



Illinois Department of Transportation

2300 South Dirksen Parkway / Springfield, Illinois/62764

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National Bridge Inspection Standards (NBIS)
Fracture Critical Member Inspections

COUNTY SUPERINTENDENTS OF HIGHWAYS
MUNICIPAL ENGINEERS
CONSULTING ENGINEERS

#90-25

Revisions to the NBIS adopted in 1988 (23 CFR Section 650.303(e)(1)) require that all fracture critical members of bridges in the National Bridge Inventory (NBI) be inspected at regular intervals. Each affected bridge must be identified and inspected by January 1, 1992. These changes have now been incorporated into the Illinois Structure Information System (ISIS) which the Department utilizes to provide annual updates to the NBI.

Preliminary screening of local agency structures was initiated by Letter #89-3, dated January 23, 1989. That effort has been completed and final verification and inspection of fracture critical members may proceed. A county by county listing of currently identified or potential fracture critical bridges with verification instructions is being transmitted to all District Bureaus of Local Roads and Streets under separate cover. Each District will pass this information on to the appropriate local agency.

The new fracture critical requirements fall into three main categories:

- 1.- Collection of fracture critical member inventory information.
- 2.- Inspection and evaluation of identified fracture critical members.
- 3.- Follow-up of corrective measures.

In addition, certain bridges will require a special bridge member inspection as stated in the NBIS, Section 650.303(e)(3). This requirement applies to those structures which contain unique or special features requiring additional attention during inspection to ensure the safety of such bridges. Included in this category are bridges with fatigue prone weld details that are subjected to high stress levels and repetition of loading, multi-girder pin and link suspended span bridges, and bridges experiencing unusual displacement of structural elements. Any structures suspected of fitting into this category should be reported to the Department and will be recorded in the ISIS under Special Feature Inspection Interval (Item 92C) and Special Feature Inspection Date (Item 93C).

FRACTURE CRITICAL MEMBER INVENTORY

Fracture critical members in bridges are those whose failure can cause the sudden collapse of the bridge or a significant portion of it. Such members are always in axial tension or bending and are made of a homogeneous material such as structural steel. Detailed guidelines for fracture critical member identification and inspection can be found in the publication, FHWA-IP-86-26, Inspection of Fracture Critical Bridge Members distributed to all participants of the FHWA approved course, "Inspection of Fracture Critical Bridge Members". Copies are being sent to County Superintendents of Highways and Municipal Engineers under separate letter. Others can obtain copies through the National Technical Information Service, Springfield, Virginia 22161.

Generally excluded from fracture critical inspection requirements are structural members with one or more of the following characteristics:

- 1.- Truss tension members made up of more than two components, e.g. a truss panel having a lower chord with 4 eyebars.
- 2.- Diagonal tension members of riveted trusses.
- 3.- Floorbeams attached to the main structure by rivets or bolts and clip angles.
- 4.- Riveted built-up flexural members.
- 5.- Eyebars in trusses.
- 6.- Other tension and flexural members for which a structural analysis shows that redundancy is provided.

Inventory information to be collected for the ISIS includes Fracture Critical Bridge Type (Item 92A1), Fracture Critical Number of Spans (Item 92A2), and Number of Fracture Critical Members (Item 92A3). Descriptions of these items are included in the IDOT Structure Information and Procedure Manual (SIP Manual), pages 202 - 205. This information is to be recorded on the "Fracture Critical Member Inventory Report" (copy attached) and submitted through the District Bureau of Local Roads and Streets.

Specific information should be gathered from as-built plans if possible and confirmed during the first field inspection. Locations of the identified fracture critical members will be marked on a copy of the applicable portions of the plans. If plans are not available, sketches are acceptable. The marked plans or sketches must be kept in either a local agency Fracture Critical Bridge file or General Bridge file and indexed for ready reference to each identified fracture critical bridge.

FRACTURE CRITICAL MEMBER INSPECTION AND EVALUATION

The Fracture Critical Inspection Interval (ISIS Item 92A, page 201 of the SIP Manual) will be the same as the Routine NBIS

Inspection Interval (ISIS Item 91) for all structures. This will be a visual inspection giving extra attention to the fracture critical members during the routine NBIS Maintenance Inspection and filling out the form "Fracture Critical Inspection Report" (BM-BIR-FC 1). In addition, an in-depth fracture critical member inspection will be performed at five year intervals. The initial in-depth fracture critical inspection must be completed by January 1, 1992. When the Fracture Critical Appraisal Rating (Item 93A1) is lower than '5', the interval for in-depth inspections will be reduced to less than the usual 5 years in order to insure that the structure continues to be capable of safely carrying vehicular traffic.

In-depth fracture critical member inspections are to be performed in accordance with the guidelines in the aforementioned Federal publication FHWA-IP-86-26. Two types of in-depth fracture critical member inspection are described in that publication:

1. A normal close-up, hands-on inspection using standard, readily available tools.
2. A special, detailed inspection using more sophisticated nondestructive testing methods that require specialized training.

The type of in-depth inspection should be appropriate for the fracture critical member type and condition and the likelihood of the development of fatigue cracking. For example, the "special, detailed inspection" would be made for fracture critical members which are not visible and can not be inspected using normal inspection tools (such as pins in suspended spans) or which have potential for fatigue crack development due to a combination of high traffic and high stress.

Decisions regarding the type of in-depth inspection should be made in the office by the engineer in charge of bridge inspection supervision before field operations are started and may still need to be modified in the field based upon inspection findings. All links and pins in suspended span continuous truss and two girder bridges shall be inspected using ultrasonic testing. The type of in-depth inspection, whether "normal" or "special", should be indicated on form BM-BIR-FC 1 to be submitted to the District Local Roads Office.

Fracture critical inspections shall be performed only by individuals qualified to be inspection team leaders for routine NBIS Maintenance Inspections who have also successfully completed the previously mentioned fracture critical bridge inspection course or equivalent. Special in-depth fracture critical bridge member inspections requiring ultrasonic testing (UT) shall be performed by individuals trained as a minimum Level II Nondestructive Test (NDT) inspector.

The following ISIS items shall be reported for the inspection of each Fracture Critical Bridge Type (Item 92A1):

- Item 93A - Fracture Critical Inspection Date
- Item 93A1 - Fracture Critical Appraisal Rating
- Item 93A2 - Fracture Critical Inspection Remarks
- Item 93A3 - Fracture Critical Inspection By (Name)
- Item 93A4 - Fracture Critical Inspection Temp.

Descriptions of these items are on pages 208-214 of the SIP Manual.

Evaluation of fracture critical members should follow the same general guidelines as for steel superstructures or substructures. Assignment of an appraisal rating is specified on pages 209-210 of the SIP Manual. The Superstructure Condition (Item 59) or Substructure Condition (Item 60), depending on the location of the fracture critical member, shall be no higher than the Fracture Critical Appraisal Rating. When the inspector lowers the appraisal rating to 4 or less, the affected member(s) should undergo a thorough structural analysis.

FRACTURE CRITICAL INSPECTION FOLLOW-UP

Critical findings shall be investigated and action necessary to protect public safety and/or the structure shall be taken immediately. Routine maintenance needs discovered during the inspection shall be scheduled for remedial work. The required follow-up work and its completion should be recorded in the space provided on the Fracture Critical Inspection Report form.

Information regarding the referenced publications may be obtained from the District Bureaus of Local Roads and Streets. Any questions concerning fracture critical member inventory, inspection or follow-up may be directed to Tim Souther, Local Bridge Unit, phone 217/785-8748.

Very truly yours,



William T. Sunley, P.E.
Engineer of Local Roads and Streets

cc-District Engineers

FRACTURE CRITICAL MEMBER INVENTORY REPORT

STRUCTURE NUMBER: _____ - _____

92A1 - FRACTURE CRITICAL BRIDGE TYPE: _____

FRACTURE CRITICAL MEMBERS

NUMBER OF FRACTURE CRITICAL ...

LOWER CHORD TENSION MEMBERS - _____	TENSION DIAGONALS - _____
TENSION VERTICALS - _____	TOP CHORD TENSION MEMBERS - _____
FLOORBEAMS - _____	FLOORBEAM HANGERS - _____
GIRDER FLANGE TENSION ZONES - _____	
PIN & LINK ASSEMBLIES - _____	SUSPENDED SPAN BEARING SEAT - _____
CABLES (SUSPENSION/STAYED) - _____	TIES (BOX/STIFFENED GIRDER) - _____
BOX BEAM TENSION ZONES - _____	
PIER CAPS - _____	PIER COLUMNS - _____
OTHER (SPECIFY- _____)	- _____

92A3 - FRACTURE CRITICAL NUMBER OF MEMBERS:
TOTAL FOR INDICATED BRIDGE TYPE - _____

92A2 - FRACTURE CRITICAL NUMBER OF SPANS (FOR INDICATED BRIDGE TYPE): _____

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STRUCTURE NUMBER: _____ - _____

92A1 - FRACTURE CRITICAL BRIDGE TYPE: _____

FRACTURE CRITICAL MEMBERS

NUMBER OF FRACTURE CRITICAL ...

LOWER CHORD TENSION MEMBERS - _____	TENSION DIAGONALS - _____
TENSION VERTICALS - _____	TOP CHORD TENSION MEMBERS - _____
FLOORBEAMS - _____	FLOORBEAM HANGERS - _____
GIRDER FLANGE TENSION ZONES - _____	
PIN & LINK ASSEMBLIES - _____	SUSPENDED SPAN BEARING SEAT - _____
CABLES (SUSPENSION/STAYED) - _____	TIES (BOX/STIFFENED GIRDER) - _____
BOX BEAM TENSION ZONES - _____	
PIER CAPS - _____	PIER COLUMNS - _____
OTHER (SPECIFY- _____)	- _____

92A3 - FRACTURE CRITICAL NUMBER OF MEMBERS:
TOTAL FOR INDICATED BRIDGE TYPE - _____

92A2 - FRACTURE CRITICAL NUMBER OF SPANS (FOR INDICATED BRIDGE TYPE): _____