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Chapter 4 - Condition Evaluation of Bridges for Local Public Agencies

CHAPTER 4
CONDITION EVALUATION OF BRIDGES
FOR LOCAL PUBLIC AGENCIES

The purpose of this chapter is to provide bridge safety inspection guidance for Local Public Agencies, including the staff and consultants who support them, to ensure that all NBIS requirements are met for the 19,000-plus LPA owned bridges. Iowa DOT I.M. 7.020 also provides additional guidelines and procedures for LPAs to assist them in complying with the NBIS. This chapter provides guidance on inspection planning, required documentation and appraisal and condition evaluation for bridges. Methods and techniques for inspecting and where to code for Deck, Superstructure, Substructure, Culverts, Channels, Posting and Approaches is covered. Additional SIIMS documentation for miscellaneous items and reporting for special items like fatigue-prone details and NSTMs is provided in sections 4.4 and 4.5. The chapter concludes with maintenance recommendations and instructions for using the MR&R section of SIIMS, including a listing of all of the maintenance recommendation codes.

The guidance for this chapter is especially important considering that Local Public Agencies are responsible for approximately 99 percent of the poor condition rated bridges in the state. Many of these bridges were constructed during or before the 1970s and include a high percentage of steel girder, concrete slab, and culverts.

4.1 INSPECTION PLANNING

4.1.1 Reviewing Past Inspection Reports, SIIMS Data, Existing Bridge Plans, and Bridge Repair Plans

The first step in preparing for any bridge inspection is to gather information regarding the existing bridge so the inspector is informed about the configuration and type of bridge as well as its documented history. Understanding the details of the existing bridge is essential to ensure that the number of inspection personnel and type of equipment and tools, including non-destructive testing equipment, needed to perform the inspection can be determined. When as-built plans and plans of any repairs or rehabilitation projects are available, the inspector must review the plans for a complete understanding of the bridge configuration and structure type. Reviewing the plans will allow the inspector to plan for the access requirements that might affect how the bridge will be inspected. Typically, if existing plans are available, they are included as part of the bridge’s record within the SIIMS database. Another helpful resource is any available shop drawings produced by the contractor or the contractor’s fabricators at the time the bridge was initially built or rehabilitated. If there are no drawings or even a load rating sketch available, it will be necessary to generate bridge sketches to include framing, cross sections, substructure, and other elements as needed to be able to verify or code new SNBI inventory information.

In addition to existing plans and shop drawings, the bridge record within SIIMS contains past inspection reports for the bridge. The inspector must review past inspection reports to identify previously documented problem areas. These past reports document the progressions of damage or deterioration over the course of multiple inspections, thus allowing the inspector to identify trends or problem areas worsening over time and potential future problem areas. The inspection reports should also include photographs documenting the condition of the bridge.

4.1.2 Determining Required Inspection Documentation and Preparing Needed Sketches

While reviewing the available information for the bridge, the inspector will begin to develop an understanding of the bridge. During this review, the inspector must determine if it would be beneficial to prepare sketches or tables in advance to be used for documenting current conditions in order to be more efficient in the field and record crucial inspection findings more clearly. The inspector must decide if the previous report documentation was sufficient to convey the condition of the bridge and support SNBI Condition Ratings, as well as NBE Condition States. For example, before going into the field for the bridge inspection, the inspector must decide if a table would be best to record bearing movement, expansion joint movement data, clearances, or probing/scour measurements. Based on available data, sketches may be a better choice for recording crack locations and sizes for the underside surface of the bridge deck or for individual piers or abutments. In general, if previous sketches or tables are available and legible, updating those sketches in the field can save time on inspection.

4.1.3 Arranging for Access and Other Inspection Equipment

A critical component of any bridge inspection preparation is determining how the inspector will access the bridge components during the inspection. In addition, depending on the type of inspection and nature of the bridge components, such as whether the bridge includes NSTM components requiring arm's-length access, the access requirements may require more rigorous planning.

Depending on the type of inspection, size of the bridge, and its height above ground level, inspection access could be as simple as ground-level observations. Frequently, ladders, a UBIV, a manlift, or even rope access techniques will be necessary to access key bridge components properly. However, developing an access plan requires careful consideration of several elements:

- Components to be inspected
- Topography and features crossed by the bridge that might limit access options
- Whether traffic interruptions can be tolerated
- Load restrictions on the bridge
- The geometry of the bridge and its sidewalks, bridge rails, and fencing
- Review of whether specific access methods may provide a cost advantage by saving time and labor even at the expense of the equipment costs or rental

If the inspector determines that a manlift or UBIV is required to access the bridge components for inspection, advance planning is required to either schedule the equipment, if State-owned, or to determine availability and rent the equipment from an outside source. Various UBIV options are available that allow the vehicle reach and the number of rotating turrets to be tailored to the specific constraints of the bridge to be inspected. The correct UBIV for the best accessibility may be especially critical for truss bridges, where the ability to maneuver the boom of a UBIV through and between truss members will be dependent on the configuration of the UBIV. The inspector will use SNBI Item B.IE.12 to record the access equipment used for the inspection.

4.1.4 Arranging for Advanced Bridge Washing

It is important that the previous inspection report is reviewed for presence of debris, animal nesting materials, and bird droppings to then coordinate with LPA maintenance personnel to determine if the bridge needs washing prior to inspection. Inspections scheduled during winter months may not allow advanced bridge washing due to freezing conditions. Additionally, some environmental regulations may limit periods when active nests of migratory birds, such as swallows, may be removed.

4.1.5 Executing Any Required Agency Notifications and Permits

Many bridges cross facilities requiring advance notification or permits with other agencies. Bridges over navigable waterways such as the Mississippi and Missouri rivers will require advance notice to the U.S. Coast Guard so barge operators can be notified of the inspection activities, especially if the inspection will require the mechanical arms of a UBIV to be extended below the superstructure of a bridge where it could conflict with barge traffic. Bridges crossing a border between states will require advance notification/coordination with the adjacent state.

Similarly, bridges over railroads will require advance notification of the railroads so a UBIV does not conflict with active train traffic. If railroad right-of-way must be crossed or used to provide bridge access, the bridge inspector must have a railroad flagger present, and a right-of-access permit may need to be obtained, depending on the railroad. In addition, a railroad flagger will be required to control inspection access windows or train movement during bridge inspection activities. The inspector must notify the railroad far enough in advance to allow them time to schedule a flagger for the inspection and to obtain the access permit.

If any critical utilities are mounted on the bridge or crossing the bridge that could cause safety concerns (for example, an overhead high voltage line that needs to be de-energized to avoid conflict with the mechanical arm of a UBIV), advance coordination with the utility will be required.

4.1.6 Adjusting Work Schedules

As practicable, but still maintaining NBIS compliance with required inspection frequencies, bridge inspections must be performed when weather conditions will have minimal impact on workflow. If possible, inspections for bridges over rivers and streams might be rescheduled to align with low-flow months to allow the best view and access to components near the waterline. For the most effective inspections, periods of extreme temperature or high winds should be avoided. The Team Leader must also know the limitations on lane closure windows and schedule to avoid rush hour traffic. The safety of the inspectors and the public vehicles traveling through the traffic control patterns should also be considered when inclement weather arises during the period of inspection.

The Team Leader must also use their best judgment to determine if inspection activities must be suspended due to changing weather conditions. For example, potential exposure to lightning, particularly when working on steel bridges, would justify suspending inspection operations to ensure crew safety.

4.2 CONDITION EVALUATION USING THE SPECIFICATIONS FOR THE NATIONAL BRIDGE INVENTORY (SNBI) ITEMS

4.2.1 Appraisal Evaluations

A number of SNBI items for bridges are inspected, evaluated, and coded based on acceptable standards or performance. For example, items B.RH.01 and B.RH.02 for Bridge Railings and Transitions are coded based on what standards they were or were not crash-tested to. Deterioration or damage must be noted as part of the inspection report in Item B.C.05 and B.C.06. Other items that require appraisal are Overtopping Likelihood, Approach Roadway Alignment, Scour Vulnerability, Scour Plan of Action, and Seismic Vulnerability.

4.2.1.1 Overtopping Likelihood

Overtopping Likelihood (Item B.AP.02) calls for the inspector's appraisal of the likelihood that this bridge riding surface is overtopped during times of high channel flow. Bridge overtopping likelihood, since the year built (Item B.W.01), is typically determined from historical bridge inspection or maintenance records, hydraulic studies, local residents/landowners, and/or site indicators including highwater marks on the bridge or its surroundings, debris remains on bridge upper members, etc. For newer bridges with limited historical inspection or maintenance information, hydraulic design information can be used to establish an overtopping likelihood. Therefore, this item appraises the waterway opening with respect to the passage of flow through the bridge. Appraisal ratings consider the roadway's functional classification, the expected frequency of overtopping, and potential traffic delays as a result of overtopping. Table 4.2.1-1 summarizes appropriate appraisal evaluation values for Overtopping Likelihood.

Table 4.2.1-1 Appraisal Values for Overtopping Likelihood

Code	Description
0	Never
1	Remote – once every 100 years or less frequently
2	Very Low – once every 51 to 99 years
3	Low – once every 26 to 50 years
4	Moderate – once every 11 to 25 years
5	High – once every 3 to 10 years
6	Very High – once every 2 years or more frequently

4.2.1.2 Approach Roadway Alignment

Approach Roadway Alignment (Item B.AP.01) calls for the inspector's appraisal of the approach roadway alignment. This item identifies bridges that do not function adequately due to the horizontal or vertical alignment of the bridge and approach roadway. The approach roadway alignment must not be compared to current standards, but rather to the existing roadway alignment; therefore, this appraisal differs from other appraisal evaluations. The basic criterion is how the alignment of the bridge and approach roadway relates to the general highway alignment for the section of highway the bridge carries. Do not consider speed reductions due to the bridge width or intersecting highways when reporting this item. The operating speed reduction is in comparison to the posted speed limit for the highway segment. Use code G (Good) when the operating speed is no different at the bridge than the rest of the highway segment that crosses the bridge. Use code F (Fair) when the operating speed is noticeably different at the bridge than the rest of the highway segment that crosses the bridge. Use code P (Poor) when the operating speed is substantially different at the bridge than the rest of the highway segment that crosses the bridge.

4.2.1.3 Roadside Hardware (Bridge Railings and Transitions)

Roadside Hardware Items (B.RH.01 & B.RH.02) call for appraisal of the effectiveness of bridge railings and transitions to redirect errant vehicles and reduce crash severity. The items in this subsection are inventoried to indicate if hardware at the bridge is required, present, or has been crash tested. Do not consider the condition of the hardware when reporting these items. The crash test level to assign to a barrier rail or transition can be found in the Iowa DOT Bridge Rail Guide.

- Bridge Railings (B.RH.01) - This roadside hardware includes all types and shapes of bridge railings (parapets, median barriers, or structure mounted) located on the bridge or that cross over culverts. Use SNBI Table 6 to code this item. If there is more than one type of bridge railing on the bridge, then code the first applicable code working from the bottom of the table to the top.

- Transitions (B.RH.02) – This roadside hardware serves as the transition from the roadside approach railing to the bridge railing and is firmly attached and anchored to the bridge railing to provide sufficient tension in the transition rail upon impact. Use SNBI Table 6 to code this item. If there is more than one type of bridge railing on the bridge, then code the first applicable code working from the bottom of the table to the top.
- For both of the above items, see SNBI for additional coding guidance with regards to railing specifications and crash testing. Also, refer to State, Federal agency, local, or Tribal government policies for acceptable bridge railing standards. Use code I when no information is known about the crash test level or an agency-approved standard. Also, use code I when an overlay is applied to the deck/slab and the height no longer meets the original geometry requirements of the crash-tested rail.

4.2.2 General Condition Rating Codes

Condition ratings are used to describe the existing physical state of bridge components as compared to their original as-built conditions. In order to promote uniformity between bridge inspectors, the condition codes used to rate bridge components must characterize the overall condition of the entire component being rated and are not intended to rate localized defects or nominally occurring instances of deterioration or disrepair. A condition rating code must therefore consider the type, location, and severity of the defects; the extent to which they exist throughout the item being evaluated; and the degree to which the defects affect strength and/or performance of the bridge or component.

The as-designed load carrying capacity of the component is not to be used in evaluating condition items. The fact that a bridge was designed for less than the current legal loads, and that the bridge may even be posted, must not influence the condition ratings.

The items below, as shown in Table 4.2.2-1, are used to describe the general condition ratings of bridges and culverts and must be updated after each inspection cycle, as applicable, based on structure type, construction, and feature crossed. Therefore, the condition of these items provides a simple snapshot of the current overall condition of a bridge or culvert. See Section 7 of the SNBI for details on how to code these items.

Table 4.2.2-1 SNBI Component Condition Ratings

SNBI Item	Item ID
Deck Condition Rating	B.C.01
Superstructure Condition Rating	B.C.02
Substructure Condition Rating	B.C.03
Culvert Condition Rating	B.C.04
Bridge Railing Condition Rating	B.C.05
Bridge Railing Transitions Condition Rating	B.C.06
Bridge Bearings Condition Rating	B.C.07
Bridge Joints Condition Rating	B.C.08
Channel Condition Rating	B.C.09
Channel Protection Condition Rating	B.C.10
Scour Condition Rating	B.C.11
Bridge Condition Classification	B.C.12
Lowest Condition Rating Code	B.C.13
NSTM Inspection Condition	B.C.14
Underwater Inspection Condition	B.C.15

Descriptive conditions used within the text of an inspection report or descriptive labels used in the comment fields for SIIMS must correlate to the numerical rankings described below for SNBI Items B.C.01 through B.C.15 based on the deficiencies found for the individual components. Any condition ratings above that are 5 or less require a comment indicating what defects or deficiencies are present and to what extent and severity.

Bridge Condition Classification (B.C.12) is a Good/Fair/Poor coding calculated as shown in Table 4.2.2-2 by FHWA using the lowest condition rating for the deck, superstructure, substructure, and/or culvert items. Note that Item B.C.12 is not intended to be reported by inspectors or designated agency personnel. Lowest Condition Rating Code (B.C.13) is a numerical code calculated similarly to B.C.12 by FHWA and is not intended to be reported by inspectors or designated agency personnel.

Table 4.2.2-2 Grouping of Descriptive Conditions

Code (B.C.12)	Lowest Condition Rating (B.C.13)	Description
G	7, 8, 9	Component defects are limited to only minor problems.
F	5, 6	Structural capacity of the component is not affected by minor deterioration, section loss, spalling, cracking, or other deficiency.
P	0, 1, 2, 3, 4	Structural capacity of the component is affected or jeopardized by significant deterioration, section loss, spalling, cracking, or other deficiency.

4.2.2.1 Deck, Superstructure, Substructure, Railings and Bearings

The general condition ratings shown in Table 4.2.2-3 shall be used as a guide in evaluating the Deck (Item B.C.01), Superstructure (Item B.C.02), Substructure (Item B.C.03), Bridge Railing Condition Rating (Item B.C.05), Bridge Railing Transitions Condition Rating (Item B.C.06), Bridge Bearings Condition Rating (Item B.C.07), NSTM (B.C.14) and Underwater Inspection Condition (B.C.15).

Table 4.2.2-3 General Condition Rating Guidance for Deck, Superstructure, Substructure, Culvert, Bridge Railings, Bridge Railing Transitions, and Bearings (B.C.01-B.C.07, B.C.14, B.C.15)

Code	Condition	Description
N	NOT APPLICABLE	Component does not exist.
9	EXCELLENT	Isolated inherent defects.
8	VERY GOOD	Some inherent defects.
7	GOOD	Some minor defects.
6	SATISFACTORY	Widespread minor or isolated moderate defects.
5	FAIR	Some moderate defects. Strength and performance of the component are not affected.
4	POOR	Widespread moderate or isolated major defects. Strength and /or performance of the component is affected.
3	SERIOUS	Major defects. Strength and/or performance is seriously affected. Condition typically necessitates more frequent monitoring, load restrictions, and/or corrective actions.
2	CRITICAL	Major defects. Component is severely compromised. Condition typically necessitates frequent monitoring, significant load restrictions, and/or corrective actions in order to keep the bridge open.
1	IMMINENT FAILURE	Bridge is closed to traffic due to component condition. Repair or rehabilitation may return the bridge to service.

Code	Condition	Description
0	FAILED	Bridge is closed due to component condition and is beyond corrective action. Replacement is required to restore service.

4.2.2.2 Culvert

In addition to Table 4.2.2-3 guidance, the additional guidance shown in Table 4.2.2-4 shall be used to evaluate a Culvert (Item B.C.04).

Table 4.2.2-4 Additional Guidance for Condition Ratings for Culverts

Code	Description
N	Not applicable. Used if structure is not a culvert.
9	No deficiencies.
8	No noticeable or noteworthy deficiencies that affect the condition of the culvert. Insignificant scrape marks caused by drift.
7	Shrinkage cracks, light scaling, and insignificant spalling that does not expose reinforcing steel. Insignificant damage caused by drift with no misalignment and not requiring corrective action. Some minor scouring has occurred near curtain walls, wingwalls, or pipes but without exposure or undermining of footings of wingwalls, curtainwalls, headwalls, or piping. Metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting.
6	Deterioration or initial disintegration, minor chloride contamination, cracking with some leaching, or spalls on concrete or masonry walls and slabs. Local minor scouring at curtain walls, wingwalls, or pipes with minor exposure of footings but no undermining or displacement. Metal culverts have a smooth curvature, non-symmetrical shape, significant corrosion, or moderate pitting.
5	Moderate to major deterioration or disintegration, extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion with some undermining of foundations at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection in one section, moderate section loss without effect on strength.
4	Large spalls, heavy scaling, wide cracks, considerable efflorescence, or opened construction joint permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion with moderate undermining of foundations at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, significant section loss impacting the strength of the culvert.
3	Any condition described in Code 4 but that is excessive in scope. Severe movement or differential settlement of the segments or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe scour or erosion with major undermining at curtain walls, wingwalls, or pipes. Walls exhibit racking and evidence of water infiltration behind walls and under culvert bottom. Metal culverts have extreme distortion and deflection in one section, serious section loss which requires frequent monitoring, load restriction or corrective action.
2	Integral wingwalls collapsed. Severe settlement of roadway due to loss of fill. Section of culvert may have failed and can no longer support embankment. Complete undermining at curtain walls and pipes. Corrective action required to maintain traffic. Metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion.
1	Culvert is closed. Corrective action may put it back in light service.
0	Culvert is closed. Replacement is necessary.

4.2.2.3 Bridge Joints Condition Rating

This item (B.C.08) addresses the condition of all types and shapes of bridge deck joints. The condition assessment includes all aspects of the joints such as any seals, headers (metal or concrete), connections, and other metal members. When a joint is designed as an open joint, leakage or lack of a seal is not considered a defect. Do not consider the condition of protective coatings and other protection systems when determining the condition rating code for this item, except to the extent that problems with the protective coating system are indicative of problems with the underlying joint material. In cases where the joint is not visible, the inspector can assess the condition based on other indirect indicators of the condition.

Table 4.2.2-5 Bridge Joints Condition Rating (B.C.08)

Code	Condition	Description
N	NOT APPLICABLE	Bridge does not have deck joints.
9	EXCELLENT	Isolated inherent defects.
8	VERY GOOD	Some inherent defects.
7	GOOD	Some minor defects.
6	SATISFACTORY	Widespread minor or isolated moderate defects.
5	FAIR	Some moderate defects.
4	POOR	Widespread moderate or isolated major defects.
3	SERIOUS	Some major defects.
2	CRITICAL	Widespread major defects.
1	IMMINENT FAILURE	Joints have failed and are ineffective.
0	FAILED	Joints have failed and present a safety hazard.

4.2.2.4 Channel Condition Rating and Channel Protection Condition Rating

Use the SNBI Items B.C.09 and B.C.10 tables for coding Channel Condition Rating and Channel Protection Condition Rating, respectively. Table 4.2.2-6 and Table 4.2.2-7 shall be used as additional guidance in evaluating these two related channel items.

Table 4.2.2-6 Channel Condition Rating (B.C.09)

Code	Condition	Description
N	NOT APPLICABLE	Bridge does not cross over water.
9	EXCELLENT	No defects.
8	VERY GOOD	Inherent defects only.
7	GOOD	Some minor defects.

Code	Condition	Description
6	SATISFACTORY	Widespread minor or isolated moderate defects.
5	FAIR	Moderate defects. Bridge and approach roadway are not threatened.
4	POOR	Widespread moderate or isolated major defects; bridge and/or approach roadway is threatened.
3	SERIOUS	Major defects. Bridge or approach roadway is seriously threatened. Condition typically necessitates more frequent monitoring, load restrictions, and/or corrective actions.
2	CRITICAL	Major defects. Bridge or approach roadway is severely threatened. Condition typically necessitates frequent monitoring, significant load restrictions, and/or corrective actions in order to keep the bridge open.
1	IMMINENT FAILURE	Bridge is closed to traffic due to channel condition. Channel rehabilitation may return the bridge to service.
0	FAILED	Bridge is closed due to channel condition, and is beyond corrective action. Bridge location or design can no longer accommodate the channel, and bridge replacement is needed to restore service.

Table 4.2.2-7 Channel Protection Condition Rating (B.C.10)

Code	Condition	Description
N	NOT APPLICABLE	Bridge does not cross over water or channel protection devices do not exist.
9	EXCELLENT	Isolated inherent defects.
8	VERY GOOD	Some inherent defects.
7	GOOD	Some minor defects.
6	SATISFACTORY	Widespread minor or isolated moderate defects.
5	FAIR	Some moderate defects. Performance of the channel protection is not affected.
4	POOR	Widespread moderate or isolated major defects; performance of channel protection is affected.
3	SERIOUS	Major defects. Performance of channel protection is seriously affected. Condition typically necessitates more frequent monitoring or corrective actions.
2	CRITICAL	Major defects. Channel protection is severely compromised. Condition typically necessitates more frequent monitoring or corrective actions.
1	IMMINENT FAILURE	Channel protection has failed, but corrective action could restore it to working condition.
0	FAILED	Channel protection is beyond repair and must be replaced.

4.3 FIELD DATA ITEMS IN SIIMS

For LPA bridges not located on the NHS, element-level reporting of condition states for bridge components is not required by the NBIS. As a result, LPAs must evaluate the various field data using a condition evaluation scale similar to the values shown in Table 4.2.2-3 for Deck, Superstructure, and

Substructure; Table 4.2.2-6 and SNBI tables for channel condition rating items; or Table 4.2.2-4 for Culvert components.

4.3.1 Deck Inspection

The inspector must examine concrete decks for cracking, spalling, potholes, efflorescence, leaching, delamination, exposed reinforcing steel, and full or partial depth failures. If the concrete deck consists of partial- or full-depth pretensioned panels, it must also be inspected for failures at the pretension and post-tension anchor zones, failures of grout-filled joints between panels, and failures of bearing edges along supporting beams.

Steel grid decks and concrete-filled grid decks must be inspected for corrosion, broken welds, broken or damaged bearing bars or cross bars, and section loss. Concrete at filled grid decks should be checked for spalling/scaling, water leakage through the deck, and ponding water.

Corrugated steel decks must be inspected for bottom side corrosion and top fill/riding surface de-bonding of asphalt and/or concrete materials.

Timber decks must be inspected for damage, splits, checks, broken planks, crushing, excessive wear, rot, and loose, broken, or missing fasteners. Laminated decks should also be checked for delaminating members and deterioration of post-tensions assemblies/anchorages.

The overall condition rating of the Deck (Item B.C.01) shall be coded as shown in Table 4.2.2-1. For culverts or other structures without a deck, such as a corrugated metal structural plate arch bridge, code 0 for Item B.SP.09 and code N (not applicable) for Item B.C.01. Decks integral with the superstructure, such as for a cast-in-place box girder bridge or a concrete T-beam bridge, shall be rated for the deck only, and the superstructure condition of the integral deck-type bridge must not influence the deck rating. Deck field notes must be maintained in the remarks field of the items described below or in the General Comments field. When the Deck GCR is <=5, a comment is required in the General Comments field to explain the reason for the rating.

The condition of supplemental wearing surfaces, joints or expansion devices, curbs, sidewalks, parapets, railings, and drainage scuppers must not be considered in the overall deck evaluation. However, their condition must be noted in the inspection report.

4.3.1.1 Wearing Surface

Wearing surfaces for protecting bridge decks may include flexible materials such as asphaltic concrete, semi-rigid materials such as an epoxy concrete overlay, or rigid materials such as a low slump concrete overlay. The wearing surface must be inspected for spalls, delaminations, patched areas, potholes, cracks, and overall effectiveness. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the wearing surface. If there is no wearing surface, the condition must be coded “N.” In addition, SNBI Item B.SP.10 (Wearing Surface) must be coded in SIIMS to identifying the material type.

4.3.1.2 Curbs

The inspector must examine concrete curb sections, including concrete barrier rails, for cracking, spalling, delamination, impact damage, overall condition, and alignment. Cracking in the face of curbs or barrier rails could result from shrinkage cracking, reflective cracking at barrier rail vertical reinforcing, or structural cracking. Any exposed or corroding reinforcing steel must be documented. Precast concrete parapet or barrier rail elements must be checked for evidence of active water leakage between the parapet and deck causing corrosion and potential failure of anchorages.

Timber wheel guards, including riser blocks, must be inspected for splits, checks, and decay. In addition, wheel guards must be checked to determine if they are bolted securely in place.

A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the curbs. If there are no curbs, the condition must be coded "N." In addition, Item B.G.06 (Bridge Width Curb-to-Curb) must also be coded in SIIMS.

4.3.1.3 Median

Raised concrete medians often are non-structural toppings to the bridge deck but may show signs of deterioration, such as cracking, scaling, spalling or impact damage from snowplows. Raised medians that are structural deck elements intended to support vehicle loads must be evaluated for their load carrying capabilities. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the median. If there is no median, the condition must be coded "N." In addition, SNBI Item B.G.10 (Bridge Median) must be coded in SIIMS to identifying the median type.

4.3.1.4 Sidewalks

The inspector must examine concrete sidewalks for cracking, scaling, spalling, potholes, or delamination. Sidewalks must be evaluated for compliance with requirements of the Americans with Disabilities Act with respect to accessibility compliance and safety items such as tripping hazards, potential for ponding of water or ice, and condition of walking surface. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the sidewalks. If there are no sidewalks, the condition must be coded "N." In addition, SNBI Items B.G.07 and B.G.08 (Left and Right Sidewalk Widths) must be measured and coded.

4.3.1.5 Bridge Railings

The inspector must evaluate bridge railings for their adherence to railing standards and for their adequacy of geometry and structural capacity. The face of railing exposed to traffic shall be smooth and continuous. The inspector must be familiar with the railing requirements of the bridge owner. Metal railings must be inspected for corrosion damage, loose or broken components, and impact damage. Connections must be inspected for loose or missing bolts or rivets and for broken welds. SNBI Item B.C.05 must be coded in SIIMS for the bridge railing condition using Table 4.2.2-3.

4.3.1.6 Bridge Railing Transitions

The inspector must evaluate bridge railing transitions (from the bridge railing to the approach guardrail) for their adherence to railing standards and for their adequacy of geometry and structural capacity. The face of railing exposed to traffic shall be smooth and continuous considering the direction of travel. The inspector must be familiar with the railing requirements of the bridge owner. Metal railings must be inspected for corrosion damage, loose or broken components, and impact damage. Connections must be inspected for loose or missing bolts or rivets and for broken welds. SNBI Item B.C.06 must be coded in SIIMS for the bridge railing transition condition using Table 4.2.2-3.

4.3.1.7 Rail Protection System

For painted railing components, the inspector must examine the coating for chalking, fading, or peeling. The condition of the paint coating must be documented. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the paint coating. If there is no painting coating on the rails, the condition must be coded "N."

4.3.1.8 Drains

The inspector must determine if drains are functioning properly, ideally under wet weather conditions. Any clogged drain scuppers, missing drain grates, or water ponding must be documented. Drains and downspout piping connections must be examined to confirm connections are intact and water is being properly discharged away from the structure. Any corrosion or holes in downspout piping must be noted. In addition, the inspector must note any erosion or undermining at drain outfalls. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the drains. If there are no drains, the condition must be coded "N."

4.3.1.9 Utility Connections

The inspector must examine utility connections and supports for proper function under expansion and contraction. Any discontinuities in conduit, exposed wiring, or missing junction box covers must be noted. The inspector must be aware of the type of utilities present on a bridge and the nature of the hazards present during inspection.

Utilities are frequently retrofitted on bridges, and the nature of the retrofit must be inspected for improper welding techniques or welds to tension members, which may create fatigue-sensitive conditions. Any utility deficiencies must be reported promptly since the bridge inspector may be the first person to report a utility failure and the utility owner may not be aware of a problem. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the overall condition of the utility connections. If there are no utilities, the condition must be coded "N."

4.3.1.10 Joint Leakage

The inspector must note drainage leaking through open joints, cracks, or spalls in the curbs, parapets, or other elements where leakage is not intended. A condition rating (0 – 9) must be assigned on the Deck Form in SIIMS to describe the degree of joint leakage. The condition must be coded "N" if this item does not apply.

4.3.1.11 Expansion Joints and Devices

It is good practice to measure and record joint openings between identifiable locations so the opening width can be checked during future inspections to establish a record of joint movement over time. The ambient temperature and the time of day for the measurement must be documented. The inspector must look for proper joint alignment, the condition of any joint glands or seals (if present), and evidence of spalls in the slab edges adjacent to joint armoring. In addition, the inspector must listen for audible sounds of joint damage under traffic loading. Joints must be inspected from the bridge deck and from below to determine the condition of joint supports and to detect leakage. Where drainage troughs are provided under open joints, the inspector must check for build-up of debris in troughs that could prevent proper drainage or impede joint movement.

Sealed joints such as strip seals must be inspected for debris in the neoprene glands, tears, and separation of the gland from the steel extrusions. For bolt-down reinforced elastomeric joints, the inspector must check for missing anchor bolt covers, broken anchor bolts, separation of joint elements, and audible sound of loose panels under traffic. The undersides of modular joints must be inspected for evidence of weld cracking between support bars and joint extrusions, as well as for equal movement gaps between adjacent extrusions.

SNBI Item B.C.08 must be coded in SIIMS for the condition of the expansion joints and devices. If there are no expansion joints or devices, the condition must be coded "N."

4.3.2 Superstructure Inspection

The inspector should examine superstructure members for signs of distress, which may include horizontal or vertical displacement of components affecting structure stability, excessive deflection, cracking, deterioration, section loss, collision damage, or overload damage.

An overall condition rating of the Superstructure (Item B.C.02) shall be provided in SIIMS as shown in Table 4.2.2-3. Code "N" must be used for all culverts.

Superstructure field notes must be maintained in the remarks field of the items in SIIMS described below or in the General Comments field. When the Superstructure GCR is <=5, a comment is required in the General Comments field to explain the reason for the rating.

Photographs of deterioration in high stress areas are required.

On bridges where the deck is an integral part of the superstructure (such as concrete T-beams, where the deck is cast with the beams), the superstructure rating may be affected by the deck condition. If the deck is an integral part of the superstructure, the superstructure rating must not be higher than the deck rating. Both ratings must be the same for concrete slab bridges.

A concrete slab bridge does not contain beams or girders. The deck and superstructure are synonymous and must have the same condition rating. Concrete slab bridges contain larger reinforcing bars than a standard deck. Continuous slabs have large reinforcing bars over the piers near the top of the deck. The inspector must document any transverse cracking over a pier because of the increased potential for corrosion of the main reinforcing steel in this area.

The inspector must document concrete deterioration near the abutments whether it is occurring on the top or bottom of the slab. Severe deterioration in this area can affect the shear capacity of the concrete slab. Repairs to this area due to deterioration are difficult. Temporary support of the deck may be required in some cases.

The condition of bearings, joints, and paint system must not be included in superstructure condition rating except in extreme situations but must be noted in the remarks. NSTMs must receive careful attention since their failure could lead to collapse of a span or the bridge. An overall condition rating of the NSTM (Item B.C.14) shall be provided in SIIMS as shown in Table 4.2.2-1.

4.3.2.1 Bearing Devices

Bridge bearings transmit the superstructure loads to the substructure elements and allow for rotation at fixed bearings, and rotation and movement at expansion bearings.

- The inspector must inspect steel components of bearings for corrosion that would limit or restrain intended movements.
- Elastomeric bearings must be checked for abnormal flattening or shear deformation, bulging, or splitting.
- High load/multi-rotation bearings, such as pot bearings and disc bearings, must also be inspected for proper seating of components with respect to each other, weld cracks, and wear, binding, and deterioration of guide bars.

In addition, all bearings must be checked for proper alignment and orientation for the ambient temperature, loose or broken anchor bolts, any movement of components under heavy truck load (which may indicate an uplift condition), and excessive pack rust, dirt, or debris that could restrict movement. Bearing pedestals must be examined for concrete spalling that could indicate high edge loading conditions.

When inspecting expansion bearings, it is good practice to document the positions of the bearings by measuring either the offset from a neutral position or the angle of inclination from plumb so it can be determined if the bearings are working properly with respect to thermal bridge movements (see Figure 4.3.2-1 through Figure 4.3.2-5). When documenting the position of the bearings, it is essential to note the temperature at which the measurements were taken to indicate if the temperature is above or below the neutral temperature, and the time of day to indicate whether the temperature is rising or falling.

SNBI Item B.C.07 must be coded in SIIMS for the condition of the bearing devices.

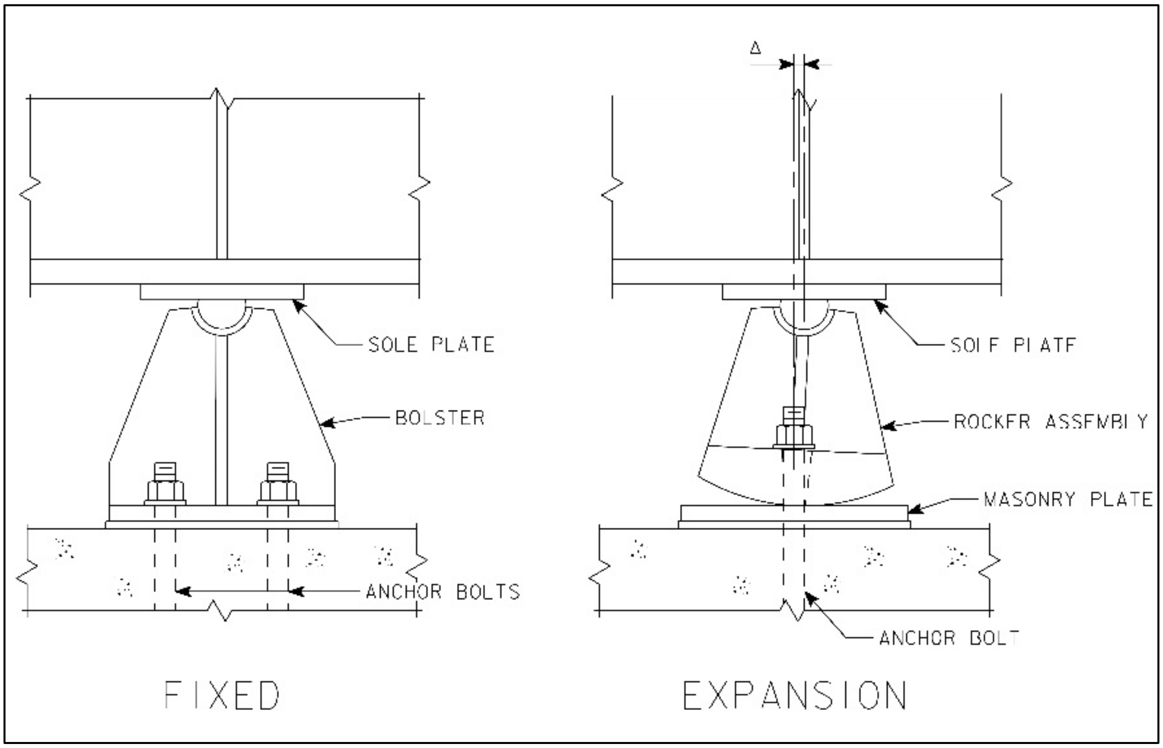

Figure 4.3.2-1 Steel Fixed Bolster and Steel Rocker Bearings

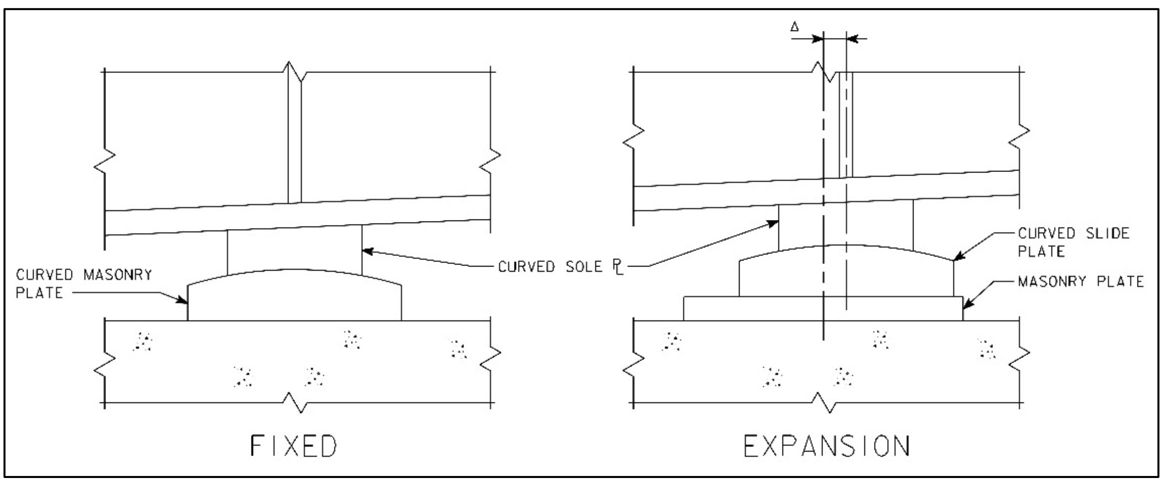

Figure 4.3.2-2 Steel Sliding Plate Bearings

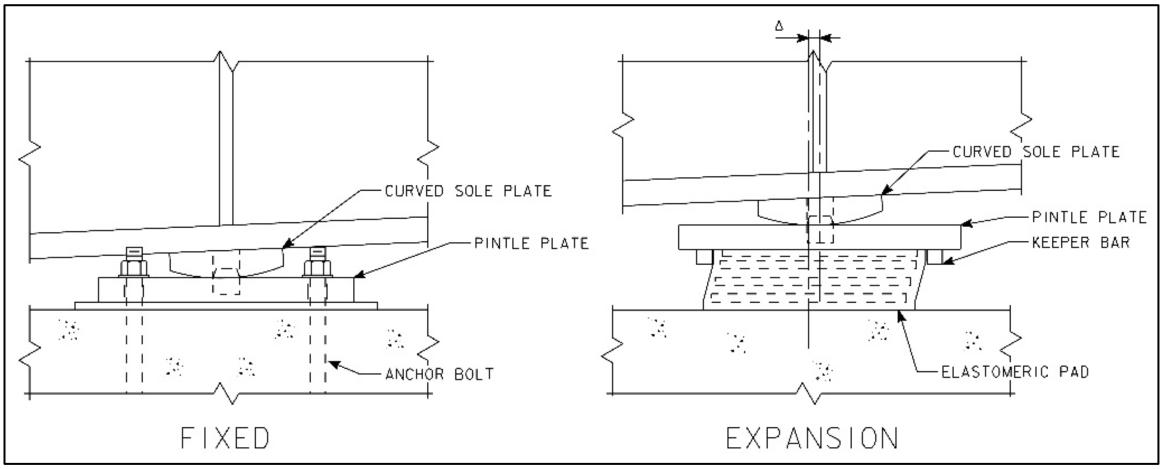

Figure 4.3.2-3 Pintle Plate & Pintle Plate with Elastomeric Pad Bearings

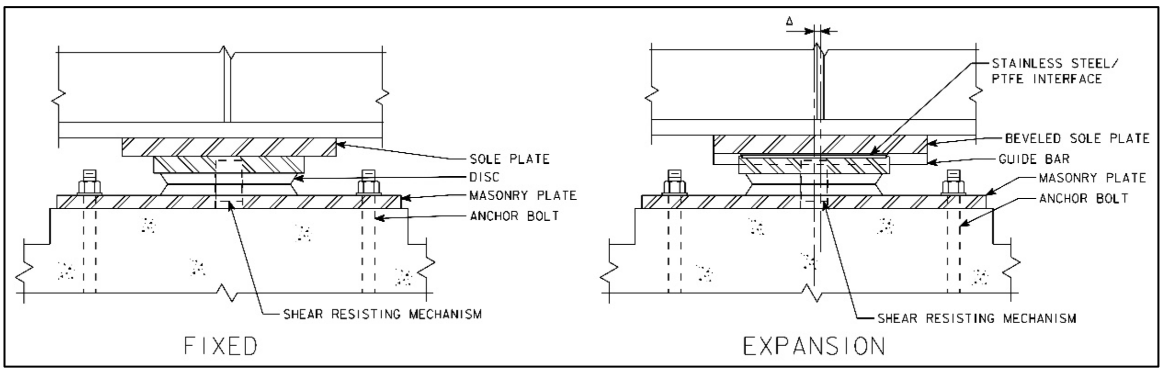

Figure 4.3.2-4 Disc Bearings

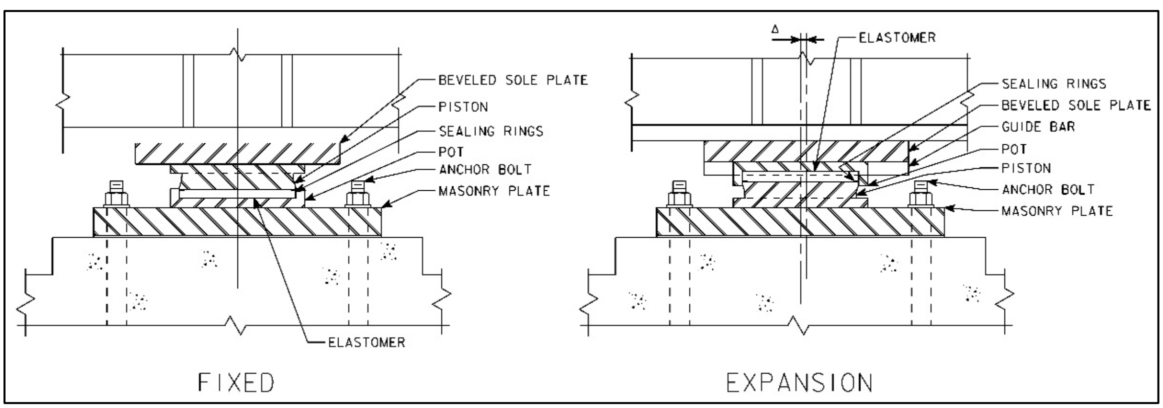

Figure 4.3.2-5 Pot Bearings

4.3.2.2 Stringers

For steel stringers, inspection must include checking for paint failure, corrosion, section loss, evidence of fatigue or fracture, evidence of overload, and connection damage. At areas of section loss, the inspector must use a D-meter or calipers to determine the thickness of steel remaining. For stringer connections where the stringer is connected to a floorbeam or other element with clip angle connections, the clip angle connections must be examined, especially where the connections may be subject to deterioration from leaking expansion joints above the connection. For stringers resting on the top flange of floorbeams, the anchor bolts connecting the stringer to the floorbeam must be checked to determine whether they are intact.

For concrete stringers, typical defects to check for include scaling, delamination, spalling, cracking, and honeycombing. With most of these defects, the damage to the concrete may, in turn, cause deterioration and loss of section to the accompanying reinforcing steel. The inspector must measure exposed reinforcing steel to determine the section remaining. High shear stress areas must be checked near supports for diagonal shear cracking and near midspan areas for flexure cracks oriented perpendicular to the tension flange.

When inspecting timber stringers, the inspector must visually inspect for checks, shakes, knots, splitting, crushing, decay, insect attack, natural defects, fire damage, overstress, or delamination (for Glulam members). Physical testing typically includes sounding with a hammer to determine areas of decay or rot, penetration tests with a pick, or core drilling to determine limits and extents of rot. In addition, the inspector must check fastener locations where the protective barrier created by preservative treatment is compromised.

A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the stringers. If there are no stringers, the condition must be coded "N."

4.3.2.2.1 Lateral Support

The load capacity for stringers supporting a steel, timber, or concrete deck may be controlled by the unbraced length of the compression flange for the stringer. If plans are not available, the inspector must document whether the stringers are braced at support locations, note the spacing of intermediate lateral supports (if provided), and document the depth of the lateral bracing members with respect to the overall depth of the stringer. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the stringer lateral supports. If there is no lateral support, the condition must be coded "N."

4.3.2.3 Girders/Beams

Inspection of steel, concrete, and timber girders/beams would focus on the same features as described for stringers as noted in Section 4.3.2.2. In contrast to steel stringers, which often consist of rolled sections, steel girders/beams are more likely to be built-up welded or riveted members. Therefore, the inspection of built-up steel girders/beams would require more emphasis on the connecting welds and rivets of these built-up members as well as fatigue cracks, which may initiate near weld terminations or other stress risers. In addition, for built-up riveted members, there is a higher tendency for pack rust to form between individual components of the built-up members. Girder and beam members are also more likely to incur impact damage; therefore, the inspector must document this type of deterioration during the inspection.

For steel bridges, if only two primary girder/beam members are present per span, the bridge lacks load path redundancy. These members would be considered NSTMs. NSTMs require inspection from an arm's length distance.

A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the girders/beams. If there are no girders/beams, the condition must be coded "N."

4.3.2.3.1 Lateral Support

The load capacity for girders supporting a steel, timber, or concrete deck may be controlled by the unbraced length of the compression flange for the girder. If plans are unavailable, the inspector must document whether the girders are braced at support locations, note the spacing of intermediate lateral supports (if provided), and document the depth of the lateral bracing members with respect to the overall depth of the girder.

A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the lateral supports for girders/beams. If there is no lateral support, the condition must be coded “N.”

4.3.2.4 Floorbeams

Inspection of steel, concrete, and timber floorbeams would focus on the same features as described for stringers as noted in Section 4.2.2.2 In contrast to steel stringers, which often consist of rolled sections, steel floorbeams are more likely to consist of built-up welded or riveted members. Therefore, the inspection of built-up steel floorbeams would require more emphasis on the connecting welds and rivets of these built-up members. Also, with built-up riveted members, there is a higher tendency for pack rust to form between individual components of the built-up members.

A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the floorbeams. The condition must be coded “N” if there are no floorbeams.

4.3.2.4.1 Lateral Support

The load capacity for floorbeams may be controlled by the unbraced length of the compression flange for the floorbeam. If plans are not available, the inspector must document whether the floorbeams are braced at intermediate locations between supports by stringers. If the top flange of a floorbeam is in contact with the deck, it is considered fully braced.

A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the lateral supports for floorbeams. The condition must be coded “N” if there is no lateral support.

4.3.2.5 Trusses – General

Trusses consist of members acting primarily in tension or compression. The inspector must examine steel compression members to confirm they are straight, with no bows or kinks, so as not to introduce eccentric loading into the members. In addition, the inspector must check connections to ensure that they are intact. Steel tension members in trusses are generally NSTMs, as are truss member gusset plates, and pins at pinned trusses; therefore, any NSTMs that are located within the truss structure shall be inspected at arm’s length. The inspector must carefully check weld locations, material flaws, changes in member cross section, or other potential stress risers in tension members that could initiate the formation of a crack. Looped rod tension members and eyebars must be closely examined for cracking in the loop or eyebar areas. For these members made up of multiple loop rods or eyebars, the inspector must check to ensure that all components equally share the tensile load. For pin-connected trusses, the inspector must check the condition of pins and ensure that nuts and spacers are in place. In addition, the inspector must check for broken, loose, or missing rivets, bolts, or nuts. The inspector must inspect gusset plates for signs of distortion from overload. The paint condition, corrosion, and section loss of members, particularly riveted built-up members that may trap moisture between connected components, must be documented. At areas of section loss, the inspector must measure the thickness of members with calipers or a D-meter to determine the thickness remaining.

For timber trusses, timber members must be inspected for checks, splits, cracks, insect damage, and decay. The inspector must carefully check joints for decay where there are contact surfaces where moisture can be trapped or enter around holes for bolts or truss rods. The inspector must check for evidence of crushing at ends of compression members. At end panel joints, where the timber members may come in contact with the ground or trap dirt and debris, the inspector must check for decay and rot.

In addition, the inspector must check connections for loose, broken, or missing bolts or nuts. Roofs and sides of covered bridges must be investigated to ensure they are protecting structural members from the elements. Any fire hazards, which need to be corrected to safeguard the structure, must be reported.

A condition rating (0 – 9) for B.C.02 must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the truss. The condition must be coded "N" if this field does not apply. An overall condition rating of the NSTM (Item B.C.14) shall be provided in SIIMS as shown in Table 4.2.2-1.

4.3.2.5.1 Portals

Portal bracing members between lines of trusses are usually the members with the most restrictive vertical clearance. The inspector must check these portal bracing members for impact damage. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the portal members. The condition must be coded "N" if there are no portals.

4.3.2.5.2 Bracing

All upper and lower bracing members must be checked for damage and to observe if they are properly adjusted and functioning correctly. Lateral and sway bracing must be observed under live load to confirm proper function. Connection gusset plates for lateral and sway bracing members may easily trap the nesting material of birds or other debris, thus retaining moisture and promoting corrosion and section loss. The condition of connections and any section loss of rivets, bolts, gusset plates or structural members must be documented. Connection plates of lateral bracing and sway bracing must be checked for fatigue cracking due to wind or live load induced vibration. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the truss bracing. The condition must be coded "N" if there is no truss bracing.

4.3.2.6 Paint

The paint coating of steel members must be inspected for chalking, peeling, and overall effectiveness. Generally, chalking is the first indication that the paint system is beginning to fail. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of the paint. If there are no painted members, the condition must be coded "N."

4.3.2.7 Rivets or Bolts

Rivets and bolts must be examined to document loose, broken, or missing rivets, bolts, or nuts. In heavily corroded areas, the loss of rivet or bolt heads due to corrosion must be documented. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of rivets and bolts. The condition must be coded "N" if there are no rivets or bolts.

4.3.2.8 Welds – Cracks

Particularly in tensile zones of members or for members fully in tension, welds must be examined for cracks or poor workmanship. Tack welds, temporary fit-up welds, and field welds in tension members must be carefully examined. The inspector must check for instances of intersecting welds in tensile zones, which could provide stress risers. Weld cracks found in tension zones may require nondestructive testing methods, such as dye penetrant testing or magnetic particle testing, to determine the termination point of the crack. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of welds. If there are no welds, the condition must be coded "N."

4.3.2.9 Steel Corrosion

Corroded steel members may require removal of rust build-up by hammering, scraping, or grinding to determine extents of section loss. The inspector must document if corrosion is surface rust only, rust with section loss, or pack rust. In addition, the inspector must document the locations of defects and the extent of rust and must measure the remaining steel thickness. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall severity of steel corrosion. The condition must be coded “N” if this data field does not apply.

4.3.2.10 Timber Decay

Inspection for timber decay must include physical testing, typically by hammer sounding or penetration tests with a pick or core drill, to determine extents of sound timber cross section remaining. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall severity and extent of timber decay. The condition must be coded “N” if this data field does not apply.

4.3.2.11 Concrete Cracking

Documentation of concrete cracking must include a description of the crack location, width of crack, and length of crack. Feeler gauges or wallet-sized transparent cards with various crack width comparison gauges are available for estimating crack widths. The inspector must note the location and nature of the crack, such as whether the crack is a diagonal crack radiating upward toward midspan from a support location (shear crack) or if it is a crack beginning at and oriented perpendicular to the tension side of the member near midspan (positive moment flexure crack). A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall severity and extent of the concrete cracking. The condition must be coded “N” if this data field does not apply.

4.3.2.12 Collision Damage

All vehicular collision damage or flood debris impact to superstructure members must be noted. In addition, the extents of damage, particularly deterioration that could affect the public safety or the load carrying capacity of the bridge, must be documented on the Critical Finding Form in SIIMS This might include damaged prestressing strands of concrete beams, torn bottom flanges of steel beans, or torn elements of truss members. Documentation must be supplemented with nondestructive testing, if required, to determine the remaining usable section properties of damaged members. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall severity and degree of collision damage. If this data field does not apply, the condition must be coded “N.” Damage may warrant a Critical Finding report be completed as part of the Routine or In-Depth inspection.

4.3.2.13 Deflection Under Load

Excessive superstructure deflection under load could indicate failure of a critical member. The inspector must sight along barrier rails of the bridge or check bridge expansion joints to observe for unusual deflection of the bridge superstructure or possible substructure settlement. In addition, the inspector must watch for localized deflection of members, which could indicate a connection failure. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall extent of deflection under load.

4.3.2.14 Alignment of Members

The inspector must watch for misalignment of members that could be caused by an overload condition or localized failure. Gusset plates must be checked for distortion or misalignment. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall condition of member alignment.

4.3.2.15 Vibration Under Load

Although all bridges will tend to vibrate to some degree, the inspector must take note of excessive vibrations under load. In addition, the inspector must listen for audible rattles or banging of members that could be indicative of damaged or loose members, such as lateral bracing, expansion joints, or bearings not in full contact with structural members. A condition rating (0 – 9) must be assigned on the Superstructure Form in SIIMS to describe the overall extent of vibration under load.

4.3.3 Substructure Inspection

All substructure elements must be inspected and documented for visible signs of distress, including evidence of cracking, section loss, settlement, misalignment, rotation (tipping), lateral movement, scour, undermining, collision damage, overload conditions, and corrosion. Integral abutment wingwalls to the first construction or expansion joint shall be included in the evaluation for abutments. For non-integral superstructure and substructure units, the substructure shall be considered the portion below the bearings. For structures where the substructure and superstructure are integral, the substructure shall be considered as the portion below the superstructure.

An overall condition rating of the Substructure (Item B.C.03) shall be provided as shown in Table 4.2.2-1. Code "N" must be used for all culverts. The substructure condition rating must be made independent of the condition ratings for the deck and superstructure.

For scour critical bridges, the scour conditions may substantially affect the overall condition of the substructure. When Item B.C.11, Scour Critical Bridges, is coded 2 or less, the Substructure rating (Item B.C.03) should be coded with the same value as Item B.C.11.

Substructure field notes must be maintained in the remarks field of the items described below or in the General Comments field. When the Substructure GCR is <=5, a comment is required in the General Comments field to explain the reason for the rating.

4.3.3.1 Abutments

Abutments are located at the ends of the bridge and support the superstructure at the transition between bridge and pavement. Abutments can be supported by spread footings or piles. There are several types of abutments including integral, semi-integral, as well as full-height, partial height, and stub abutments. Abutment components may include stems, backwalls, caps, seats, footings, piles and integral wingwalls, depending on design.

Integral Abutments - An integral abutment is connected to the superstructure in a way that makes the abutment flex with the expansion and contraction of the superstructure. This flexing will often displace soil and create a trough in front of the footing and a void under the approach pavement at the paving notch. These conditions are not detrimental to the structure. The void under the approach must be monitored to make sure it does not grow too large due to water erosion.

Semi-Integral Abutments - Semi-integral abutments vary from integral abutments in that the upper portion of the abutment stem is integral with the superstructure but is isolated from the lower portion via some sort of expansion joints material (typically preformed joint fill material). A semi-integral abutment can be a retrofit or an original design. Leaching of subsurface drainage from the approach fill occurring between the footing and the backwall may be present, which may indicate a non-functioning sub-drain.

Full Height, Partial Height, and Stub Abutments - Abutment stems are load carrying portion of the abutments from the bridge seats to the footings, if applicable, or ground. Backwalls are the portion of the abutments above the bearing seats. The backwall must be examined for signs of crushing or cracking from deck pressure against the backwall. The joint opening must be measured between the deck and backwall on the underside of the joint. The joint opening on top of the backwall may not be comparable to the gap between the deck and backwall underneath the joint.

4.3.3.1.1 Caps

The horizontal surfaces on the tops of the beam seats are particularly vulnerable to deterioration due to the road debris and chloride-laden runoff that may be deposited on the cap from open or failed expansion joints. For concrete abutments, cracking, spalling, delamination, scaling, efflorescence, and corrosion of reinforcing steel in the concrete elements must be documented. Areas around bridge bearings must be checked for spalls or cracks from the concentrated bearing loads. For timber abutment caps, the inspector must look for rot / decay of the timber cap in addition to any splits, checks, or shakes. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the abutment caps. If there are no caps, the condition must be coded "N."

4.3.3.1.2 Wings

The inspector must check for lateral movement of the wingwalls (rotation, bulging, sliding, or shifting) as well as settlement. Such movements may cause cracking in concrete wingwalls, broken timber wingwall planks, buckled steel sheet pile, or distress at the interface with the abutment cap and backwall. Wingwall movement or settlement may also be caused by stream scour. Ends of wingwalls must be checked for erosion damage, which may allow roadway runoff to be trapped behind the wingwalls and create saturated soil conditions, increasing the soil loads on wingwalls. Cracking, spalling, delamination, scaling, efflorescence, and corrosion of reinforcing steel in the concrete elements must be documented. Rot/decay, splits, checks, and shakes in timber elements must be documented. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the abutment wings. The condition must be coded "N" if there are no wings.

4.3.3.1.3 Backwall

The inspector must examine the backwall for signs of crushing or cracking from deck pressure against the backwall. The inspector must also check abutment backwalls for rotation or bulging from unbalanced earth loads. For concrete backwalls, cracking, spalling, delamination, scaling, efflorescence, and corrosion of reinforcing steel in the concrete elements must be documented. In addition, the tops of concrete backwalls must be examined for scaling and concrete deterioration from chloride-laden bridge runoff and mechanical action of approach slab rotation. For timber backwalls, the inspector must look for broken or split planks, as well as splits, checks, and rot/decay. For steel sheet pile backwalls, the inspector must look for and document buckled sheet piles. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the abutment backwalls. If there are no backwalls, the condition must be coded "N."

4.3.3.1.4 Footing

Abutment footings must be investigated for evidence of scour or undercutting. The inspector must document if the ground line has been scoured or eroded below the bottoms of the footings. The areas around spread footings must be probed for scour holes, and footings must be observed for signs of settlement. Cracks, delamination, scaling, efflorescence and/or spalling in concrete or masonry footings must be documented. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the abutment footings. If there are no footings or the footings are not visible, the condition must be coded "N."

4.3.3.1.5 Piles

The inspector must document if piles are exposed below the bottom of the abutment footing. Piles must be checked for damage from flood debris. The inspector must document the vertical alignment of piles if excessive unbalanced soil load at abutment or scour has caused the abutment to rotate or slide. For steel piles showing signs of section loss, the thickness of pile flanges and web must be measured to determine the thickness of steel remaining. Timber piles must be sounded with a hammer and probe as necessary to detect and measure for rot/decay, especially in zones alternately wet and dry. Splits, checks, and shakes in timber elements must also be documented. A condition rating (0 - 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the abutment piles. The condition must be coded "N" if there are no piles, or the piles are not visible.

4.3.3.1.6 Scour/Erosion

Particularly for bridges on dirt or gravel roads in which no approach slabs are provided, the approach roadway adjacent to the bridge backwall and wingwalls must be examined for erosion holes or signs of settlement that may indicate loss of soil behind the abutment. Ends and exposed faces of wingwalls must be checked for erosion where bridge or side ditch runoff could cause erosion problems around the abutment. Abutments must be examined for distress due to stream scour. The inspector must check for erosion near abutments where deck drains outlet onto the bridge berms. The condition of scour and erosion countermeasures such as channel armoring or riprap adjacent to the abutment or wingwalls must be documented. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition with respect to abutment erosion or scour.

4.3.3.1.7 Settlement

Footing settlement from scour or undercutting is discussed in Section 4.3.3.1.4, above. The inspector must check for localized settlement of abutment due to erosion from roadway side ditches or outlets from bridge scuppers. Settlement, particularly for abutments on spread footings, could also be caused by overload conditions. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition with respect to abutment settlement. The condition must be coded "N" if there is no settlement noted.

4.3.3.2 Piers or Bents

4.3.3.2.1 Caps

For piers located under bridge expansion joints, pier caps are particularly vulnerable to deterioration due to the road debris and chloride-laden runoff that may be deposited on the cap from open or failed expansion joints. For concrete pier caps, cracking, spalling, and corrosion of reinforcing steel must be documented. Areas around bridge bearings must be checked for spalls or cracks from the concentrated bearing loads. For timber pier caps, the inspector must look for crushing at beam bearing areas, rot, decay of the timber cap, and any splits, checks, or shakes. Steel bent caps must be checked for corrosion loss. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the pier caps. The condition must be coded "N" if there are no caps.

4.3.3.2.2 Columns

The inspector must check pier columns or stems for lateral movement or tilt that could be caused by unbalanced soil loads or locked-up bearing devices. The inspector must document cracks, spalls, and corrosion of reinforcing steel for concrete pier columns or stems, especially columns or stems under bridge expansion joints, exposed to bridge scupper outlets, or exposed to salt spray from adjacent roadways. For steel columns, the inspector must document any corrosion and measure for section loss as required. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the pier columns or stem. The condition must be coded "N" if there are no piers.

4.3.3.2.3 Footing

If pier footings are exposed, concrete and masonry footings must be checked for cracks, spalls, or corrosion of reinforcing steel. Footings must be checked for signs of settlement. Exposed pier footings could also be indicative of unexpected scour or erosion. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the pier footings. The condition must be coded "N" if there are no footings, or the footings are not visible.

4.3.3.2.4 Piles

The inspector must document if piles are exposed below the bottom of the pier footing. For pile bents, piles must be checked for damage from flood debris or deterioration at the waterline. The inspector must document the vertical alignment of pile bents if unbalanced soil load at pier or scour has caused the pier to rotate or tilt. For steel piles showing signs of corrosion loss, the thickness of pile flanges and web must be measured to determine the thickness of steel remaining. Timber piles must be sounded with a hammer and probe as necessary to detect and measure for rot or decay, especially in zones alternately wet and dry. Cracks or spalls in concrete piles must be noted. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the pier piles. If there are no piles or the piles are not visible, the condition must be coded “N.”

4.3.3.2.5 Erosion or Scour

Piers on land may be subject to erosion from multiple sources including run-off or leakage from deck drains. For piers located in more than 2 feet of water, evaluation for effects of scour may need to be performed by means of an Underwater Inspection. A qualified Team Leader must perform an underwater wading inspection and use tactile methods to determine extents of scour holes adjacent to and under the pier footing. Underwater Inspection must also check for the scour effects, such as abrasion, which occur on the concrete footings by noting any loss of cement paste, aggregate popouts, spalls, or other defects discovered below the water line. For water depths of 6 feet or greater, inspection by diving is required. Under no circumstance should an inspector be submerged below water, and if a comprehensive probing and tactile inspection cannot be completed, qualified divers may need to be employed to conduct a thorough inspection. The Underwater Inspection Form in SIIMS must be completed when wading or diving inspection is performed.

For piers exposed to scour only during high water events, inspections must be scheduled during low flow events, if possible, to document the condition of scour countermeasures or any scour effects on the pier. Scour holes are often infilled with sediment during low flow events, so inspectors must note the depth and size of any areas that are softer and less compact than the adjacent channel bottom. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of scour at the piers. The condition must be coded “N” if this field does not apply.

4.3.3.2.6 Settlement

The inspector must sight along bridge rails to detect settlement at pier locations. For suspected settlement conditions, the suspected pier must be further investigated to determine the cause and extents of settlement. For suspected settlement, the inspector must consider mounting a survey target on the top of the pier to allow monitoring of the pier settlement over time. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition with respect to pier settlement.

4.3.3.3 Concrete Cracking

Documentation of concrete cracking for substructure members must include a description of the crack location, width of crack, and length of crack. Feeler gauges or wallet-sized transparent cards with various crack width comparison gauges are available for estimating crack widths. For abutment or pier caps, the inspector must note the location and nature of the crack, such as whether the crack is a diagonal crack radiating upward toward midspan from a support or column location (shear crack) or if it is a crack beginning at and extending perpendicular to the tension side of the cap near midspan (positive moment flexure crack). A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall severity with respect to concrete cracking. The condition must be coded “N” if this data field does not apply.

4.3.3.4 Steel Corrosion

Corroded steel members may require removal of rust build-up by hammering, scraping, or grinding to determine extents of section loss. The inspector must document if rust corrosion is surface corrosion only, rust with section loss, or pack rust. In addition, the inspector must document the location of defects and the extent of rust and must measure the remaining steel thickness. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall severity of steel corrosion. The condition must be coded "N" if this data field does not apply.

4.3.3.5 Timber Decay

Inspection for timber decay must include physical testing, typically by hammer sounding or penetration tests with a pick or core drill, to determine extents of sound timber cross section remaining. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall severity with respect to timber decay. The condition must be coded "N" if this data field does not apply.

4.3.3.6 Debris on Seats

Particularly under open or leaking bridge joints, road debris may build up on abutment and pier beam seats and cap beams. Build-up of pigeon nesting material or excrement can also obscure the clear view of cap elements and hinder inspection procedures. All such types of debris have a tendency to hold moisture and promote concrete deterioration, corrosion of steel, and decay of timber members. Prior to initiating inspection operations, maintenance crews must initiate bridge cleaning efforts to allow for the most efficient use of the inspector's time and allow for a thorough inspection. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall severity with respect to debris on the seats. The condition must be coded "N" if this data field does not apply.

4.3.3.7 Paint

The paint coating of steel substructure members must be inspected for chalking, peeling, and overall effectiveness. Chalking is often the first indication that the paint system is beginning to fail. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall condition of the paint coating. The condition must be coded "N" if there are no painted members.

4.3.3.8 Collision Damage

Bridge substructure members located adjacent to active roadways may encounter collision damage from an errant vehicle. Damaged members must be thoroughly checked, and impact damage such as concrete spalls or cracks and bent or cracked steel members must be documented. Immediate action must be taken if public safety is in question or if there is a question regarding substructure stability. In this case a Critical Finding should be issued. A condition rating (0 – 9) must be assigned on the Substructure Form in SIIMS to describe the overall severity of the collision damage. If there is no collision damage, the condition must be coded "N. The rating for the damage on the Substructure form may influence the overall condition rating of the substructure.

4.3.4 Culvert Inspection

A culvert with an opening greater than 20 feet as measured along the center of the roadway is considered a bridge-sized structure and is subject to NBIS requirements. Similarly, a grouping of culverts with a length greater than 20 feet as measured along the roadway centerline, and where the clear distance between openings is less than half the smaller contiguous opening, is considered a bridge-sized structure.

Culverts must be inspected for their overall condition, any approach roadway and embankment settlement, the condition of their end treatments (headwalls, parapets, and wingwalls), and the condition of their appurtenance structures (such as aprons, weirs, and energy dissipaters). The inside of a culvert must be inspected for any damage or deterioration. Weep holes must be checked to determine if they are functioning or if they are plugged. Joints must be checked for deterioration or spalls.

An overall condition rating of the Culvert (Item B.C.04) shall be provided as shown in Table 4.2.2-3. Culverts must be evaluated with respect to their alignment, settlement, joints, structural condition, scour, and other elements associated with culverts. The rating code is intended to be an overall condition evaluation of the culvert. Integral wingwalls to the first construction or expansion joint shall be included in the evaluation.

Culvert field notes must be maintained in the remarks field of the items described below or in the General Comments field. When the Culvert GCR is <=5, a comment is required in the General Comments field to explain the reason for the rating.

4.3.4.1 Barrel

The inspector must sight along the length of the culvert barrel to look for signs of settlement. The roadway embankment must also be viewed for signs of settlement, erosion or settlement of side slopes, pavement cracking, or pavement patching indicative of embankment settlement. Joints within the culvert must be checked for differential movement, infiltration of water, or exfiltration into the surrounding supporting soils. The inspector must check for loss of filler material or sealers at joints. The inspector must watch for signs of piping along the outside face of the culvert walls or below the base slab.

4.3.4.1.1 Concrete

For concrete box culverts, sidewalls, the top slab, and the base slab must be inspected for abrasion, cracking, or spalling of concrete surfaces, as well as for honeycombing of concrete and exposed reinforcing steel. Deteriorated areas must be sounded to determine the extents of delamination. A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall condition of the culvert concrete. If the culvert has no concrete elements, the condition must be coded “N.”

For concrete arch culverts, the entire arch, with closer attention to the area near the spring line, must be inspected for abrasion, cracking, or spalling as well as honeycombing of concrete and exposed reinforcing steel.

4.3.4.1.2 Steel

For steel culverts, any flattening of the top or sides of the metal elements or any shape distortions from the original as-built conditions must be noted. The inspector must check the base of Corrugated Metal Plate (CMP) structures for differential settlement or undermining. In addition, the inspector must check along the length of the CMP for misalignment of plate elements, leakage at seams and dents, or local defects. Finally, the inspector must check for cracks and distortions, especially at bolt locations. A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall condition of the steel components. If there are no steel components, the condition must be coded “N.”

4.3.4.1.3 Timber

Timber culverts must be inspected for checks, splits, shakes, fungus decay, rot, deflection, and loose fasteners. Gaps between adjoining members that are leaking fill material must be noted. A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall condition of timber components. If there are no timber components, the condition must be coded “N.”

4.3.4.2 Headwall

Headwalls may be constructed with concrete, steel, or timber. Inspect for the typical deterioration damage of the material type used.

At concrete headwalls, the inspector must check for indications of movement, rotation, or settlement of wingwalls, and separation or rotation of wingwalls from the main barrel.

For metal structures that do not have concrete headwalls, the inspector must check for any upward displacement at the inlet. For inlet or outlet ends mitered into the embankment slope, the inspector must check for evidence of edges folding inward.

For timber headwalls, the inspector must look for checks, splits, shakes, fungus decay, rot, deflection, and loose fasteners. Gaps between adjoining members that are leaking fill material must be noted.

A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall condition of the headwalls. If there are no headwalls, the condition must be coded "N."

4.3.4.3 Cut-Off Wall

The downstream cut-off wall must be checked for potential scour behind the wall in the upstream direction. The depth and limits of scour near the cutoff wall must be determined by probing with a rod. A condition rating (0 – 9) must be assigned on the Field Data Collection Form in SIIMS to describe the overall condition of the cut-off walls. The condition must be coded "N" if there are no cut-off walls, or they are not visible.

4.3.4.4 Adequacy

The inspection must include an evaluation of whether the size of the culvert adequately addresses the hydraulic demand. The inspector must look for high water marks as well as whether there are signs piping occurring along the outside of the culvert walls. In addition, the inspector must look for signs of erosion at the inlet end of the culvert or overtopping of the culvert. A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall culvert hydraulic adequacy.

4.3.4.5 Debris

The inspector must check for accumulation of debris, particularly at the inlet end of the culvert, which could block the entrance. In addition, the inspector must check for silting in of the culvert barrel. The inspector must note whether brush, trees, or debris are interfering with proper flow through the culvert. A condition rating (0 – 9) must be assigned on the Culvert Form in SIIMS to describe the overall severity of debris accumulation.

4.3.5 Channel and Channel Protection

When examining the channel and channel protection, inspectors must observe the adequacy of the waterway opening under the structure or approaching culvert inlet to determine if the waterway is unobstructed and affords free flow of water. Obstructions such as debris or growth may contribute to scour and may be a potential fire hazard to the structure. Sand and gravel bars deposited in the channel may direct stream flow in such a manner as to cause harmful scour at piers or abutments. In addition, the inspector must note any misalignment of the channel with respect to the substructure. The inspector should be particularly concerned with visible signs of excessive water velocity, which may affect undermining of slope protection, erosion of banks, and realignment of the stream, which, in turn, may result in immediate or potential problems.

The surrounding area must also be observed to determine if the bridge and approaches are causing problems, such as flooding due to inadequate openings of the structure or skew of the piers or abutments, or if erosion of banks or levees is resulting from improper protection.

4.3.5.1 Channel Condition

An overall condition rating of the Channel (SNBI Item B.C.09) shall be provided as shown in Table 4.2.2-2. This condition rating must take into account stream bank stability, the condition of streambed or bank protection systems, river control devices, streambed movement, and whether there is debris in the channel that could affect the hydraulic opening of the channel at the bridge. Accumulation of drift and debris on the superstructure, substructure, or culvert inlet must be noted in the inspection report but shall not be included in the condition rating. Consider the channel upstream and downstream only to the degree that it threatens the bridge and approach roadway.

When the Channel Condition GCR is <=5, a comment is required in the Remarks field to explain the reason for the rating.

4.3.5.2 Channel Protection

An overall condition rating of the Channel Protection (Item B.C.10) shall be provided as shown in Table 4.2.2-2. This condition rating must evaluate the condition and effectiveness of channel protection devices installed on the banks or in the stream to mitigate channel issues that may impact the bridge. When reporting this item, consider erosion and scour, damage (unraveling, displacement, separation, and sagging), and material defects (scaling, abrasion, spalling, corrosion, cracking, splitting, and decay). Channel protection devices are considered countermeasures that control, inhibit, delay, or minimize stream instability and scour problems, including river training and armoring countermeasures. River training countermeasures may include spurs, bendway weirs, guide banks, drop structures, and check dams.

When the Channel Protection GCR is <=5, a comment is required in the Remarks field to explain the reason for the rating.

4.3.5.3 Channel Scour

Scour can usually be categorized into three types: general, contraction, and local. General scour involves channel bed degradation along a considerable distance of the channel and would typically occur whether or not the bridge structure was present. Contraction scour is the lowering of the streambed under the structure resulting from the acceleration of the stream flow due to a reduced waterway opening at the bridge. Local scour is the lowering of the streambed adjacent to an obstruction in the streambed, such as a pier foundation.

The inspector must check for timber or any other debris accumulation in the channel or added vegetation that could contribute to contraction scour or local scour. In addition, ice jams, excessive riprap, sedimentation, an excessive number of piers in the channel, and inadequate bridge length can all contribute to contraction scour. Probing around pier and abutment locations must be employed to determine the depth and extents of scour holes. In addition, although scour holes could infill with silt or sediment, probing would indicate the difference in compaction of natural soils and soils deposited following scour activities. Inspectors must also consider design scour depth and critical scour depth, commonly found in hydraulic designs, scour evaluations, and scour plans of action (POA), when determining the scour condition ratings. When observed conditions are not consistent with the scour design or the assumptions used in the scour appraisal, this indicates a need to reevaluate Item B.AP.03 (Scour Vulnerability).

A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS **for Scour Condition Rating (Item B.C.11)** to describe the overall severity of the channel scour and how this scour potentially affects overall bridge stability. The condition must be coded "N" if this field does not apply. When the Channel our GCR is <=5, a comment is required in the Remarks field to explain the reason for the rating.

4.3.5.4 Underwater Condition Rating

An overall condition rating of underwater members (SNBI Item B.C.15) shall be provided as shown in Table 4.2.2-2. This condition is for underwater members identified to be inspected in the underwater inspection procedures and will also impact and be incorporated into the overall Substructure Condition rating.

4.3.5.5 Fender System

Fender systems or dolphins are used to protect bridge substructures from unintended impact by floating debris or maneuvering vessels. Fenders are typically a protective unit or cover around a pier or the face of an abutment and are frequently attached to the substructure. Dolphins are generally a stand-alone unit placed upstream or downstream from a pier.

Piles must be inspected for fenders or dolphins in a manner similar to inspection of bridge substructure components. Steel frame members, cables, and connections must be inspected for corrosion, impact damage, and abrasion from vessel or debris impact. Timber piles and fender components must be inspected for decay, insect damage, marine organisms, impact, and structural damage. Connections and cables must be checked for corrosion. Concrete components must be checked for spalling, cracking, corrosion of reinforcing steel, and damage or abrasion from debris or vessel impact. Auxiliary components such as rubber rub rails must be checked for damage and connection damage. Any hydraulic components must be checked to ensure that they are working correctly. In addition, navigation lighting and beacons must be checked for broken or missing lenses, proper light function, and damage to connections, wiring, and conduit.

A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall condition of the fender systems. If there are no fenders or dolphins, the condition must be coded “N.”

4.3.5.6 Spur Dikes and Jetties

Spur dikes and jetties are river control structures designed to modify the flow of the river to help control lateral streambed movement. Spur dikes are often placed on the outside of a river bend to protect the stream bank by slowing velocities and inducing sediment deposition. The overall effectiveness of spur dikes and jetties must be evaluated from the standpoint of whether they are functioning as intended to protect the bridge. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall condition of the spur dikes and jetties. If there are no spur dikes or jetties, the condition must be coded “N.”

4.3.5.7 Vegetation

Excessive vegetation or tree growth along a channel’s banks can also lead to contraction scour. In contrast, grass and other light vegetation along stream banks can promote bank stability and help prevent sloughing. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall bank stability with respect to vegetation growth.

4.3.5.8 Riprap

Riprap and other armoring types of countermeasures are not intended to alter the stream’s flow significantly but are designed to reduce the hydraulic stresses from design flood events. Riprap is often used to protect piers and abutments from contraction or local scour. The inspector must evaluate riprap for proper placement and whether it is functioning as intended to protect the stream banks. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall effectiveness of the riprap. If there is no riprap, the condition must be coded “N.”

4.3.5.9 Embankment Erosion

Lateral stream migration is the relocation of the stream channel over time due to lateral scour of the embankments. The inspector must note the angle of attack of the natural stream with respect to the bridge opening, which may be a contributing source of embankment erosion. In addition, the inspector must note bank sloughing and undercutting by the stream action. Left unchecked, early stages of lateral stream migration can lead to channel misalignment, where the stream flow now impacts one of the bridge abutments or flows under a bridge at a skew angle incompatible with the span opening(s). A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall severity of embankment erosion.

4.3.5.10 Drift

Drift and debris accumulations against the upstream side of piers partially blocking the hydraulic opening must be recorded. Debris build-up can cause unintended contraction scour or local scour. In addition, drift build-up can present a fire hazard to the bridge. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall severity of the drift build-up with respect to its potential to create a scour or a fire hazard.

4.3.5.11 Channel Change

As noted in Section 4.2.5.3, as stream embankments scour over time, lateral stream migration can occur. Overtopping during flood events could also cause stream cutting and a channel change. Channel cross sections must be reviewed over subsequent inspection cycles to identify appropriate countermeasures that may be needed to promote stability of the bridge opening. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall channel stability with respect to channel change.

4.3.5.12 Adequacy of Opening

The inspector must check the adequacy of the overall waterway opening. Specifically, the inspector must check for high water marks and must look for signs of contraction scour, lateral stream migration, or embankment sloughing that may indicate whether the opening size is inadequate. A condition rating (0 – 9) must be assigned on the Channel Form in SIIMS to describe the overall adequacy of the hydraulic opening.

4.3.5.13 Scour Vulnerability and Scour Plan of Action

A qualified Program Manager or Team Leader shall complete the scour analysis as per I.M. 7.020. SNBI Item B.AP.03 shall be coded according to the findings of the scour analysis, and any bridge coded as C, D, E, or U for SNBI Item B.AP.03 is considered scour critical.

A bridge that is found to be Scour Critical must have a Plan of Action (POA) (Item B.AP.04) developed as per I.M. 7.020. The POA includes a specific plan for monitoring, inspecting, or closing a Scour Critical bridge during or after a flood event. A field in SIIMS identifying that a POA has or has not been implemented must be filled in with a “Yes” or “No” (Item B.AP.04, Scour Plan of Action). The analysis method must also be documented in SIIMS. Check boxes for Level A, B, or C analyses are provided in SIIMS to identify the type of analysis performed. One or more analysis types may be checked. The analysis documentation and POA must be uploaded into SIIMS.

When observed bridge or site conditions are not consistent with the scour design, the scour plan of action, or the assumptions used in the scour analysis, observed scour is considered in the coding of the Substructure Condition Rating (Item B.C.03). In this case, the scour deficiencies observed by the inspector are rated in the Scour Condition Rating (Item B.C.11), but these deficiencies may indicate a need to request a reevaluation Item B.AP.03 (Scour Vulnerability).

4.3.5.14 Unknown Foundations

The Unknown Foundation Risk Assessment Worksheet in I.M. 7.020 is completed to determine the scour risk level of a bridge. A risk assessment score <=25 can be considered "Low" risk or Level C; a score between 26 and 29 is considered "Moderate" risk or Level B and a score >=30 is considered "High" risk or Level A. A bridge with an unknown foundation must be analyzed for potential risk of failure during a flood event. There are two levels of analysis that can be performed. I.M. 7.020 Attachment H has guidance and a flowchart for Level A analysis; Attachment I has a flowchart for Level B analysis. Check boxes for Level A and B analyses are provided in SIIMS to identify the type of analysis performed. Both check boxes may be checked when the Level A assessment identifies risk level as Moderate or High. The risk level shall also be entered in SIIMS. In SIIMS, it must be documented that a POA has or has not been implemented. Enter "Yes" or "No" in the corresponding field identifying whether a POA has been implemented. The analysis documentation and a POA must be uploaded into SIIMS.

4.3.6 Bridge Data

4.3.6.1 Load Posting Table

If the bridge is load restricted, the inspector must verify whether the posted limits in the field match the recommended limits. The posting status of a bridge may change multiple times between data submittals and throughout its service life, such as after reevaluation of the load rating. Data for SNBI Items B.PS.01, B.PS.02, B.EP.01, B.EP.02, B.EP.03, and B.EP.04 must be reported for each change in posting status. Reporting posting status changes that were accepted into the NBI in prior years is not required unless it is found that the accepted data were incomplete or incorrect. The actual tonnage shown on the signs in the field must be entered in the table (see Table 15 Load Posting Status Codes under SNBI Section 5.2). Remarks must be made to clarify the load limits or explain any discrepancies; however, the status codes in Table 15 will identify most posting conditions.

4.3.6.2 Signing

The inspector must verify that other required regulatory signs are properly posted at the correct height, are not obstructed by vegetation, and are clear and legible. These signs may include reduced speed limit signs, restricted vertical clearance signs, narrow bridge signs, bridge closure signs, and lateral delineators. Posted for Load signs must be coded in accordance with the codes in SNBI Section 5.3 and the Posting Value reporting is to follow the guidance in Section 5.3.

A rating of Good, Fair, or Poor must be used to document the legibility and visibility of the signs. For applicable signs at the bridge site, comments on the legibility and visibility of the signs must be made on the Bridge Data Form in SIIMS.

4.3.6.3 Approaches

4.3.6.3.1 Approach Alignment

The approach roadway alignment must be evaluated in terms of how much the horizontal and vertical geometry near the bridge causes a vehicle's normal roadway operating speed to be reduced. This is coded in Item (B.AP.01) as G, F or P for Good, Fair or Poor.

4.3.6.3.2 Concrete Approaches

The inspector must check the approach pavement condition for cracking, settlement, unevenness, or roughness. Joints between approach pavement and abutment must be examined to verify they do not leak and provide adequate movement for bridge thermal expansion. The inspector must check that roadway approach drainage does not pond on shoulders and does not erode approach fills or areas at ends of wingwalls. In addition, the inspector must verify approach roadway drainage is directed away from the bridge. A condition rating (0 – 9) must be assigned on the Bridge Data Form in SIIMS to describe the overall condition of the approach slabs. If there are no approach slabs, the condition must be coded "N."

4.3.6.3.3 Relief Joints

The inspector must check pavement relief joints in the bridge approaches for proper function to determine if they are properly accommodating thermal movement. The inspector must check for road debris or other factors that might inhibit movement at pressure relief joints. A condition rating (0 – 9) must be assigned on the Bridge Data Form in SIIMS to describe the overall condition of pressure relief joints. If there are no pressure relief joints, the condition must be coded "N."

4.3.6.3.4 Guardrail

Guardrail and all guardrail components, including transition sections at bridge rail and guardrail end treatments, must be checked for conformance to current standards. The inspector must check guardrail installation height and the condition of guardrail for impact damage, cracks, rust, and secure connections. Posts must be firmly embedded in the ground, and laterally displaced posts must be reported. Wood posts must be checked for rot or insect damage. If impact attenuator devices are used, the inspector must check for evidence of damage due to impact and that energy absorbing components have not ruptured. The inspector must also check that cable anchorages are secure and undamaged. A condition rating (0 – 9) must be assigned on the Bridge Data Form in SIIMS to describe the overall condition of the approach guardrail. If there is no approach guardrail, the condition must be coded "N." In addition, Items B.RH.02 and B.C.06 for Transitions also need to be coded in the SNBI.

4.3.6.3.5 Embankment

The approach embankment must be checked for steepness, signs of excessive erosion, settlement, and undermining of pavement, shoulders, or guardrail. Steepness must be measured and compared to the design slope of the embankment. A condition rating (0 – 9) must be assigned on the Bridge Data Form in SIIMS to describe the overall condition of approach roadway embankments.

4.4 ADDITIONAL SIIMS DOCUMENTATION

4.4.1 Photographs, Sketches, Plans, Documents, and Files

Photographs, sketches, plans, documents, and files are attached under the Report Info - Pictures section in SIIMS. Almost any file type can be added to a bridge file. The type of document will determine whether the document must be attached with an inspection report or as part of the Bridge File. If a document relates to only a specific inspection, such as photographs and sketches, it must be attached to the "In Progress" inspection report. When a document relates to the bridge, such as design plans or a scour plan of action, the document must be attached in the "Files" area under the appropriate file type on the Asset Details page.

Files attached as part of an inspection report must be attached before the inspection report is finalized. If a document or file is not attached before the inspection report is finalized, the report must be unapproved to attach the files and then reapproved.

Files not related to an inspection can be attached in the Asset Details page at any time, whether an inspection is in progress or not. The description field for each document must include specific information about the subject of the document so anyone looking at the Bridge File will know what each document contains without having to open each document.

4.4.1.1 Recommended Photographs

For Routine Inspections, the following photographs are recommended:

1. Bridges
    a. Approaches, with and against the route direction
    b. Profile view
    c. Upstream and downstream views, when over water
    d. Both abutments (overall)
    e. Typical pier, including one of each type if there are multiple types
    f. Bottom of the deck overall to show girder type and configuration
    g. Top of deck overall
    h. All deck joints
    i. Guardrail overall
    j. Load Posting Signs
    k. Vertical Clearance Signs
    l. Approach Warning Signs
    m. CS3 or CS4 deficiencies
2. Culverts
    a. Both inlet and outlet profiles
    b. Roadway above
    c. Upstream and downstream views
    d. Typical interior of culvert/barrel when accessible
    e. CS3 or CS4 deficiencies
    f. Any condition that may warrant repair

In-Depth Inspections must include all the required photographs for a Routine Inspection as well as photographs relating to the field notes on deteriorated or unique conditions. In addition, photographs of the posting signs must be included in the report. Structures with a condition rating coding of 4 or less for Deck (SNBI Item B.C.01), Superstructure (SNBI Item B.C.02), Substructure (SNBI Item B.C.03), Channel (SNBI Item B.C.09), or Culvert (SNBI Item B.C.04) are required to have photographs of the deficiency, although it is good practice to photographically document any significant deficiency. Add photographs that impact/control the condition ratings either singularly or as a combination with other deteriorated contributing elements.

4.4.2 Load Rating Evaluation Form

The Load Rating Evaluation Form must be completed for every inspection. This form will determine if the existing load rating needs to be re-evaluated to determine if it is still valid or if a new load rating is needed. The Evaluation Form can be filled out by the inspector or the QC reviewer. It is part of the error check process and must be filled out before the report can be finalized. The date and name of the individual completing the form must be entered at the top of the form.

Most questions on the form default to “No.” The question at the top of the page and the question at the bottom of the page default to “blank” and must be answered at each inspection. If any one of the questions is changed to “Yes,” a re-evaluation of the load rating or potentially a new load rating calculation will be required. When the Load Rating Evaluation Form indicates re-rating or re-evaluation is needed, the inspector will submit the report to the Load Rating engineer for review.

4.4.3 Load Rating

The load rating must be completed by a Professional Engineer licensed in the State of Iowa. As noted above, the need for a load rating re-evaluation or a new load rating calculation is determined by filling out the Load Rating Evaluation Form.

If the load rating is re-evaluated and there is no reason found to update the load rating, the following fields on the Load Rating Evaluation Form shall be updated:

1. **Name:** – The Engineer who performed the Load Rating re-evaluation
2. **Date:** – The date the re-evaluation was completed

Does the bridge need to be re-rated?: – change the answer to this question to "No"

If the load rating is re-calculated and the ratings have changed, the entire Load Rating Bridge Report page must be updated. The Load Rating Bridge Report page can be generated by an unlicensed engineer, but a licensed engineer must put their name and license number at the bottom of the form. It is recommended the new calculations be attached to the inspection report before it is finalized. If the ratings are not completed before the inspection is finalized, a Load Rating Report must be created to update the ratings and attach the calculations.

4.4.4 Critical Findings

The purpose of the Critical Findings Report in SIIMS is to ensure serious bridge damage or defects are reported, that the necessary notifications are made to the bridge owner by the Program Manager or Team Leader, and proper and timely action is taken to ensure the safety of the traveling public. This process alerts the bridge owner so damage or deterioration can be repaired in a proper and timely manner and ensures damage and repairs are documented.

The procedures to be used for LPAs when issuing a Critical Findings Report are as follows:

1. The individual discovering the critical finding shall:
   a. Immediately report the finding to the responsible local official, who may notify law enforcement or maintenance personnel to close the bridge.
   b. If the bridge is on the NHS, the FHWA must be notified within 24 hours.
   c. Complete Part I of the Critical Findings Report within 48 hours of the finding.
2. The responsible local official shall:
   a. Take action to ensure the safety of the traveling public.
   b. Complete Part II of the Critical Findings Report within 5 days of the finding.
3. Before a closed bridge may be reopened to traffic, the following must be completed:
   a. A Professional Engineer, licensed in the State of Iowa, must approve any structural repairs.
   b. The bridge must be load rated.
   c. A Team Leader must inspect the bridge.

A Critical Finding is a structural or safety related deficiency that requires immediate action to ensure public safety. Critical structural and safety related deficiencies found during the field inspection or as a result of a structural analysis of the bridge must be immediately brought to the attention of the bridge owner or responsible agency by the Program Manager or Team Leader if a safety hazard is present. This process alerts the bridge owner so that:

1. Timely action is taken to ensure the safety of the traveling public.
2. Damage or deterioration can be repaired in a proper and timely manner.

3. The damage and repairs are documented in the bridge file.

The process also aids in identifying problem areas that affect other bridges with similar details so follow-up inspections can be performed if needed.

A standard Critical Findings Report form has been incorporated into SIIMS. Conditions requiring a Critical Findings Report shall include, but are not limited to, the following:

- A partial or complete closure of a bridge, due to condition
- A condition rating of 2 or less for any of the following SNBI items:
    - B.C.01, Deck Condition Rating
    - B.C.02, Superstructure Condition Rating
    - B.C.03, Substructure Condition Rating
    - B.C.04, Culvert
    - B.C.09, Channel Condition Rating
    - B.C.11, Scour Condition Rating
- A condition rating of 3 or less for B.C.14, NSTM Inspection Condition.

A bridge may remain open to traffic if:

- It is determined the bridge could be used safely at a lower posted load limit and immediately posted at the reduced limit.
- The structural or safety issue only impacts a portion of a bridge (i.e., the fascia girder) and a shoulder closure is provided over the compromised member.

At the discretion of a bridge owner, other conditions, not specified in this manual, may be designated that would require the preparation of a Critical Finding Report.

4.4.5 Channel Cross Section

A channel cross section on the upstream side of the bridge is required to be a part of the bridge record, except for structures with artificial bottoms, such as concrete box culverts and corrugated metal pipe culverts. Channel cross section must be reviewed every inspection to determine if it requires updating or a new cross section developed. Cross section measurements must be taken at regular locations along the upstream fascia. If scour along a substructure unit (pier/abutment) exposes a footing, channel measurements must be taken at regular intervals along the length of the affected substructure unit. Consideration must then be given to performing a bathymetric/grid survey of the channel bottom when Scour Condition Rating (Item B.C.11) has a condition rating of 4 or less. For instances of excessive stream migration, a plan view of the channel must be generated that shows the upstream channel alignment, downstream channel alignment, and channel alignment with respect to substructure units.

A standard Channel Bed Measurement form has been incorporated into SIIMS. Each bridge structure is required to have data points at the top of bank, toe of bank, thalweg, and each substructure unit. The Channel Bed measurements are updated in SIIMS for natural waterways. Reference I.M. 7.020 Underwater Inspections (23 CFR 650.313, e) for more information on channel cross section data.

Bridge structures over natural waterways and drainage ditches are required to have an updated Channel cross section completed every 10 years, as per I.M. 7.020. Although the Channel Bed Measurement is required in SIIMS, hand-drawn channel sketches may be uploaded to the report, or the standard Channel Bed Measurement form in SIIMS may be used to generate a channel cross section sketch where the potential for and/or real time damage to the bridge substructure exists.

4.4.6 SNBI Calculations

Calculated fields are recalculated and updated in SIIMS during entry of inspection data for a new inspection.

The data fields that are calculated in the SNBI Calcs section in SIIMS are:

1. SNBI Item B.C.12, Bridge Condition Classification
2. SNBI Item B.C.13, Lowest Condition Rating Code
3. SNBI Item B.G.16, Calculated Deck Area.
4. SNBI Item B.IE.06, Inspection Due Date

In addition, Iowa calculates a "Bridge Condition Index" (BCI) using a formula similar to the previous FHWA Sufficiency Rating (SR). It is a number from 0-100, where 100 represents the best possible condition.

4.4.7 Supplemental Inspection Information

The NBIS requires information on inspection equipment needs and maintenance history be maintained for all bridges. The Supplemental Inspection Information section in SIIMS provides a means to document this information. This section includes:

1. Special equipment requirements for inspection (to be recorded using SNBI Item B.IE.12)
2. Traffic control needs during inspection
3. Time requirements for inspection
4. Construction work history (repair type (B.W.03) and year completed (B.W.02))

4.5 REPORTING OF SPECIAL ITEMS

4.5.1 Fatigue-Prone Details

Fatigue-prone details consist of, but are not limited to, the following:

- Welded cover plates, particularly the end terminations
- Web gap area at diaphragm stiffeners when out-of-plane bending is possible
- Welded gusset plate connections to girder webs, flanges, or truss members
- Weld terminations of longitudinal stiffeners
- Coped areas in a floorbeam or cross beam
- Tack welds in tension areas
- Intersecting welds

Fatigue is the tendency of a member to fail at a stress level below yield stress when subjected to cyclical loadings. Fatigue-prone details require additional attention. If fatigue cracks or fractures are noted, non-destructive testing methods, such as dye penetrant testing or magnetic particle testing, may be required to determine the extents of cracks in steel members. Ultrasonic methods are typically used to test pin members for defects. Thickness gauges (D-Meters) or calipers can be used to determine the thickness of steel remaining for a particular member.

Triaxial constraint is a 3-dimensional stress state that reduces the ductility of a material. Under triaxial constraint, steel is unable to deform, and brittle fracture can occur under service conditions where ductile behavior is normally expected. Due to the nature of these unique conditions, the chance for member failure is greater for these conditions and they warrant added emphasis during inspection. Finally, the ability of inspectors to recognize conditions of triaxial constraint is important to guard against brittle failure.

AASHTO prioritizes fatigue details into categories from A (least critical) to E’ (most critical). The inspector shall be familiar with the various fatigue categories and be able to classify the categories encountered in the field to determine the seriousness of the detail. Fatigue-prone details must be identified and noted in the inspection report so that the details can be monitored for cracks in subsequent inspections. If any fatigue prone details fall into categories E or E’, SNBI Item B.IR.02 must be coded Y.

4.5.2 Nonredundant Steel Tension Member Elements

NSTMs are steel members in tension or with a tension element, whose failure would be expected to cause a partial or full collapse of the bridge. The NBIS requires NSTMs to be inspected at arm’s length.

Examples of NSTMs include tension members on trusses, two girder systems, some floorbeams and steel pier caps.

Steel floorbeams are considered nonredundant steel tension members when:

1. The connections to main girders are considered flexible or hinged.
2. There are no stringers.
3. The stringers are configured as simple spans
4. The stringers are continuous and the floorbeam spacing is greater than 14 feet.

4.5.2.1 NSTM Pre-inspection Preparation

Prior to inspecting a bridge with known NSTMs, the following procedures must be used in preparation for the inspection:

1. Review the NSTM locations as identified in the bridge file.
2. Identify all fatigue-prone details requiring a hands-on inspection.
3. Determine what documentation will be needed as part of this inspection.
4. Determine the workflow needed and access requirements for inspecting the NSTMs in the most efficient manner.
5. Discuss the workflow with all the members of the inspection team so they understand their role in the inspection. It is recommended the workflow be documented and kept in the bridge file.
6. Assess the equipment needs to perform this inspection. This will include lighting adequate to identify small defects. It is recommended to keep a list of the equipment needed for the inspection in the bridge file.
7. Make arrangements to have the superstructure washed if debris, bird nests, or bird droppings inhibit proper inspection of important areas.
8. Make arrangements to have the necessary access equipment available for the inspection.
9. Verify who shall be notified if a potentially serious condition is found.

4.5.2.2 Requirements During NSTM Inspection

During an NSTM inspection, the following procedures must be used:

1. Perform a hands-on inspection to visually inspect the NSTMs for deterioration, defects, damage, and cracks. Perform a hands-on inspection of all fatigue-prone details. A hands-on inspection is defined as the inspector being able to touch all surfaces of the tension carrying regions of NSTMs.
2. Clean suspect locations for better visual assessment and use appropriate non-destructive testing methods to verify potential crack locations and member thickness in deteriorated areas.
3. Photograph and sketch locations where deficiencies are found. Include appropriate dimensions and perspectives on all sketches. The inspector must take close-up photographs, which should be taken before and after any cleaning, paint removal, or testing. Include a photograph of the general location so others can understand exactly where close-up photographs were taken.
4. The Nonredundant Steel Tension Member Locations and Conditions form (Attachment K or L in I.M. 7.020) must be completed for each NSTM bridge.
5. If a serious defect is found, notify the appropriate personnel immediately to determine what actions are necessary.
6. SNBI Item B.C.14 must be coded to report on the overall condition of NSTMs. For bridges with both superstructure and substructure NSTMs the lower of the two condition ratings will be reported.

4.6 MAINTENANCE, REPAIR, AND REPLACEMENT (MR&R)

4.6.1 Maintenance Recommendations

The Maintenance, Repair, and Replacement (MR&R) section of SIIMS is used to make recommendations for repair, rehabilitation, and replacement. Defects not repaired could affect the functionality of the bridge, its load carrying capacity, or the safety of the public. In addition, if repairs are not made, the defect could lead to added deficiencies that could be avoided through proactive repair. The inspector shall make recommendations for repair and shall include recommended time frames for completing the repairs (for example, within 1 month, during the next bridge maintenance cycle, or prior to the next routine inspection) in order to convey the urgency of repairing the defect and to aid the bridge owner in prioritizing the repair. The bridge owner will need to evaluate the recommendations for repair and evaluate the suggested time frames with respect to the costs of the repairs and the available funding in the bridge repair program. Repair recommendations may require a follow-up In-Depth Inspection of the defects to support the development of repair plans and a cost estimate.

When a recommendation is made, one of three check boxes must be checked to identify the type of recommendation. The three options are:

1. Corrective – Defects that must be repaired as soon as practicable because the condition of the bridge is affected.
2. Preventive – Maintenance will prevent future deterioration. Deterioration is not causing a structural or safety issue at this time.
3. Monitor – The Local Agency must monitor the condition at an appropriate interval.

A default type will be checked after the recommendation code is selected from the drop-down menu. This does not mean this is the only option for the recommendation. Some recommendation codes will display the Corrective and Preventive box checked. In this case, the severity of the condition must be used to determine which type of recommendation must be made. One of the boxes must be unchecked before the report is finalized.

Recommendations made during an inspection but not yet completed will come forward at future inspections. If a past recommendation has not been completed and is still necessary, the recommendation must be left as it is. A duplicate recommendation is not appropriate. If additional deterioration is found and the recommendation needs to change to a different code, then the recommendation status must be changed to "Cancelled" and a new recommendation added.

Recommendations previously completed serve as maintenance history. The NBIS requires a maintenance history be maintained for all bridges. This is accomplished with SNBI Items in Subsection 7.5 – "Work Events" on the Supplementary Inspection Information page in SIIMS.

4.6.1.1 Available Recommendation Codes

The Maintenance Recommendation Codes currently available for bridge work are shown in Table 4.6.1-1. Recommendation codes 199, 299, 399, 499, and 599 are for situations not included in any of the available codes. The appropriate codes for Deck (199), Superstructure (299), Substructure (399), Channel (499), or Approach (599) work must be used. These codes can be used for Corrective, Preventive, or Monitoring situations.

Table 4.6.1-1 Maintenance Recommendation Codes

Code	Recommendation	Corrective or Preventive
Deck		
100	Remove gravel from approaches	P
101	Remove gravel from snow & ice	P
103	Clean deck drains	C
104	Clean deck & drains	C
105	Remove loose concrete - Bottom of deck	C
110	Spall patch - Minor	P
111	Spall patch	C
112	Spall patch - Major	C
114	Deck deterioration - Possible failure	C
121	Recommend PCC overlay	C
132	Replace - Urgent	C
140	Inject w/ epoxy	P
141	Inject & patch spalls	C
142	Replace overlay	C
145	Repair Curb / Rail Spalls	C
150	Repair or replace sliding plate joint	C
151	Repair crumb rubber joint	C
152	Repair or replace strip seal gland	C
153	Pourable Joint Repair	C
160	Extend deck drains	C
161	Repair extensions	C
162	Seal concrete below drains	C
170	Paint steel handrail	C
171	Repair collision damage	C
172	Seal concrete handrail	P
199	Miscellaneous - Deck	C

Code	Recommendation	Corrective or Preventive
Superstructure		
200	Clean superstructure	P
212	Spot paint - Schedule	P
213	Complete paint - Consider	P
214	Complete paint - Schedule	C
215	Zone paint - Severe rusting	C
221	Possible cracks - Drill	C
223	Loosen diaphragm bolts	C
230	Tighten loose bolts	C
232	Replace missing bolts	C
234	Tighten & replace	C
240	Repair - Spalls	C
241	Seal	C
249	Seal spalls	C
250	Repair spalls	C
251	Moisture - Seal	C
252	Cracks - Seal	C
260	Repair concrete diaphragms	C
261	Repair nicks & gouges	C
271	Repair collision damage	C
299	Miscellaneous - Superstructure	C
Substructure		
300	Clean bridge seats	P
301	Clean & paint bearings	P
302	Clean seats & paint bearings	P
303	Drain bridge seats	C
304	Re-set bearings	C
310	Repair near face & seat	C
311	Repair far face & seat	C
312	Repair both faces & seats	C
313	Repair near backwall	C
314	Repair far backwall	C
315	Repair both backwalls	C
320	Repair cap & bridge seat	C
321	Repair columns	C
322	Repair bridge seat & columns	C
340	Repair culvert walls	C
371	Repair collision damage	C
399	Miscellaneous - Substructure	C

Code	Recommendation	Corrective or Preventive
Channel		
400	Remove flood debris - Piers	P
401	Remove unbalanced fill - Piers	C
402	Cut off old pile in channel	P
403	Remove trees & brush	P
410	Repair erosion - Near berm	C
411	Repair erosion - Far berm	C
412	Repair erosion - Both berms	C
413	Repair erosion - Around near wing	C
414	Repair erosion - Around far wing	C
415	Repair erosion - Around all wings	C
416	Berm - Repair erosion - Near berm undermined	C
417	Berm - Repair erosion - Far berm undermined	C
418	Berm - Repair erosion - Both berms undermined	C
420	Repair degradation - Consider	P
421	Repair degradation - Schedule	C
422	Repair meander - Consider	P
423	Repair meander - Schedule	C
430	Remove flood debris	P
431	Repair erosion at outlet	P
433	Clean out - Schedule	C
440	Seal cracks	P
441	Seal cracks & repair - Consider	C
442	Seal cracks & repair - Schedule	C
499	Miscellaneous - Channel	C
Approach		
500	Re-cut near pressure relief joint	C
501	Re-cut far pressure relief joint	C
502	Re-cut both pressure relief joints	C
503	Install near pressure relief joint	C
504	Install far pressure relief joint	C
505	Install both pressure relief joints	C
510	Repair pavement - Near approach	C
511	Repair pavement - Far approach	C
512	Repair pavement - Both approaches	C
520	Repair shoulders - Near approach	C
521	Repair shoulders - Far approach	C
522	Repair shoulders - Both approaches	C
523	Repair near concrete panels	C
524	Repair far concrete panels	C
525	Repair all concrete panels	C
530	Guardrail repair near end	C

Code	Recommendation	Corrective or Preventive
531	Guardrail repair far end	C
532	Guardrail repair both ends	C
571	Guardrail - repair collision damage	C
599	Miscellaneous - Approach	C