Evaluation and Documented Engineering Judgment" is described in a memo issued by FHWA on February 2, 2011 (FHWA Memo). The Memo states "…judgment ratings must be documented." This reference shall serve as additional guidance for the use and documentation of judgment ratings in the state of Michigan.

Per AASHTO Manual for Bridge Evaluation, 2nd Edition 2010 (w/2011 Interims) Section 6.1.4:

> *"For bridges where necessary details, such as reinforcement in a concrete bridge, are not available from plans or field measurements, a physical inspection of the bridge by a qualified inspector and evaluation by a qualified engineer may be sufficient to establish an approximate load rating based on rational criteria."*

Furthermore, it states:

> *"A concrete bridge with unknown details need not be posted for restricted loading if it has been carrying normal traffic for an appreciable period of time and shows no distress. The bridge shall be inspected regularly to verify satisfactory performance."*

The commentary for section 6.1.4 states:

> *"Knowledge of the live load used in the original design, the current condition of the structure, and live load history may be used to provide a basis for assigning a safe load capacity. Bridge owners may consider nondestructive proof load tests to establish a safe load capacity for such bridge."*

Engineering judgment alone shall not be used to determine the live load capacity of a bridge component when sufficient structural information is known to utilize a rational method of analysis and rating.

The appropriate rating(s) shall be determined by the engineer upon careful consideration of all available information including, but not limited to:

- Year of construction and material properties of members
- Assumed design (Inventory) loading and controlling Operating vehicle
- Measurable structural dimensions
- Condition of load carrying components
- Redundancy of load path
- Changes since original construction
- Comparable structures of known design

These items are further discussed below:

Year of construction and material properties of members
If the year of construction is known or can be approximated, **material strengths and properties** may be estimated using an appropriate reference such as the MDOT Bridge Analysis Guide (BAG) Tables 10.25-10.29. The reference used and the assumed material strengths shall be documented.

Assumed Design (Inventory) loading and controlling Operating Vehicle
Year of construction may be used to establish the design vehicle for the structure. A history of Michigan **design loads** is included in chapter 2 of the MDOT BAG.

Span length may be used to compare moment and shear live load effects between vehicles, and to confirm which vehicle(s) control. Tables of moments and shears for legal and AASHTO "H" vehicles can be found in Chapter 10 of the MDOT BAG.

The observed performance of the structure under traffic shall be noted. Based on field observations and route ADTT information, consider the likelihood that the bridge has been subjected to full legal loads. For example, if a bridge is on a low volume rural roadway with little or no truck traffic, it may not have been designed for, nor ever subjected to full legal load. In such cases, posting may be necessary in order to prevent overload of the structure even if it does not show signs of distress.

Measureable structural dimensions
Span-to-depth ratios can be helpful to establish whether the bridge was designed in accordance with accepted design standards corresponding to the date of construction.

Condition of load carrying components
Member conditions shall be documented in detail and any observed conditions that could affect structural capacity shall be noted and accounted for in all judgment ratings. For example, the presence of vertical cracks near the middle of the span, or diagonal cracks near the supports may indicate overstress of a concrete member, and posting may be necessary.

In the absence of measureable loss that would require a detailed section loss calculation, the capacity of structures may be adjusted in accordance with the condition factors set forth in AASHTO Manual for Bridge Evaluation (MBE) Table 6A.4.2.3-1.

Changes since original construction
Modifications to the structure since original construction can increase or decrease member capacities. Any observed modifications shall be documented and effects to the structure noted.
Comparable structures of known design
Comparable structures of known design may be used to approximate the capacity of a structure with unknown components.

Redundancy of load path
The capacity of structures with limited redundancy may be adjusted in accordance with the system factors set forth in AASHTO MBE Table 6A.4.2.4-1.

Guidance for recording SI&A items 63-66 When using Engineering Judgment
Items 63, 64MA and 65 shall be coded "0" per the MDOT SI&A Coding Guide and Bridge Advisory BA-2012-01.

Federal Operating Rating (Item 64F) and Federal Inventory Rating (Item 66) shall be recorded in Metric Tons. Determine the appropriate Federal Operating Rating and divide by 1.67 to determine Federal Inventory Rating. If judgment is based on a known or assumed design vehicle, determine the appropriate Federal Inventory Rating and multiply by 1.67 to determine Federal Operating Rating.

Michigan Operating Rating (Item 64MB) shall be recorded in rating factor. Determine the rating factor of the controlling vehicle.

Michigan Operating Controlling Vehicle (Item 64MC) shall be the controlling vehicle based on Moment and Shear tables in Chapter 10 of the MDOT BAG. If two vehicles produce the same controlling moment or shear, or if different vehicles control moment and shear for a given span, the vehicle with the heaviest weight shall be recorded (see note below).

All applicable items shall be documented and placed in the bridge file along with the proposed ratings.

If there is not enough information available to properly determine a judgment rating, additional steps must be taken to establish the load carrying capacity of a structure.

If the strength of concrete or reinforcement is in question, material samples may be taken from the structure and tested. Material sampling shall be performed in accordance with Section 5 of the AASHTO MBE.

Alternately, the structure may be load tested to determine safe load carrying capacity. Load testing shall be performed in accordance with Section 8 of the AASTHO MBE. Items 63, 64MA and 65 shall be coded "4 – Load Testing".

Note: The direction to record the heaviest vehicle that causes the same controlling moment or shear only applies to item 64MC. When determining the posting load for a bridge (if applicable), the lightest controlling vehicle weight in each category (1 unit, 2 unit and 3 unit) shall be used for Item 141-Posted Loading.