



BRIDGE ADVISORY
Construction & Technology Division
Bridge Operations Section

BRIDGE ADVISORY NUMBER: BA-2009-04 – (Revised) **DATE:** October 2, 2009

Note: This advisory is reissued from August 24, 2009, to delete codes S, P, Q, and R, which were mistakenly shown. It also shows the footnotes and examples referenced.

SUBJECT: Coding Federal Bridge Inventory Item 113

ISSUED BY: MDOT Bridge Operations Engineer

REVIEWED BY: Scour Critical Bridge Committee

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The Federal Highway Administration (FHWA) published a memorandum April 27, 2001, that revised the coding instructions for National Bridge Inventory (NBI) Item 60, Substructure Rating and Item 113, Scour Evaluation. The Michigan Structure Inventory and Appraisal Coding Guide have been revised to reflect these changes.

The text of the revised instructions for coding item 113 is shown below. The source is <http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/revguide.cfm>

Item 113 - Scour Critical Bridges

1 digit

Use a single-digit code as indicated below to identify the current status of the bridge regarding its vulnerability to scour. Evaluations shall be made by hydraulic/geotechnical/structural engineers. Guidance on conducting a scour evaluation is included in the FHWA Technical Advisory T 5140.23 titled, "Evaluating Scour at Bridges."¹ Detailed engineering guidance is provided in the Hydraulic Engineering Circular 18 titled "Evaluating Scour at Bridges."² Whenever a rating factor of 2 or below is determined for this item, the rating factor for Item 60 -- Substructure and other affected items (i.e., load ratings, superstructure rating) should be revised to be consistent with the severity of observed scour and resultant damage to the bridge. A plan of action should be developed for each scour critical bridge (see FHWA Technical Advisory T 5140.23, HEC 18 and HEC 23³). A scour critical bridge is one with abutment or pier foundation rated as unstable due to (1) observed scour at the bridge site (rating factor of 2, 1, or 0) or (2) a scour potential as determined from a scour evaluation study (rating factor of 3). It is assumed that the coding of this item has been based on an engineering evaluation, which includes consultation of the NBIS field inspection findings.

Code Description

- N Bridge not over waterway.
- U Bridge with "unknown" foundation that has not been evaluated for scour. Until risk can be determined, a plan of action should be developed and implemented to reduce the risk to users from a bridge failure during and immediately after a flood event (see HEC 23).
- T Bridge over "tidal" waters that have not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections until an evaluation is performed ("Unknown" foundations in "tidal" waters should be coded U.)
- 9 Bridge foundations (including piles) on dry land well above flood water elevations.
- 8 Bridge foundations determined to be stable for the assessed or calculated scour condition. Scour is determined to be above top of footing (Example A) by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the service life of the bridge⁴), by calculation or by installation of properly designed countermeasures (see HEC 23).
- 7 Countermeasures have been installed to mitigate an existing problem with scour and to reduce the risk of bridge failure during a flood event. Instructions contained in a plan of action have been implemented to reduce the risk to users from a bridge failure during or immediately after a flood event.
- 6 Scour calculation/evaluation has not been made. (Use only to describe case where bridge has not yet been evaluated for scour potential.)
- 5 Bridge foundations determined to be stable for assessed or calculated scour condition. Scour is determined to be within the limits of footing or piles (Example B) by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the service life of the bridge), by calculations or by installation of properly designed countermeasures (see HEC 23).
- 4 Bridge foundations determined to be stable for assessed or calculated scour conditions; field review indicates action is required to protect exposed foundations (see HEC 23).
- 3 Bridge is scour critical; bridge foundations determined to be unstable for assessed or calculated scour conditions:
- Scour within limits of footing or piles. (Example B)
- Scour below spread-footing base or pile tips. (Example C)

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- 2 Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations, which are determined to be unstable by:
 - a comparison of calculated scour and observed scour during the bridge inspection, or
 - an engineering evaluation of the observed scour condition reported by the bridge inspector in Item 60.
 - 1 Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic. Failure is imminent based on:
 - a comparison of calculated and observed scour during the bridge inspection, or
 - an engineering evaluation of the observed scour condition reported by the bridge inspector in Item 60.
 - 0 Bridge is scour critical. Bridge has failed and is closed to traffic.

¹[FHWA Technical Advisory T 5140.23, Evaluating Scour at Bridges](#), dated October 28, 1991.

²[HEC 18, Evaluating Scour at Bridges](#), Fourth Edition.

³[HEC 23, Bridge Scour and Stream Instability Countermeasures](#), Second Edition.

⁴[FHWA Memorandum "Scourability of Rock Formations,"](#) dated July 19, 1991.

Consistent with the above coding from FHWA, MDOT is providing the following additional guidance:

1. A Scour Action Plan must be developed for any bridge with item 113 coded as 0,1,2,3, or U. It may be more practicable to develop a Scour Action Plan for a bridge with unknown foundations than to determine the foundation type.
2. If a bridge abutment foundation has spread footings and the foundations are protected by properly designed and installed scour countermeasures, the bridge may be rated Item 113 = 7. When the scour countermeasure is rip-rap properly designed for the 100 year flood, a scour action plan form should be filled out and the bridge should be inspected after the flood event for damage to the rip-rap. Note, this differs from a scour critical bridge where monitoring may be necessary during the flood event. Additionally, rip-rap needs to be inspected during routine bridge inspections for degradation or displacement of the rip-rap. If there is concern that the rip-rap is no longer functioning as intended, the bridge should be rated Item 113 = 3.
3. As shown above, a bridge is deemed "scour critical" if the "bridge foundations determined to be unstable for assessed or calculated conditions". A "critical" element of a bridge is defined as an element that if it were to fail the bridge could become unstable. When determining criticality redundancy is an important factor. For example, a steel member in tension is not considered critical if there are redundant members that can resist the load if one of the members were to fail. Similarly, if there is redundancy in a bridge foundation to resist scour (such as multiple rows of foundation piles) combined with properly designed, installed, and regularly inspected countermeasures, item 113 can be coded 8 and an action plan is not necessary.

4. Greater caution should be exercised when assigning a scour critical bridge rating for bridges having multi-spans and piers in the water, because piers typically are more vulnerable to scour than abutments, and it can be harder to inspect the condition of the scour countermeasures when the piers are in deep water.

It is also important that scour be considered in coding item 60, Substructure Rating. The language from the FHWA memorandum shown below shall be followed:

All substructure elements should be inspected for visible signs of distress including evidence of cracking, section loss, settlement, misalignment, scour, collision damage, and corrosion. The rating factor given to Item 60 should be consistent with the one given to Item 113 whenever a rating factor of 2 or below is determined for Item 113 - Scour Critical Bridges.

Resource Links:

FHWA Memorandum April 27, 2001:

<http://www.fhwa.dot.gov/engineering/hydraulics/policymemo/revguide.cfm>

Structure Inventory and Appraisal Coding Guide:

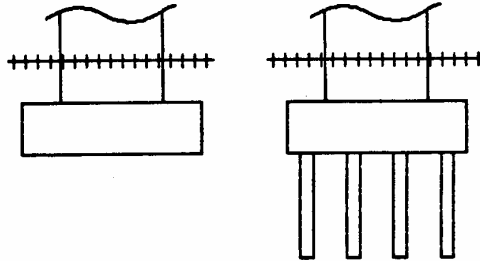
http://www.michigan.gov/documents/MDOT-Bridge-SIAMANUAL-2_87989_7.pdf

EXAMPLES:

CALCULATED SCOUR DEPTH

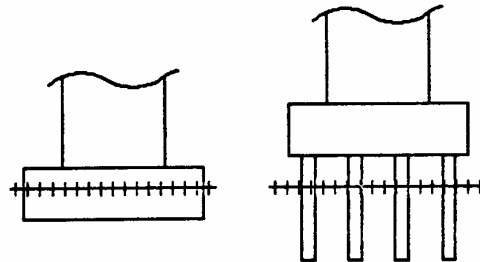
ACTION NEEDED

A. Above top of footing



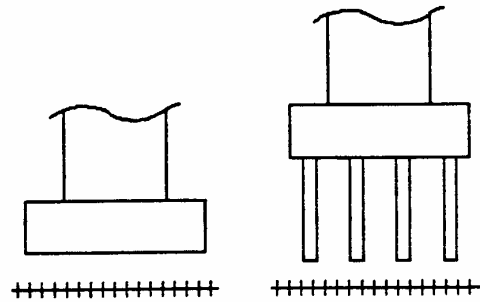
None - indicate rating of 8 for this item

B. Within limits of footing or piles



Conduct foundation structural analysis

C. Below pile tips or spread-footing base



Provide for monitoring and scour countermeasures as necessary

SPREAD FOOTING
(NOT FOUNDED
IN ROCK)

PILE FOOTING

+++++ = Calculated scour depth