



MINNESOTA DEPARTMENT OF TRANSPORTATION
Program Support Division
Technical Memorandum No. 07-10-B-02
July 19, 2007

To: Distribution 57, 612, 618, 650

From: Rick Arnebeck
Division Director
Engineering Services

Subject: Guidelines for In-Depth Inspection of Fracture Critical and other Non-Redundant Bridges and for Underwater Inspections

Expiration

This Technical Memorandum supersedes Technical Memorandum No. 02-22-B-01 and it will expire July 19, 2012 unless superseded prior to that date.

Implementation

This policy and its instructions are effective immediately.

Introduction

This Technical Memorandum provides guidelines to be used for In-Depth Inspection of Fracture Critical and other Non-Redundant Bridges and for Underwater Inspections.

Purpose

The In-Depth and Underwater Bridge Inspection Program is a joint effort of the Bridge Office (BO), the District Offices, and local government agencies. The purpose of this program is to ensure the safety of bridges with fracture critical and underwater members in accordance with Minnesota Statutes 165 and Minnesota Rule 8810, as well as complying with federal regulations and guidelines, which require appropriate inspection of bridge members. (National Bridge Inspection Standards, Title 23, Code of Federal Regulation, Part 650).

Guidelines

Definition

A Fracture Critical (FC) Bridge is a bridge that is not load path redundant and that has at least one fracture critical member or member component. Fracture critical members or member components (FCM's) are steel tension members or steel tension components of members whose failure would be expected to result in collapse of the bridge (Ref: AASHTO Manual for Maintenance Inspection of Bridges – 1994, www.transportation.org). A FCM lacks redundancy if when it fails, there is no alternate load path or member to which the failed member can shed its load.

Bridges that require underwater inspection have members that cannot be visibly evaluated during periods of low flow or examined by feel for condition, integrity and safe load capacity, due to excessive water depth or turbidity.

General Guidelines for In-Depth Inspection of Fracture Critical and other Non-Redundant Bridges

Inspection under these guidelines will apply to all bridges, except those bridges that carry only railroad and or pedestrian traffic, that have members determined to be fracture critical or with special features. The Bridge Office will evaluate all bridges that are not load path redundant to determine if and where fracture critical members are present. The frequency of in-depth inspection of each non-redundant member will be based upon the criticality and condition of the member. In-depth inspections of non redundant bridge members that are determined to be fracture critical will be scheduled at intervals not to exceed 24 months. In depth inspections of bridge members that are determined not to be fracture critical based on an evaluation of their internal or structural load redundancy or which are located on very low volume local roads and are determined to have negligible risk of failure will be scheduled at intervals not to exceed 5 years for bridges on local roads, and 4 years for bridges on Trunk Highways. All non-redundant bridges shall have Routine Inspections performed every year. Special in-depth inspections of other structures may be required to monitor a particular known or suspected deficiency.

The Bridge Office will, for all Non Redundant and FC bridges, monitor the In-Depth Inspection Program, maintain information files on the bridges, and assure the quality of 3rd party or district inspections in accordance with the attached Quality Assurance Plan. The Bridge Office will maintain a list of the following for those bridges which contain Non-Redundant and FCM's and those which contain unique or special features requiring additional attention during inspection to ensure the safety of such bridges (e.g. pin and hanger details and steel pier caps):

- Location and description of such members for each bridge
- In-depth or special feature inspection frequency
- Inspection procedure(s)
- Date of the last inspection
- Description of inspection findings
- Description of any follow-up action resulting from the most recent inspection

In-depth inspections are the responsibility of the Bridge Office. The Bridge Office will delegate these inspections if requested by the District. Currently, the Bridge Office will conduct these inspections in Districts 1, 2, 3, 4, 7, and 8. Districts 6 and Metro will conduct these inspections in their District. Scheduling priority for inspections will be given to large and complex bridges. For inspections conducted by the District, the Bridge Office will offer planning assistance as well as on-site inspection assistance. Traffic control and access equipment (man-lift, etc.) remain the District's responsibility regardless of participation by the Bridge Office.

The Bridge Office will provide a wide range of services to the Districts and local governments in support of in-depth inspections, including: identification of FCM's, training, on-site inspections, and non-destructive testing (NDT). Training provided to the Districts will include inspection procedures for FCM's, procedures for basic NDT methods, and identification of non-redundant bridges, FCM's and critical details.

Inspector Qualifications

In-depth inspections shall be conducted under the direct supervision of individuals which have been certified as, either, Mn/DOT Bridge Safety Team Leaders in accordance with the Mn/DOT Bridge Inspector Certification Program. Only qualified American Society for Non-Destructive Testing (ASNT) Level II or III technicians shall conduct NDT services, by ultrasonic methods.

Inspection Procedures and Reporting

In-depth inspections shall be conducted using under-bridge inspection units (snoopers), man-lifts, boats, ladders or any means necessary to visually inspect all FC members from a distance not to exceed 600 mm (**24 in.**).

Field inspections should be conducted in a systematic and organized manner that will be efficient and minimize the possibility of any bridge item being overlooked. All inspections shall be conducted following appropriate Mn/DOT safety guidelines for both the employee and the public. Critical findings shall be reported within 24 hours to the District, County, or City Bridge Engineer and to the Bridge Office Bridge Inspection Engineer and/or Bridge Construction and Maintenance Engineer. Detailed and narrative reports including sketches and photographs shall be provided to the Bridge Office and the District Bridge Engineer upon completion of the inspection. Reports shall include such items as:

- Identification of FCM's, special features, and/or critical details
- Description of areas visually inspected
- Description of areas tested by NDT methods
- Amount of corrosion and associated field measurements of loss of section
- Description of fatigue prone areas
- Length and extent of cracking present, and
- Extent of external damage due to impact or external factors

General Guidelines for Underwater Inspection

National Bridge Inspection Standards (NBIS) require inspection of all bridges as needed, not to exceed five (5) years in frequency to determine the condition of the underwater portion of the substructures with certainty. Certain underwater structural elements may be inspected at intervals, not to exceed seventy-two months, with written FHWA approval. Minnesota defines a bridge as needing underwater inspection when, "the water depth is such that the underwater portions of a substructure cannot routinely be inspected using waders during periods of low water depth." There are currently about 165 bridges carrying traffic on the trunk highway system in Minnesota that require special underwater inspections. The frequency of underwater inspection will be based upon the criticality and condition of the members underwater.

Underwater inspections shall be both a visual and a tactile inspection of the entire underwater portion of the substructure. Inspections shall include checking all concrete for erosion, wear, abrasion, scaling, spalling, exposure, and deterioration, and for any exposed reinforcing steel and all cracking. All exposed structural steel and piling shall be checked for misalignment and loss of section. All timber shall be sounded and checked for presence of bores, decay, and weathering. The channel bottom shall also be inspected for presence, size, condition of riprap, and for any evidence of scour.

The Bridge Office will, for all Trunk Highway bridges, monitor and conduct the underwater inspection program and maintain information files on the bridges. These underwater inspections will normally be performed by diving contracts administered by the Bridge Office. The Bridge Office will maintain a list of the following for those bridges which require underwater inspections:

- Location of the bridge and member to be inspected
- Type of foundation
- Bottom of foundation elevation or pile tip elevation
- Depth soundings at bridge as well as upstream and downstream of bridge
- Type and frequency of required inspections
- Inspection procedure(s)
- Date of last inspection
- Special equipment requirements
- Description of inspection findings
- Description of any follow-up action(s) resulting from most recent inspection

Inspector Qualifications for Underwater Inspections

Underwater inspections shall be conducted under the direct supervision of individuals, which have been certified as, either, Mn/DOT Bridge Inspection Team Leader or have minimum NBIS Bridge Team Leader qualifications. The underwater inspector must have knowledge and experience in bridge inspection and must also be an experienced and accomplished diver.

Underwater inspections should be conducted in a systematic and organized manner that will be efficient and minimize the possibility of any underwater bridge item being overlooked. All inspections shall be conducted following appropriate OSHA safety guidelines for both the diver and the public. Critical findings shall be reported immediately to the Bridge Office Bridge Inspection Engineer and/or Bridge Construction and Maintenance Engineer. Detailed and narrative reports including sketches, photographs, and/or videotapes shall be provided to the Bridge Office upon completion of the inspection. Reports shall include recommendations on condition assessment, repairs, and time interval for the next inspection.

Questions

Any questions regarding the content of this Technical Memorandum should be directed to **Todd L. Niemann, Structural Metals and Bridge Inspection Engineer, Bridge Office at (651) 366-4567.**

Any questions regarding the publication of this Technical Memorandum should be directed to Sophia Wicklund, Design Standards Unit at (651) 336-4701 or Michael Elle, Design Services Engineer at (651) 366-4622. A link to all active Memoranda and a list of historical Technical Memoranda can be found at: <http://www.dot.state.mn.us/atoz.html>

Attachment

Quality Assurance Plan - Mn/DOT In-Depth Fracture Critical Bridge Inspection Program

Quality Assurance Plan Bridge Office

Mn/DOT In-Depth and Fracture Critical Bridge Inspection Program
July 10, 2007

Introduction and Purpose

This policy outlines Mn/DOT's Quality Assurance Plan regarding in-depth and fracture critical bridge inspections. The Bridge Office carries overall responsibility for administering the fracture critical inspection program. As detailed in this plan, Quality Assurance will be accomplished via review of all inspection reports, joint inspections of selected bridges, and Federal Highway Administration (FHWA) compliance reviews to National Bridge Inspection Standards.

In-depth and Fracture Critical Inspection Teams in District 6 (Rochester) perform in-depth and fracture critical bridge inspections on all bridges (district and local jurisdiction) within their district. Similar teams in the Metro Division perform in-depth and fracture critical bridge inspections on all Metro Trunk Highway bridges. The Bridge Office performs all other in-depth and fracture critical inspections for District and Local Agency bridges.

Fracture Critical Definition

The Bridge Office determines which bridges are designated as non-redundant and fracture critical in accordance with Technical Memorandum 07-10-B-02 dated July 19, 2007 and state and federal guidelines. A fracture critical bridge is a steel structure, subject to dynamic cyclic loading, which has at least one tension member or member component, whose failure would be expected to result in the collapse of the bridge.

Inspection Frequency & Scheduling

The Bridge Office determines the frequency of in-depth inspections (typically four (4) or five (5) year intervals), and tracks when inspections are due and when they have been completed. At the beginning of each inspection season, the Bridge Office will notify inspection teams which bridges are due for in-depth inspections. The Office/District responsible for performing the inspection is responsible for the planning and scheduling during a given season, and submits the schedule to the Bridge Office.

In accordance with current State law, the maximum interval for Routine Inspections of Non-redundant bridges is one year. Routine Inspections are required to include inspection of Fracture Critical and other non-redundant members.

Qualifications of Inspectors

The Bridge Office is responsible for reviewing the inspector's qualifications. The lead inspector must be certified (by Mn/DOT) as a Bridge Safety Team Leader. Completion of the FHWA training class

"Inspection of Fracture Critical Bridge Members" and the Mn/DOT Bridge Inspection Proficiency Examination is required. Only individuals qualified as American Society for Non-Destructive Testing (ASNT) Level II or III technicians, shall conduct non-destructive testing (NDT), by ultrasonic methods.

Bridge Office Participation in Inspections

The Bridge Office will participate in one or more inspections performed by other Districts. This will typically be on major structures, or on bridges with significant structural deficiencies, deterioration, or damage. The purpose of these joint inspections is two-fold;

- 1) the utilization of in-depth fracture critical inspectors from both the district and the Bridge Office expedites the inspection and reduces the time that traffic restrictions are needed, and,

- 2) joint inspections allows the Bridge Office to observe inspections procedures for consistency. The Bridge Office will provide NDT assistance as required for the Districts, Counties, or Municipalities.

Review of Inspection Reports

Within 6 months of performing an in-depth inspection the inspection team shall submit a detailed written report, including sketches and photographs of the inspection [independent of the annual PONTIS safety inspection report] to the State Bridge Inspection Engineer. The format of the report shall be similar to the reports developed by the Bridge Office. Due to the safety concerns with bridge fatigue issues the Bridge Office will review all in-depth inspection reports. The Bridge Office Bridge Inspection Engineer and Regional Construction Engineer shall review the Trunk Highway bridge reports. Within thirty (30) days of its receipt, the Bridge Office Bridge Inspection Engineer will forward written comments as necessary to the inspection team regarding the findings, recommendations, or conclusions. The Bridge Office Bridge Inspection Engineer shall date and sign the file copy of the report upon conclusion of their reviews. The Bridge Office will maintain reports on file for all fracture critical bridges statewide.

Fracture Critical members must be inspected from an arms length distance every 24 months. When the arms length inspection is combined with the routine inspection, the inspector's notes for PONTIS Element 966 Fracture Critical Smart Flag shall note that members were inspected at arms length, the date of the inspection, and any change in condition from that noted in the last in-depth inspection report. Whether the fracture critical inspection is done as part of a routine inspection, or as part of an in-depth inspection, the date of the fracture critical inspection shall be recorded in the Mn/DOT Structure Inventory Report.

"Critical" Findings

A critical finding for the purpose of fracture critical inspection shall be defined as any condition that in the judgment of the inspection team leader, may, if not corrected in a timely manner, cause the failure of all or part of the bridge. Critical findings shall be reported within 24 hours to the District, County, or City Bridge Engineer and to the Bridge Office Bridge Inspection Engineer or Regional Construction Engineer.

The Bridge Office will confer with appropriate District/County/City staff to develop short and long-term strategies to correct the problem and will conduct compliance reviews to ensure that the bridge owner has completed recommended actions and/or repairs.

FHWA Annual Audits

The Federal Highway Administration (FHWA) conducts annual compliance reviews of the bridge inspection programs of Mn/DOT's Central Office, Districts, and Counties. The Bridge Office also participates in these audits. Review of the fracture critical inspection process is included within the scope of these audits.