FOREWORD

In order to serve, protect and preserve the health, safety and welfare of the public, New York State requires the comprehensive inspection of all bridges that are publicly owned, operated, or maintained as defined in section 230 of the Highway Law, and that also carry public highway traffic.

This document replaces the Bridge Inspection Manual - 82 published in 1982 by the New York State Department of Transportation Structures Design and Construction Division. This manual explains the requirements for general bridge inspections as required by New York State's Uniform Code of Bridge Inspection, NYCRR PART 165.

JAMES M. O'CONNELL, P.E.

DIRECTOR OF STRUCTURES and
DEPUTY CHIEF ENGINEER
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ACKNOWLEDGEMENTS

This manual is the result of a collective effort of many people in the Department's Main Office and the Regions. The writing was done by members of the rewrite committee listed below, with extensive review by members of the committee and others in the Main Office and Regional bridge inspection groups. In the final stages of the work, the Main Office Bridge Inspection Unit coordinated all technical comments, did the final edit and did several rewrites to achieve uniformity in presentation, technical content and writing style.

Special thanks to Don Emerich whose help in editing grammar, punctuation and style was invaluable. Thanks also to Art Yannotti for suggestions and insights on the more troublesome inspection issues, Ron Montana and Sharon Witbeck for their help with the graphics, and Linda Banks for typing and what seemed to be endless retyping.

Andre Bigon, editor and coordinator.

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CHAPTER 1

INTRODUCTION

This manual is a guide to performing bridge inspections as required by New York State’s Uniform Code of Bridge Inspection (Appendix F). It must be used when inspecting any publicly owned, operated or maintained bridge in New York State that is open to vehicular traffic. There are a small number of bridges that do not carry traffic but are routinely inspected and have their data entered into the New York State Bridge Inventory and Inspection System (BIIS). This manual should also be used when inspecting these non-mandated bridges.

This manual is not an engineering textbook, nor a primer on fundamentals of bridge inspection. For questions related to material behavior, mechanics, or fundamentals of bridge inspection, consult the latest edition of the Federal Bridge Inspector’s Training Manual/90.

Technical Advisories used to clarify or augment the previous Bridge Inspection Manual have been incorporated into the text of this manual. Some Technical Advisories are superseded by this manual while others are not. See Appendix L.

Engineering Instructions and Engineering Bulletins that pertain to bridge inspection have been made a part of this manual as appendices. Safety Bulletins pertaining to bridge inspection are not included here, but are listed in Appendix A — Safety.

The Numerical Rating Scale

The following rating scale is used for inspections:

1 – Totally deteriorated, or in failed condition.
2 – Used to shade between ratings of 1 and 3.
3 – Serious deterioration, or not functioning as originally designed.
4 – Used to shade between ratings of 3 and 5.
5 – Minor deterioration, but functioning as originally designed.
6 – Used to shade between ratings of 5 and 7.
7 – New condition. No deterioration.
8 – Not applicable.
9 – Condition and/or existence unknown.
Introduction

This scale is used to rate the condition of the bridge compared with the original design capacity and functioning of the bridge, not compliance to current standards. In other words, items should not be down-rated if condition is good, but design and configurations are out of compliance with current standards. The following elements are exceptions: Stream Alignment, Waterway Opening and General Recommendation. Stream Alignment and Waterway Opening are rated on site-specific performance requirements, for rating instructions reference Chapter 4A. General Recommendation is the Team Leader’s assessment of the overall bridge condition, for rating instructions reference Chapter 10.

It is essential that the inspector use the rating scale in a manner consistent with the criteria established in this manual. Meaningful statewide assessment of bridge conditions is possible only through consistent use of the rating scale.

Normally, a rating of 9 is used only if the rated element is concealed from view, if there are no secondary indications of problems, and if it is not possible to gain access for inspection. Superstructure items (primary member, structural deck, secondary member, and paint) may only be rated 9 rarely, such as completely enclosed vaults or cells with no means of entry. A rating of 9 for any item other than footing or piles, must be thoroughly explained on Form BD 188 under “Remarks.”

Temporary repairs of deteriorated elements, such as a steel plate over a hole in a deck, or shoring to support a deteriorated beam, are not considered in determining numerical rating. The item should be coded as though the temporary repair were not there. However, presence of a temporary repair should be noted on Form BD 188. A permanent repair that typically is constructed of the same materials and configuration as the original, is considered in the item’s rating.

If a bridge is being reconstructed in stages, inspect the portion that is actually carrying traffic. A note must be added indicating the nature of the work underway.

Rating the Worst of Multiple Elements

The following bridge elements are rated on the basis of the condition of the worst component (do not average the conditions of the components):

- Abutment bearings
- Abutment pedestals
- Walls (wingwalls)
- All approach items (rate worst approach for each item)
- Sidewalks and fascias (rate worst of the two)
- Railings and parapets (rate worst side)
- Pier bearings
- Pier pedestals
- Pier columns
- Lighting standards and fixtures (worst system if multiple systems are present)
- Utilities and utilities supports (worst system if multiple systems are present)
Introduction

Types and Required Intervals of Inspections

Four types of inspection are performed in New York and reported under BIIS:

1 - Biennial. Required for all highway bridges every two years and the standard and most common type of inspection. For new or reconstructed bridges, a biennial inspection is required within 60 days of fully opening to traffic or upon contract acceptance, whichever comes first.

2 - Interim. Some structures need to be inspected annually because of one or more deficiencies. Interim inspections are performed during the calendar year between the required biennial inspections, and are required if one or more of the following conditions exist:
   - General recommendation (determined by inspector) of 3 or less.
   - Condition rating (weighted average of individual item ratings) of 3.000 or less
   - Presence of an active or inactive Red Flag, or active Yellow Flag.
   - Posting for any load other than R-permit restriction.

4 - None (under contract). This is for bridges closed to all traffic due to reconstruction. A temporary detour bridge that may be carrying traffic during reconstruction is also covered by the Type 4 inspection; temporary structures are the contractor’s responsibility and do not get inspected under BIIS. Note that a biennial inspection must be performed within 60 days of reopening to traffic of the newly constructed bridge or any portion thereof. Any portion of an existing bridge that is under contract and carries traffic remains on the inspection schedule. The appropriate items are rated on the 1 to 7 scale, items removed or partially removed would rate 8.

5 - Special. Performed to address maintenance and/or inspection concerns unique to a particular bridge. These inspections are not entered into the database, so regular biennial inspections are still required. For large or unusually complex structures, a Type 5 inspection may be performed instead of an interim inspection with written approval of the Deputy Chief Engineer Structures.

Note that Type 3 inspections are no longer used with BIIS inspection forms. Type 3 inspections were previously identified in the Bridge Inspection Manual - 92 and on the corresponding ITP 249 form as in-depth inspections. In-depth inspections are normally done before beginning design for rehabilitation or replacement. In the event that a biennial or interim inspection is to be performed in addition to an in-depth inspection, the inspection must be identified as either a Type 1 (biennial) or Type 2 (interim) inspection, with all documentation required by this manual.

Intervals between biennial inspections, for bridges not requiring interim inspections, must be generally no greater than 26 months. Bridges requiring interim inspections should be scheduled so that the interval between successive inspections is not generally greater than 13 months. These intervals may be exceeded only under extenuating circumstances such as inspecting during low water to avoid a diving inspection, seasonal traffic peaks that preclude use of access equipment, etc.
Introduction

Inspection Dates and Scheduling
It is not always possible to inspect an entire bridge in one day, because of size or access constraints. If so, the recorded inspection date will be the last day the inspection crew was in the field. An effort should be made to schedule equipment use to minimize time lag between first and last days of an inspection.

When scheduling work, the project manager must consider the following:

1) Ensure that intervals since the last inspection meet the requirements given above.
2) Maximize efficient use of special access equipment.
3) Minimize need for diving inspections by scheduling visits to stream bridges during low flow. See also Appendix C (Underwater Inspection) for more information.
4) Minimize travel distance between bridges.

Inspection Team and Inspector Qualifications
All inspection teams must include a Team Leader (TL) and Assistant Team Leader (ATL). The Team Leader is responsible for ensuring that the bridge is inspected completely and that the inspection report conforms with all requirements of this manual and all applicable Engineering Instructions and Engineering Bulletins. The Assistant Team Leader may inspect and measure components, if working under the Team Leader's direct supervision. Additional personnel, such as laborers or Assistant Team Leader Trainees, may be added as needed. All field work must be reviewed by a Quality Control Engineer (QCE), whose exact duties are described in Chapter 11.

Qualifications for the Quality Control Engineer, Team Leader, and Assistant Team Leader are specified in the Uniform Code of Bridge Inspection. See Appendix F.

Bridge Orientation Conventions
Directions, stationings, and stringer numbering should be made relative to the direction of orientation of the bridge. The direction of orientation is an inventory item preprinted on the TP 349 inspection form. Looking across the bridge in the direction of orientation, a two-girder bridge, for example, would have a left and a right girder; a multi-stringer bridge would have stringers starting with #1 at the left facia. Stationings for measurements, such as channel cross-sections or profiles, should increase in the direction of orientation or from left to right when looking in the direction of orientation.

For more information on direction of orientation, see “Uncoded Items” in Chapter 3.

Reporting Format
This manual introduces the use of inspection forms in the portrait format. Previous inspections used the landscape orientation. All forms have the same identifying number as used previously except for updated letter subscript. For example, the TP 349m (1990) has been replaced with TP 349m (12/97). Throughout this manual it is simply called Form TP 349.
Use of Diving Inspections and Fathometer Surveys

Before inspecting a bridge over water, the inspector should find out if there have been diving inspections or fathometer surveys done. If so, the inspector should, as a minimum, review the most recent diving inspection and/or fathometer survey. Refer to Appendix C for more information pertaining to the relationship between diving inspections and general inspections.

Bridge Inspection Diary

Each Team Leader is required to record in a diary the following information about the inspection team’s daily activities:

- Time inspection started at bridge site
- BIN, county, feature carried and crossed
- Names of individuals helping in the inspection
- Description of specialized equipment used (boom truck, underbridge inspection unit, etc.)
- Any noteworthy actions, occurrences, etc. (bridge flagged, motor vehicle accident occurred at the bridge site, inspector personal injury, etc.)
- Time when inspection was completed at the bridge site and next destination.
- Weather

When the team is not in the field, a brief general entry should be made describing the activities the inspection team is working on.

Each person who is assigned an underbridge inspection unit (UBIU) is required to record the following, as a minimum, in his/her daily diary:

- Engine hours
- Location, time, mileage reading, etc., of departure
- Location, time, mileage reading, etc., on arrival at work site
- Record BIN, features carried and crossed and names of individuals operating and working out of UBIU bucket
- Record any unusual observations made concerning the UBIU during its operation
- Record all daily inspection activities and maintenance activities concerning the UBIU
- Record mileage reading and quantity concerning all fueling, oil additions, etc.
- Record time of departure from work site. Also, record time, location, and mileage reading at the point of destination.
- Record verification that all people operating the bucket controls are certified.

The diaries should be kept throughout the year and retained for six years.
CHAPTER 2

DOCUMENTATION

The Inspection Report

The inspection report consists of completed TP 349 and TP 350 forms, mounted photographs, the remarks sheets (form BD 188 or BD 288), condition sketches, flagging documentation, and if necessary, scout documentation (forms BD 226, 227, 230, and BD 233). A copy of this report (without photos) is sent to the Structures Division for review and entry into BINS. For state bridges, a copy of the inspection report is sent to the Regional Bridge Maintenance Engineer. For local bridges and authority bridges, a copy of the inspection report is sent to the owner of the bridge. If the bridge is not maintained by the owner of the bridge, the agency responsible for the maintenance should also receive a copy of the inspection report.

The BIN Folder

Every bridge in the state requiring inspection under the Uniform Code of Bridge Inspection must have a folder identified with the bridge identification number (BIN) containing the following items:

- Report binder containing current and previous inspection reports, load rating forms, inventory forms, and special emphasis documentation, if required (see Appendix G). Reports over four years old may be removed and archived.

- Plans ("as-built," if available) or sketches in lieu of plans, if plans are not available.

- Copies of level I load rating calculations (if available).

- Standard photos in clear vinyl packets, as specified later under Photographs.

- Copy of the most recent diving inspection, if applicable.

- All pertinent correspondence.

The BIN folders for state and local bridges are kept in the Regions. BIN folders for bridges owned by the eleven public authorities that inspect their own bridges, are maintained by the authorities. These eleven authorities are:

Niagara Falls Bridge Commission
New York State Bridge Authority
New York State Thruway Authority
Ogdensburg Bridge and Port Authority
Port Authority of New York and New Jersey

2.1
New York State Power Authority
The Seaway International Bridge Corporation
Thousand Islands Bridge Authority
MTA Bridges and Tunnels (a.k.a. Triborough Bridge and Tunnel Authority)
Nassau County Bridge Authority
Buffalo and Fort Erie Public Bridge Authority

The following documentation requirements apply only to inspection work. For further information on other forms that must be completed, consult the inventory and load rating manuals. All documentation should be completed in the field at the bridge site.

Forms

Blank forms used for inspection work are found in Appendix K.

On form TP 349, record bridge identification information, access categories, and flag information. Also, record condition of abutments, wingwalls, stream channel, and approaches on this form. Generally, some information will be preprinted on the form by computer, using existing inventory data. The inspector must manually add missing information or correct preprinted data where appropriate. For new or previously uninspected bridges, all information is recorded on a blank form. Only changes in numbered boxes on form TP 349 will update the BIS database. All other changes require making corrections using inventory forms.

On form TP 350, record condition ratings for deck elements, superstructures, piers, and utilities, in addition to notes on dates, times, and weather conditions. Information on diving requirements, special emphasis inspection requirements, and recommendation for further investigation is also recorded on this form.

In addition to the TP 349 and TP 350, the following forms are used for the inspection report:

BD 186 – Used for sketches and photo locations
BD 187 – Photo mounting sheets
BD 188 – Remarks
BD 288 – Remarks (alternate form)
BD 226 – Channel Cross Section Readings
BD 227 – Channel Cross Sections Along Fasrias
BD 230 – Channel Profile Along Abutments
BD 233 – Channel Profile Along Pier(s)
BD 242 – Flagged Bridge Report
BD 243 – Summary Red Flag Information
BD 244 – Flag Removal/Inactivation Report
The following are inspection forms that must be completed, but are not physically part of the inspection report. They are ancillary forms sent to the Structures Division with the inspection reports:

- BD 192 – Access Category
- BD 240 – Under Bridge Debris and Land Use
- BD 241 – Overhead Electrical Survey

The following forms are used in the report binder in the BIN folder:

- BD 218a – White INSPECTION cover sheet (with BIN information)
- BD 219 – Blue INSPECTION separator sheet
- BD 220 – Pink PHOTOGRAPHS separator sheet
- BD 221 – Yellow LOAD RATING separator sheet
- BD 222 – Green INVENTORY separator sheet
- BD 223 – Yellow SKETCHES IN LIEU OF PLANS separator sheet
- BD 224 – Golden DETAILS OR SITUATIONS REQUIRING SPECIAL EMPHASIS DURING INSPECTION separator sheet

**Photographs**

All photographs must be color prints with a glossy finish approximately 90 mm (3 1/2") by 125 mm (5") in size. All photos must be kept in the BIN folder and optical disk file (if available). Photographs are classified as either "standard" or "condition."

The following standard photographs must be taken of each bridge when it is first completed or when major reconstruction is completed:

- The bridge from each approach, standing about 25 m from each end of the bridge. All topside deck elements should be visible.

- An elevation view showing the general structural configuration, if possible, taken from a 90-degree angle to the centerline of the bridge.

- Deck underside showing each different type of underdeck structural system. Take a separate photo of the structural deck, if it is not visible in the first underside shot.

- General configuration of each type of abutment and wingwall.

- General configuration of each type of pier.

- Any unusual components or details, including (but not limited to) dolphins, fenders, moveable bridge components, and unusual weld details.

- Features under the bridge (streams, highways, etc.) as seen from both fascias.
Documentation

Standard photographs do not need to be retaken unless major reconstruction takes place (such as widening or deck replacement).

Standard photographs should be placed in clear vinyl packets left loose in the BIN folder. Label the backs of all photos with BIN, description and date of photo.

Condition photographs document deficiencies and must be taken when elements are rated 4 or lower. Photos must also be taken for repaired elements. When identical deficiencies for an element occur at several locations, one typical photo may be taken instead of photographing each location. For example, one overextended or rusted bearing may be photographed and identified as typical of all deficient bearings.

All condition photos should be mounted onto form BD 187. Include a brief identification of what is being photographed and a cross-reference to written comments in the inspection report, if any. A location sketch (use form BD 186) of a photo location plan for all condition photographs in the binder is also required. See figure 2.1.1 for an example.
Photo Layout:

- O = Camera Above Deck
- O = Camera Below Deck

Begin Approach

End Approach

Figure 2.1.1
Comments

Narrative comments are required for all items rated 4 or lower, including a complete technical description of the location, nature, and extent of the problem. Use numerical descriptions, such as "15% section loss of bottom flange of girder 1 along the entire length," or "delamination over 25% of the beginning left wingwall face." Comments need to be cross-referenced to photos. Vague or general statements, such as "significant primary member section loss" are unacceptable.

If an item is rated 5 or higher, a comment is not required unless it was rated lower in the previous inspection. In that case, the rating increase must be explained.

Besides describing individual items, written comments should describe aspects of the bridge that cannot be photographed, including (but not limited to):

- Excessive deflection under live load.
- Unusual noises when vehicles are crossing.
- Observations of stream velocity.
- Observations regarding traffic volume.
- Scour
- Vehicle (tire) impact caused by approach settlement or heave.

Condition Sketches

Condition sketches are required whenever item conditions cannot be documented completely with photographs and written comments. Such situations include (but are not limited to):

- Scour and undermining.
- Delaminations, spalls, and hollow-sounding areas of concrete elements.
- Bearing over-extension or under-extension.
- Impact damage to primary members.
- Tilting abutments or wingwalls.
- Plan view of poorly aligned stream channel.

Condition sketches must be drawn neatly and clearly with all pertinent dimensions recorded. It is acceptable to photocopy sketches from previous reports and update them for the current report, as long as the updated sketch is still clear and legible. The original sketch must be kept in the report from which it was copied.

2.6
Plan Verification and Update

The inspector must examine the report binder, diving reports, fathometer surveys, and plans or sketches in lieu of plans before every inspection to become familiar with the structure and identify features requiring special attention. If the bridge has been modified since the last inspection, plans or sketches must be updated to illustrate current conditions clearly. The following plan dimensions must be verified, if this has not been done in previous inspections, or if changes have occurred due to rehabilitation:

- Structural slab and wearing surface thickness.
- Out-to-out roadway dimensions.
- Longitudinal girder dimensions and spacing.
- Floorbeam dimensions and spacing.
- Stringer dimensions and spacing.
- All truss member dimensions.

On new state bridges, the as-built plan dimensions may be assumed to have been verified if the job has been accepted by the E.I.C. This assumption cannot always be made for new local bridges. Plans or sketches in lieu of plans must be dated and initialed by the Team Leader, regardless of modifications. Instead of signing the plans directly, it is acceptable to attach a sheet to the plans or sketches that can be used for Team Leader signature and to show whether changes have occurred since the last inspection.

Sketches in lieu of plans must be prepared if existing plans or sketches are missing, incomplete, or inaccurate. If totally new sketches are needed, they must be drawn in metric units and include plan, elevation, and cross-section views with these dimensions recorded.

Special Considerations for Interim Inspections

An interim inspection must always be as thorough as a biennial inspection. Documentation requirements for interim inspections, however, are somewhat reduced. During interim inspections, an element rating of 4 or less need not be documented with photographs and comments if the condition has not changed significantly since the previous biennial inspection. All that is needed is a comment stating “item condition unchanged since the last biennial report,” and a reference to the appropriate photo in the previous report. Conditions that have changed since the biennial report, whether due to increased deterioration or repairs, must be documented with photos, comments, and/or sketches.
Apparent Violations of Load Postings

The inspector must note any apparent violations of load postings by any privately or publicly owned vehicle. This should be written separately from the rest of the inspection report. If possible, it should include the owner and plate number and estimated weight of each vehicle. For multiple violations by the same vehicle, note also the number of violations.

If possible, the inspection team should call the apparent load violation in to the Regional Structures Engineer immediately for all bridges except those in incorporated cities. The Regional Structures Engineer should immediately call the appropriate office of the State Police. The State Police have jurisdiction for enforcing weight limits for all bridges in the state, but defer to city police departments within incorporated cities. County and local law enforcement agencies generally do not have the scales necessary to enforce load limit laws.

The written overload report should be delivered to the Regional Structures Engineer as quickly as possible, preferably the same day, especially if a call to the Regional Structures Engineer could not be made. The Regional Structures Engineer must inform in writing, both the owner of the bridge and the appropriate law enforcement agency (city or state), that apparent overloads are occurring. Copies of the overload report and all related correspondence must be kept in the BIN folder and (if available) the optical disk file.

Scour Documentation

Fascia drop line readings, channel profiles along substructure units, scour mapping at substructures, and substructure deficiency documentation must be done at least every two years for all bridges over water and for bridges that cross other features, but have erosion problems. Scour documentation is not required for bridges having no possibility of scour such as gorge crossings, or where accurate scour documentation is impossible (e.g. very high bridges and/or fast and deep water).

Scour documentation is required during an interim inspection if changes to the stream bed and/or foundation material have occurred or if the interim inspection is being done because of a problem related to scour.

For more information regarding scour documentation requirements, see Chapter 4, Section B.
CHAPTER 3

CONTROL DATA

For all reports submitted to the Structures Division, the Team Leader's name and signature must be present on form TP 349. The Assistant Team Leader must also be identified. The Team Leader, Assistant Team Leader, and any other inspection personnel present must also be identified on form TP 350.

Usually, the control data will be preprinted on the TP 349 form. However, in certain situations, the inspection forms will be blank, and the inspector will have to enter all control data. Those items that must be coded into the mainframe database are explained below.

RC Code

The first digit of the region-county code indicates the NYSDOT region where the bridge is located. For region 10, code this item 0. For region 11, code this item N. The second digit identifies the county in ascending alphabetical order. For example, assume you are inspecting a bridge in Cortland County that is in NYSDOT region 3. The correct RC coding is therefore 32 for region 3, county 2.

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<td>5 - Rockland</td>
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<td>6 - Ulster</td>
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<td>7 - Westchester</td>
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REGION 9  REGION 10  REGION 11 (NEW YORK CITY)
1 – Broome  1 – Nassau  1 – Bronx
2 – Chenango  2 – Suffolk  2 – Kings
3 – Delaware
4 – Otsego
5 – Schoharie
6 – Sullivan

Bridge Identification Number (BIN)

The BIN is a seven-character identification unique for each bridge in the state. The first six characters are always numbers. The last character can be a number or a letter. Each level of a bi-level bridge, each separate structure in a series of parallel structures, and each ramp structure attached to a main bridge is considered an individual bridge with its own BIN. A plate displaying the BIN should be attached to each individual bridge. If the BIN plate is missing, note this in the “Remarks” section.

The first digit of the BIN usually identifies the bridge as belonging to one of the following categories:

1 – State owned
2 – Village, town, or city owned
3 – County owned
4 – Canal bridge
5 – On or over a Public Authority Highway
6 – Located on an Indian Reservation
7 – Railroad owned

If the last BIN character is 1, 2, 3, 4, 5, or 6, the bridge is in a parallel configuration. When facing the direction of orientation, the bridge farthest left has the BIN with a final digit of 1. The next leftmost bridge has a BIN with a last digit of 2, and so on.

If the last BIN character is 7 or 8, the bridge is in a bi-level configuration, with the 7 denoting the lower level and the 8 denoting the upper level. A last BIN character of 0 or 9 indicates that the bridge is not in a parallel or bi-level configuration.

If the BIN ends with a letter, the structure is a ramp bridge physically attached to a main bridge. The first six digits of a ramp BIN always match the first six digits of the main bridge BIN. If more than one ramp is attached to the same span on the main bridge, the lowest letter is assigned to the ramp farthest left when facing the direction of orientation. Other ramps attached to the same main span are assigned alphabetic seventh characters, going clockwise. Be sure to write the BIN carefully to avoid misreading 1 for I, B for 8, or 0 (zero) for O (alpha).
Date
This is a keypunch field for both TP 349 and TP 350 forms. Code as month, day, year. All boxes must be filled in. For example, May 1, 1994 will be coded as 05 01 94. If the inspection took more than one day, the date coded is the last day that the inspection team was in the field. Both TP 349 and TP 350 forms must show the same date. Other documentation in the inspection report, such as remarks, photos, sketches, survey documentation, etc., should show dates that reflect when that part of the work occurred.

Inspection Agency
Input 10 for state employees, 13 for consultant, and 21 for authority.

Type of Inspection
Enter 1 for biennial, 2 for interim, 4 for none (under construction), and 5 for special or other. Types of inspection are explained in Chapter 1.

Vertical Clearance and Load Postings
These entries show whether the inventory database has a record of vertical highway clearance or load posting signs either on or under the bridge. These are not coded unless the preprinted information is incorrect or absent. A blank form should not be coded if the bridge is not posted. All existing vertical posting information is recorded in feet and inches. All load posting information is recorded in U.S. tons. U.S. Customary units are currently being used for load postings and vertical clearance.

Existing inventory information will appear on the preprinted forms. If the preprinted information is consistent with conditions encountered in the field, no coding is necessary. If the preprinted form shows that the bridge is not posted, but the bridge is actually posted for clearance or load, the postings must be entered. When using a blank inspection form, code these items if inventory information on the inventory field verification list is incorrect or missing.

If vertical clearance posted in the field varies from the preprinted information, the field posted clearance value must be entered on the TP 349 form. If the preprinted information shows that the bridge is posted for clearance, but no signs are present, consult the Flagging Procedure (Appendix I) for further guidance.

Any differences from preprinted vertical clearance values must be verified by measuring clearance in the field. A bridge is posted for clearance if the actual measured minimum clearance is less than 14 feet. If posting for vertical clearance is necessary, a bridge is posted for 1 foot less than the actual measured minimum vertical clearance. If the legend on the posting sign does not meet this requirement, refer to the Flagging Procedure.

If a load posting is less than the preprinted value, enter the new lower value. If a new load posting is greater than the preprinted value, review the BIN folder to determine if the posting was raised for sound technical reasons. If so, explain this in the "Remarks" section and code the new, higher value. If review of the folder suggests no sound technical reason for raising the posting, do not code this item, but consult the Flagging Procedure (Appendix I) for further guidance.
If inventory information indicates that the bridge is posted for load, but no posting signs are found, review the BIN folder. If the bridge has been replaced, and plans show that the new bridge was designed for legal loads, code the item “06.” Similarly, if the bridge has been rehabilitated and the load capacity has been increased to allow for legal loads, code the item “06.” However, if the bridge should still be posted but signs are missing, do not code this item and consult the Flagging Procedure (Appendix I) for further guidance.

The load posting code for closed bridges is 99 tons, if the closure is permanent. For bridges closed temporarily for reconstruction, do not code this item. A bridge posted with a sign prohibiting “R-permit” vehicles should be coded for 88 tons.

Flag Issued?
If no structural or safety flag has been issued, check box 61; no further explanation is required. If more than one type of flag has been issued, check all boxes that apply, and briefly explain each flag in the space provided. Phrases such as “Red, crack in non-redundant girder” or “yellow, section loss in fascia stringer” are sufficient.

If a flag is legitimately removed before the inspection is completed because repairs or another adequate action was taken, check the “none” box and line out the flag box and reason. Add a note stating the flag was removed along with the reason for the removal.

Recommend Further Investigation
This is used to suggest need for further engineering investigation or analysis. Do not use this space to show need for repair work; condition ratings and comments will do that. If no further investigation is warranted, code box 19 on TP 350 as “1.” If any of the following conditions exist, box 19 should be coded “2” (meaning further investigation is needed).

- Calculations are needed to evaluate structural significance of a particular observation. For example, deterioration may be progressing rapidly on the primary members of a bridge not posted for load. Box 19 should be coded “2” and “Evaluate for load posting” should appear under “Remarks.”

- The scope of inspection being performed is insufficient to evaluate structural significance of a potentially serious condition. For example, one may be inspecting a steel bridge where the primary members are encased in concrete, which is leaking heavily with rust stains. The primary members should be rated based on what is visible, the limitation of the rating should be explained, and box 19 should be coded “2” with a comment added recommending removal of the encasement.

These examples are cases where it is appropriate to call for further investigation. That is a matter of judgment by the Team Leader. However, if box 19 is coded “2,” an explanation is required.
Diving Inspection and Special Emphasis Inspection Requirements

On Form TP 350, items regarding diving and "special emphasis" inspection are entered during every biennial and interim inspection. If an exemption has been granted to the "special emphasis" requirement, the items must still be entered. A note should then be added in the "remarks" sheets (BD 188 or BD 288) explaining that exemption was granted because of fatigue life calculations or NYSDOT Main Office approval.

Uncoded Items

These items are not entered from the forms into the mainframe database. When using preprinted forms, these items will be preprinted. When using blank forms, observe the following guidelines.

The item "RAMP BRIDGE ATTACHED TO SPAN ______ BIN ________ " is not used for main bridges. When inspecting a ramp bridge, using a blank form, show which span and the BIN of the bridge to which the ramp is attached.

The items “STATE HWY. NO.” (if applicable) and “MILEPOINT” are aids for location and need not be entered when using a blank form.

POLIT. UNIT is the local political subdivision where the bridge is located. This helps locate the bridge in the field. An entry is not required on a blank TP 349 form.

FEATURE(S) CARRIED is a location aid for those using a preprinted form and should be completed if a blank form is used. The description may be given as a route number or a written description, such as a road name. If a route number is used, and the route has state reference markers, the marker legend nearest to the begin abutment should be preprinted after the route number. If a parkway or expressway is carried, the road name may be abbreviated.

FEATURE(S) CROSSED should also be completed if a blank form is used. Provide the name or a description for the highway, railroad, waterway, or other feature crossed by the bridge.

TOTAL SPANS include both the approach and main spans. Enter this item on blank forms.

Direction of orientation (BRIDGE ORIENTED) is the compass direction used to establish the begin abutment and span numbering system for the bridge, and does not necessarily correspond to the highway stationing convention. Once the direction of orientation is established in the bridge inventory system, do not change it even if it appears to be wrong for the bridge being inspected. This ensures consistent identification of the bridge components for all inspections over the life of the of the structure. Only after total bridge replacement, should an inventory change to the direction or orientation be considered. When using a preprinted form, stand at an abutment and look in the compass direction preprinted on the form. If you are looking across the bridge, you are standing at the begin abutment. If a blank form is used, take the direction of orientation from the inventory information listing. Write this on the form, and use it to establish the begin abutment and span numbers.
Control Data

YEAR BUILT AND AADT/YR are items that can be used as aids when performing fatigue life calculations. They do not need to be entered if a blank form is used.

SUPERSTRUCTURE TYPE(S) denote the configuration and material type of the superstructure. If the information is missing, incorrect, or incomplete, write the correct information on the form. Inventory information must also be updated for this bridge.

ACCESS CATEGORY is preprinted on the form and should be used to plan for equipment needs and scheduling. If the information is wrong, or if a blank form is being used, enter what was used and fill out an access category form (BD 192).

REVIEWED BY, P.E. NUMBER, and DATE are to be completed by the Quality Control Engineer. This certifies that a quality control review, as described in Chapter 11, has been done.
CHAPTER 4

STREAM CHANNEL AND SUBSTRUCTURE ELEMENTS

SECTION A — STREAM CHANNEL
SECTION B — SCOUR AND STREAM CHANNEL DOCUMENTATION
SECTION C — ABUTMENTS AND WINGWALLS
SECTION D — PIERS
SECTION A

STREAM CHANNEL

This section includes the following rating items:

STREAM ALIGNMENT
EROSION AND SCOUR
WATERWAY OPENING
BANK PROTECTION

Introduction

The stream channel is the most dynamic system affecting the condition of bridges. Over 70% of all bridge failures result from hydraulic forces produced by the stream channel. Geomorphic features of a stream can change dramatically over the bridge’s life. These features include changes in channel location, shape, and elevation. Significant changes can also occur in a short time during major floods.

The terms erosion and scour are at times used interchangeably, but at other times have notably different meanings. The FHWA Bridge Inspector’s Training Manual/90 defines erosion as the wearing away of soil by flowing water. Scour is erosion of a river bed area caused by stream flow. In the discussion about the stream environment below, no significant distinction between stream erosion and scour is made. Some engineers, however, commonly refer to stream erosion as the general lowering of the stream bed and scour as a more localized phenomenon. Later in this chapter, a distinction is drawn between erosion and scour as they pertain to substructures.

In several ways, the channel can change and thus jeopardize stability and safety of a bridge. Bank and channel erosion can cause a lateral shift of the stream. The resulting realignment can undermine piers, abutments, and wingwalls. Channel aggradation (deposition of sediment) reduces the waterway opening and increases stream velocity through a bridge. Flood waters attack and undermine substructures, roadway embankments, and floodplain areas. The channel can degrade (erosde) so that bed elevations are lower, undermining the foundation of piers and abutments.

When inspecting the stream channel and the bridge foundations, it is helpful to understand the three types of scour:

- General scour is the degradation of the streambed along some considerable length of the river, stream, etc. General scour of the streambed may result from the natural erosion and downcutting process that flowing bodies of water cause over time. It may be accelerated by natural cutoffs in a meandering river that steepen the channel gradient, thus increasing the flow velocity, and therefore, causing scour. Also, contributing to the acceleration of scour are
Stream Channel

various types of development or manmade modification, such as dam construction, dredging, straightening or narrowing of the channel, etc. Since general scour involves degradation of the channel bed along some considerable distance of channel, major facilities are sometimes used to control scour. These may include a series of drop structures (small dam-like structures) or other scour minimizing construction in the riverbed. Their presence may indicate that the channel is experiencing scour.

- Contraction scour results from accelerating flow due to narrowing of channel width. This could be natural, manmade, or both. Inspect for the likelihood of contraction scour by comparing width of the bridge opening to width of the river upstream and downstream from the bridge.

- Local scour is erosion of material adjoining the abutments, wingwalls, and around piers because of the abutment, wingwall, or pier obstructing flow. These obstructions accelerate flow and create turbulence that removes sedimentary particles surrounding them. Generally, depths resulting from local scour are much larger than those from general scour. Bridges in tidal locations are particularly vulnerable to local scour due to the imbalance between transport rates of input and output sediment.

Stream Channel Rating Items

The following items are to be inspected and rated as elements of the stream channel:

- Stream Alignment
- Erosion and Scour
- Waterway Opening
- Bank Protection

Each item is described later in this section.

The stream channel should be observed at least 75 m from each fascia to determine each element’s rating. If any item is rated 4 or less for a state bridge, the appropriate NYSDOT Regional Hydraulic Engineer should be notified.

Any deficiencies in the stream channel that cannot adequately be shown in photos should be sketched in a simple plan view. A sketch showing the stream alignment relative to the bridge opening and locations of debris, siltation, scour pockets, and loss of bank protection is generally far superior to photos for documenting stream channel deficiencies. See also Chapter 4, Section H.
STREAM ALIGNMENT

What to Rate

Rate the alignment of the stream channel at the bridge site in terms of skew angle where the stream approaches the bridge substructure. The scale used for rating stream alignment evaluates the alignment in terms of the approach to and flow through the substructure(s). The alignment is not evaluated in comparison to the original design.

What to Look For

Check the stream skew angle as it approaches the bridge substructure. Consider both normal and flood flows. The flow should pass through the waterway opening parallel to the faces of the piers and abutments. Check for shifts in direction of flow from previous inspections and from original plans. Note any change in direction of approach of a stream to a bridge and any change in the angle where the stream hits the substructure.

Rating Examples

7 - The stream approaches and flows through the waterway opening parallel to the faces of the piers and abutments.

5 - The stream approaches and flows through the waterway opening in a direction other than parallel, but with no evidence of scour, siltation, or other problems caused by this alignment.

3 - The stream approaches and flows through the waterway opening in a direction other than parallel, and flow may be hitting the substructure. There is evidence of scour, siltation, or other problems caused by alignment.

1 - The stream approaches and flows through the waterway opening in a direction other than parallel and flow may be hitting the substructure. The foundation is significantly undermined.

Figure 4A.1.1

Rate 7

Figure 4A.1.1 shows a stream that approaches and flows through the opening parallel to the faces of the abutment. Rate stream alignment 7.
The stream in Figure 4A.1.2 approaches and flows through the opening parallel to the faces of the abutments. Rate stream alignment 7.

The stream shown in Figure 4A.1.3 is hitting the pier at an angle, but has not caused scour or siltation problems. Rate stream alignment 5.
Figure 4A.1.4
Rate 5

Figure 4A.1.4 shows a stream flowing toward the right abutment, but scour is not evident. Rate stream alignment 5.

Figure 4A.1.5
Rate 3

Figure 4A.1.5 shows a stream approaching at a skew, hitting the left abutment and exposing the footing. Rate stream alignment 3.
Figure 4A.1.6
Rate 3

Figure 4A.1.6 shows a stream hitting the left abutment and exposing the footing. Rate stream alignment 3.

Figure 4A.1.7
Rate 1

Figure 4A.1.7 shows a stream hitting the left abutment and has undermined the footing. Rate stream alignment 1.
EROSION AND SCOUR
(Stream Channel)

What to Rate
Rate erosion and scour of channel banks and streambed. This is not a rating of local scour of the material at substructure footings. That scour is rated under the appropriate pier, wingwall, or abutment item. If general stream channel degradation is occurring and is also causing loss of material at foundations, both the stream channel erosion and scour and substructure erosion or scour should be rated low.

What to Look For
Check for cutting of channel banks and exposed root systems of bank vegetation. Check for changes in channel dimensions. Look for manmade disturbances, such as gravel mining, land development (urbanization), etc. These actions may increase velocities and potential erosion. Compare new stream channel documentation with previous records.

Consider how fast the observed erosion or scour is occurring. The more rapid the rate of erosion, the lower the rating.

Rating Examples

7 – There are no indications of erosion or scour.

5 – Minor erosion or scour is occurring at banks away from the bridge, but is not causing problems at the bridge. This rating would also be used when general streambed degradation (not affecting the bridge) has occurred over decades.

3 – Erosion and scour of the banks is beginning to encroach upon the bridge, with potential for serious problems, especially during flood conditions. Also, for general channel degradation, substructure foundations are being exposed and the erosion has occurred over a period of less than ten years.

1 – Major loss of material in the channel banks or streambed, including loss of material behind wingwalls and at the roadway embankment. For general degradation, the foundations are exposed and possibly undermined and the loss has occurred over a period of three years or less.
Stream Channel

Figure 4A.2.1
Rate 7

Figure 4A.2.1 shows a downstream channel that has stable bank vegetation. Rate erosion and scour 7.

Figure 4A.2.2
Rate 7

Figure 4A.2.2 shows an upstream channel with no undercut banks and with stable vegetation and streambed. Rate erosion and scour 7.
Figure 4A.2.3
Rate 5
Figure 4A.2.3 shows a stream that has begun undercutting vegetation on upstream banks and some sloughing has occurred. Rate erosion and scour 5.

Figure 4A.2.4
Rate 3
Figure 4A.2.4 shows a bank that has eroded to the bridge, threatening the wingwall. Rate erosion and scour 3.
Stream Channel

Figure 4A.2.5
Rate 3

Figure 4A.2.5 shows downstream banks eroded to the wingwalls. Material loss threatens the bridge. Rate erosion and scour 3.

Figure 4A.2.6
Rate 1

Figure 4A.2.6 shows bank and streambed severely eroded, exposing the abutment and wingwall piles. Rate erosion and scour 1.
WATERWAY OPENING

What to Rate

Rate the adequacy of the waterway opening at the bridge. Consider the extent to which the opening is a hydraulic constriction. This may be caused by siltation and debris or vegetation buildup in the channel upstream from the bridge, or any change in height of the waterway opening at the bridge. The waterway opening may be a hydraulic constriction for the stream if the location of abutments, piers, or scour protection is such that the opening is insufficient for high flow conditions. This may be the case even if stream alignment is good and there is no stream aggradation. The waterway opening is not evaluated on a comparison to the original design.

What to Look For

Check for accumulation of sediments (sand or gravel) in the channel that may occur at the inside of bends or where velocity decreases. Check for buildup of debris and/or vegetative growth in the channel that may restrict flow and increase velocities through the opening. Compare the opening at the bridge with previous inspections. Also look for man-made flow restrictions such as fences that can catch debris during storms. Check long term aggradation of the streambed by comparing it with previous inspections and with elevations on the record plans.

Rating Examples

7 - No change in streambed elevation (aggradation) and no evidence of restrictions.

5 - A minor siltation that has not yet caused any local scour problems at the bridge. There may be long term aggradation of the streambed that has occurred over decades.

3 - Heavy siltation and/or vegetation growth is restricting flow and scour pockets are forming near the substructures.

1 - Heavy siltation and/or vegetation growth is severely restricting the opening. Scour has exposed or undermined foundations of the piers and abutments.
Figure 4A3.1
Rate 7

Figure 4A3.1 shows no change in streambed elevation (aggradation) and no evidence of restrictions. Rate waterway opening 7.

Figure 4A.3.2
Rate 5

Figure 4A.3.2 shows a bank that has encroached on the opening, but has not caused any scour at the bridge. Rate waterway opening 5.
Figure 4A.3.3
Rate 5

Figure 4A.3.3 shows vegetation blocking one-third of the opening, but there is no scour at the abutment. Rate waterway opening 5.

Figure 4A.3.4
Rate 3

Figure 4A.3.4 shows vegetation growth and aggradation causing scour at the left abutment. Rate waterway opening 3.
Stream Channel

Figure 4A.3.5
Rate 3

Figure 4A.3.5 shows vegetation growth that blocks half of the opening causing scour at the abutment and exposing the footing. Rate waterway opening 3.

Figure 4A.3.6
Rate 1

Figure 4A.3.6 shows siltation and vegetation that have reduced the opening and undermined the footings. Rate waterway opening 1.
BANK PROTECTION

What to Rate
Rate protective material on the channel banks and streambed.

What to Look For
Check for displaced material. Look downstream and on the banks for the displaced material. Check for erosion of underlying material. Look for slumping of material indicating movement at the toe of slope. Check any change in slope of the protection. Check joints of sheet piling. Check integrity of wire in gabions. Compare existing protection with previous inspections and as-built record plans.

Rating Examples
7 – Protection is functioning as designed with no movement.
5 – Some minor movement in channel and streambed protection, but not at the substructures. Movement is not causing problems at the bridge.
3 – Major movement in channel and streambed protection that adversely affects the bridge. Any movement of protection at the substructure.
1 – Failure and loss of channel and streambed protection endangering the bridge, roadway embankment, and top of the channel banks. Movement of protection at the substructure exposing or undermining the foundation of piers and abutments.
Figure 4A.4.1
Rate 7

Figure 4A.4.1 shows bank protection that is functioning as designed with no movement of material. Rate bank protection 7.

Figure 4A.4.2
Rate 5

Figure 4A.4.2 shows downstream bank protection that has sloughed into the channel, but without affecting the bridge. Rate bank protection 5.
Figure 4A.4.3
Rate 5

Figure 4A.4.3 shows some movement of downstream channel protection, but the bridge is unaffected. Rate bank protection 5.

Figure 4A.4.4
Rate 3

Figure 4A.4.4 shows channel protection at the abutment that has been almost completely displaced. Rate bank protection 3.
Figure 4A.4.5  
Rate 3  
Figure 4A.4.5 shows protection that has sloughed away from the cutoff wall and behind the wingwall. Rate bank protection 3.

Figure 4A.4.6  
Rate 1  
Figure 4A.4.6 shows failed bank protection that has resulted in undermined abutment and wingwall footings. Rate bank protection 1.
The following items must be documented for stream channel and scour conditions (if any) at the bridge:

CHANNEL CROSS SECTION AT FASCIAS
CHANNEL PROFILE NEAR SUBSTRUCTURES
MAPPING SCOUR AND EROSION AT SUBSTRUCTURES
SUBSTRUCTURE DEFICIENCY
STREAM ALIGNMENT SKETCH

Each of these items is described later in this section.

Generally, scour and stream channel cross section and profiles must be documented at bridges over water, and also when erosion problems are identified at bridges over other features (see Chapter 4, Section A for definitions of stream erosion and scour, and Chapter 4, Section C & D for definitions of erosion and scour at substructures). Not all documentation is required at every bridge. Examples include bridges crossing gorges where the stream channel is remote from any part of the bridge, and major river crossings with deep and swift water. The Team Leader must use sound engineering judgment when any documentation is omitted. The reason for the omission needs to be stated in the inspection report.

Scour and stream channel documentation is required during an interim inspection if changes to the streambed and/or foundation material have occurred or if the interim inspection is being done because of a problem related to scour.

If the bridge is inspected by diving during the same year as the general inspection, the stream channel and scour documentation can be omitted, but only for the abutments, wingwalls, or piers that are inspected by diving. If the bridge is not receiving a diving inspection during the same year, BUT a previous diving report was completed, the Team Leader should evaluate the current stream channel and scour conditions to the extent this can be done without diving. If no changes from the most recent diving report can be detected, this should be noted in the report and the normal documentation (channel cross-sections, profiles and scour mapping) can be omitted. However, the interval between documentations (whether diving or general) must not be greater than two years. If changes are detected, the normal documentation should be done and the NYS DOT Regional Hydraulics Engineer should be notified. The Regional Hydraulics Engineer can decide the need for an immediate diving inspection or a change in diving inspection frequency.
CHANNEL CROSS SECTION AT FASCIAS

Purpose
The purpose for collecting these measurements is to document changes in the waterway opening at the bridge, and any lateral shift in the stream. This identifies scour problems before they endanger the bridge.

What to Document
Document the streambed relative to fixed points on the bridge. Estimate the skew angle of flow. Record the depth of flow and estimate the depth of flow during floods.

How to Document
Take dropline readings along each fascia of all floodplain spans. Take readings along each fascia, starting at the first substructure before the floodplain and proceeding at approximately 0.5 m increments to the substructure beyond the floodplain. For short span bridges, consider reducing this to 2 m increments. Alternatively, dropline readings may be taken at railing post locations if the spacing does not exceed 3 m. If readings were previously taken, new readings should be taken at the same locations and referenced to the same fixed portion of the bridge. Dropline readings should be measured to a reference line on the bridge that is not likely to change with time. For example, the top of the bottom chord of a truss is a better choice than top of railing because of possible railing replacement. If the top of railing is used, be sure to measure the railing height relative to a more permanent reference line such as bottom of sidewalk or deck. If accurate readings cannot be taken because of physical conditions at the site, they can be omitted. Document the reason on form BD 188.

Record the dropline readings on form BD 226 and their locations on form BD 227. Provide a simple reference sketch showing a partial transverse section identifying the reference datum, water level, and streambed. If the top of railing is used as a datum, show the railing height. Indicate the plan location of the measurement taken from the datum to the water level. This measurement should be taken where the water depth typifies the stream depth at the bridge at the time of inspection. If any evidence of flooding exists, such as high water marks or debris, estimate the depth of high water.

Show the direction of stream flow. Estimate the skew angle of flow. If the flow is parallel to the substructure faces, the angle of flow is zero. If possible, estimate the angle of flow for flood conditions.

See figures 4B.1.1 and 4B.1.2 for sample channel cross-section documentation.
Sample Channel Cross Section Documentation
Figure 4B.1.1
<table>
<thead>
<tr>
<th>STA.</th>
<th>LEFT SIDE READINGS:</th>
<th>STA.</th>
<th>RIGHT SIDE READINGS:</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>9.75 9.74 9.75</td>
<td>20</td>
<td>9.73 9.74 9.74</td>
</tr>
<tr>
<td>7</td>
<td>9.76 9.77 9.78</td>
<td>21</td>
<td>9.74 9.75 9.75</td>
</tr>
<tr>
<td>12</td>
<td>9.72 9.73 9.72</td>
<td>26</td>
<td>9.73 9.73 9.73</td>
</tr>
</tbody>
</table>

SAMPLE CHANNEL CROSS SECTION DOCUMENTATION

Figure 4B.1.2
CHANNEL PROFILE NEAR SUBSTRUCTURES

Purpose
The purpose for collecting this information is to document streambed conditions at each substructure where visual inspection cannot be done. This documentation is intended to determine if the streambed is either aggrading or degrading which will decide the rating of the substructure crown or scour item (explained in more detail later in this chapter).

What to Document
Channel profiles near substructures are required whenever the depth or turbidity of the water preclude an adequate visual inspection of the stream bottom next to the substructure. Document the streambed profile relative to fixed points on the substructure, such as top of footing or top of pier cap. Where this cannot be done, as with concrete culverts, document relative to a fixed reference, such as bottom of slab. If a rod can be used, note also the depth of penetration into the streambed. Sketch any stone protection, showing dimensions.

How to Document
Take readings along the face of the substructure at 2 m increments and extending 8 m beyond each end of the substructure. If the footing is exposed, readings should be next to the footing; if not, then about 0.3 m from the face of the substructure. Where possible, all readings should be referenced to top of bridge seat, top of plinth, or top of pier cap. Use form BD 230 for abutments and wingwalls and form BD 233 for piers. Show how the readings are measured to the datum in a sketch. Include water depth and where this measurement is taken. If possible, link this datum to the datum used for fascia dropl ine readings.

Using a probing tool such as a steel rod, check for soft areas in the streambed along the substructures, recording the depth of penetration. These measurements should be taken at 4 m increments along the substructure length. If the streambed is rock or stone, penetration documentation is unnecessary.

If scour protection is present, sketch the extent. Show dimensions and note the type of protection. If record plans are available, show information on the plans instead of the sketch on the channel profile forms. Any changes that have occurred since a previous inspection should be noted on the sketch.

See figures 4B.1.3 and 4B.1.4 for sample channel profile near substructures documentation.
BIN 1041130

NYS DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 5 OF 7

TEAM LEADER: Jane Doe
ASST. TEAM LEADER: D. Smith
DATE: 10/7/2000
Feature Carried: Route 212
Feature Crossed: Platte Kill

CHANNEL PROFILE ALONG ABUTMENTS: (meters)

<table>
<thead>
<tr>
<th>LOC.</th>
<th>READINGS:</th>
<th>ROD PENETRATION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.71</td>
<td>2.10</td>
</tr>
<tr>
<td>B</td>
<td>1.74</td>
<td>1.90</td>
</tr>
<tr>
<td>C</td>
<td>1.12</td>
<td>1.90</td>
</tr>
<tr>
<td>D</td>
<td>1.12</td>
<td>1.77</td>
</tr>
<tr>
<td>E</td>
<td>1.12</td>
<td>1.10</td>
</tr>
<tr>
<td>F</td>
<td>1.12</td>
<td>1.10</td>
</tr>
<tr>
<td>G</td>
<td>1.12</td>
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</tr>
<tr>
<td>H</td>
<td>1.12</td>
<td>1.10</td>
</tr>
<tr>
<td>J</td>
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<td>1.10</td>
</tr>
<tr>
<td>K</td>
<td>1.12</td>
<td>1.10</td>
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<tr>
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<td>1.10</td>
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<td>1.10</td>
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<tr>
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<td>1.10</td>
</tr>
<tr>
<td>R</td>
<td>1.12</td>
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REFERENCE

<table>
<thead>
<tr>
<th>YEAR</th>
<th>NOTES:</th>
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<tr>
<td>1994</td>
<td>W.D. Taken @ Loc. D = 2.30 m</td>
</tr>
<tr>
<td>1996</td>
<td>Full Taper @ Loc. D = 0.20 m. Exposed Footing from Loc. A. See Exhibit D @ Loc. E. Mild Structural Build-Up.</td>
</tr>
<tr>
<td>1998</td>
<td>Typical To 1994. All L = 2.31 m.</td>
</tr>
<tr>
<td>2000</td>
<td>W.D. Taken @ Loc. D = 1.5m</td>
</tr>
</tbody>
</table>

NOTE: L = 8.33 m

SAMPLE CHANNEL PROFILE NEAR SUBSTRUCTURES DOCUMENTATION

Figure 4B.1.3

4B.6
CHANNEL PROFILE ALONG PIER(S) : (meters)

<table>
<thead>
<tr>
<th>LOC.</th>
<th>READINGS</th>
<th>ROD PENETRATION</th>
</tr>
</thead>
<tbody>
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<td>0.18, 0.18, 0.14</td>
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<tr>
<td>B</td>
<td>0.66, 0.65, 0.65</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.69, 0.69, 0.68</td>
<td>0.19, 0.20, 0.20</td>
</tr>
<tr>
<td>D</td>
<td>0.71, 0.71, 0.71</td>
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</tr>
<tr>
<td>E</td>
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<tr>
<td>F</td>
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<td>0.14, 0.13, 0.13</td>
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<tr>
<td>G</td>
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<tr>
<td>R</td>
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</tr>
</tbody>
</table>

REFERENCE

Y = 3.81 meters @ Loc. "C" Mid Situation
1996

Y = 3.79 meters @ Loc. "K" =
1996

Y = 3.80 meters @ Loc. "B" =
1996

SAMPLE CHANNEL PROFILE NEAR SUBSTRUCTURES DOCUMENTATION

Figure 4B.1.4
MAPPING SCOUR AND EROSION AT SUBSTRUCTURES

Purpose
The purpose of collecting this information is to document extent of scour at the substructure unit.

What to Document
Document any scour observed during inspection. If dropline readings or channel profile readings indicate scour holes, this should be documented. Erosion problems at bridges over features other than water should also be documented. Estimate the stream velocity and document the streambed material and size.

How to Document
Documentation consists of a sketch showing problem location and indicating all three dimensions of the limits of material loss. If scour extends under a footing with piles, their condition should be noted. Note type of streambed material and its average size. Estimate stream velocity and note it on the sketch.

See figures 4B.1.5 and 4B.1.6 for sample sketches.
Scour and Stream Channel Documentation

BIN 1011000

NYS DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET ___ OF ___

TEAM
LEADER: JOE BROWN
DATE 4/27/95
Feature Carried: ROUTE 22
Feature Crossed: MAIN STREET

MAPping of scour and erosion

PLAN

SECTION A-A

SECTION B-B

SECTION C-C

SECTION D-D

Erosion of N. Abutment Embankment

Sample sketch of mapping scour and erosion at substructures

Figure 4B.1.5
Scour and Stream Channel Documentation

BIN 1012000

NYS DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT
SHEET 1 OF 1

TEAM
LEADER: JOHN JONES
Feature Carried: GREEN LAKE Rd.
Feature Crossed: JOHNSON CREEK

DATE 4/25/95

Mapping of Scour and Erosion

STREAMBED:
MIXED GRADE
GRavel AND SAND

ELEVATION
WEST ABUTMENT

PLAN
WEST ABUTMENT

Scour at West Abutment

SAMPLE SKETCH OF MAPPING SCOUR AND EROSION AT SUBSTRUCTURES
Figure 49.1.6

4B.10
SUBSTRUCTURE DEFICIENCY

Purpose
The purpose of recording this information is to document the extent of substructure deterioration under water.

What to Document
Document any erosion of concrete, missing masonry, broken or rotten timber lagging, holes in sheet piling, and any other form of deterioration.

How to Document
Sketch location and size of deterioration and note the type, showing all three dimensions.

See figure 4B.1.7 for a sample sketch.
SUBSTRUCTURE DEFICIENCY

25 mm deep spall, 150 mm - 250 mm wide on both sides or nose angle

WATER SURFACE 4/24/95

FLOW APPROX. 5 m/sec

EAST ELEVATION

SPALLING 150 mm DEEP

500 mm (TYP.)

1.5 m 7.5'

305 mm

DETERIORATION OF PIER 1

SAMPLE SUBSTRUCTURE DEFICIENCY SKETCH

Figure 48.1.7
STREAM ALIGNMENT SKETCH

Any deficiencies in the stream channel that cannot adequately be shown in photos should be sketched in a simple plan view. A sketch showing the stream alignment relative to the bridge opening and locations of debris, siltation, scour pockets, and loss of bank protection is generally far superior to photos for documenting stream channel deficiencies.

See figure 4B.1.8 for a sample sketch.
SECTION C

ABUTMENTS AND WINGWALLS

This section includes the following rating items:

JOINT WITH DECK
BEARINGS, ANCHOR BOLTS, PADS
BRIDGE SEAT & PEDESTALS
BACKWALLS
STEM (BREASTWALL)
WALLS
EROSION OR SCOUR
FOOTINGS
PILES
ABUTMENT RECOMMENDATION

ABUTMENT

This is a substructure at the end of a single span or at the extreme end of a multi-span superstructure. An abutment provides support for the bridge and retains or supports the approach fill.

Typical Abutments

Abutments are classified according to their position with respect to the approach embankment. The most common types are full-height, stub, and spill-through (or open). Integral abutments and mechanically stabilized earth abutments are newer designs introduced and built in recent years.

Full-height abutments (or closed types) are those extending from the grade line of the feature below to that of the feature overhead (Figure 4C.1.1). Several types of full-height abutments are in use today. Some of the more common designs include:

- Cantilever abutment, consisting of a vertical arm (stem or backwall) rigidly fixed to a horizontal base (footing). Lateral thrust of earth pressure is resisted by opposing cantilever action of the stem and footing. The stem transmits horizontal pressure to the footing, which in turn provides resistance from the dead weight of the abutment and the embankment material resting on the footing.
Abutments and Wingwalls

- Counterfort abutment (Figure 4C.1.3), similar to the cantilever but with the addition of counterforts (triangular crosswalls) which connect the vertical walls to the base. The counterforts, spaced at regular intervals, provide resistance to bending moments in the stem.

- Crib abutment, consisting of individual structural units assembled to form an open cellular structure. The cells are filled with suitable material (gravel, concrete, etc.) that along with the units themselves, provide support for the structures.

- Soldier Pile abutment (Figure 4C.1.4), consisting of a series of soldier beams supporting horizontal lagging to retain the embankment. The soldier beam is a steel pile driven into the earth with its projecting end used as a cantilever beam. Horizontal lagging usually consists of either timber planking or steel plates. Sheet piling abutments are constructed similarly.

Stub abutments (Figure 4C.1.5) are set near the top of an embankment or slope, having a relatively short vertical height. They may be supported upon piles or founded on gravel fill, the embankment, or the natural ground. The pedestals are supported directly on the footing and there is no stem, therefore, rate the stem 8. The backwall retains the fill by spanning horizontally between pedestals.

Spill-through (or open) abutments (Figure 4C.1.6), consist of vertical columns or buttresses supporting a capbeam. The approach embankment is only partially retained by the abutment. The embankment extends on its natural slope through the openings between the vertical supports.

Integral abutments (Figure 4C.1.7) are cast monolithically with the bridge deck. They encase the ends of the deck beams and are supported on a single row of piles. This type of abutment allows rotational movement.

Mechanically stabilized earth abutments, particularly reinforced earth abutments (Figure 4C.1.8) are systems consisting of three principal components: a face (usually precast concrete panels), strips or grids (usually galvanized steel), and a granular backfill. Alternating layers of granular fill and reinforcing strips are placed in lifts and connected to the facing panels. The basic concept is that horizontal earth pressure normally on the vertical wall is transferred to the metal strips through friction developed between the strips and backfill.

Abutment Rating Items

Depending on abutment type, the following elements are to be inspected and rated as part of the abutment:

- **Joint with Deck**: STEM (BREASTWALL)
- **Bearings, Anchor Bolts, Pads**: EROSION OR SCOUR
- **Bridge Seat & Pedestals**: FOOTINGS
- **Backwall**: PILES

Each of these elements is described later in this chapter.

4C.2
TYPICAL ABUTMENTS

TYPICAL FULL HEIGHT ABUTMENT
Figure 4C.1.1

TYPICAL GRAVITY ABUTMENT
(Wingwalls not Shown)
Figure 4C.1.2
Abutments and Wingwalls

TYPICAL COUNTERFORT ABUTMENT
Figure 4C.1.3

TYPICAL SOLDIER PILE ABUTMENT
(Wingwalls not Shown)
Figure 4C.1.4
Abutments and Wingwalls

TYPICAL STUB ABUTMENT
(Wingwalls not Shown)
Figure 4C.1.5

TYPICAL SPILL THROUGH ABUTMENT
Figure 4C.1.6

BACKWALL
RATE UNDER BRIDGE
FILES
FOOTING

BRIDGE SEAT
PEDESTALS
STRAIGHT
WINGWALL
STEM
FOOTING

BACKWALL
Abutments and Wingwalls

TYPICAL INTEGRAL ABUTMENT
Figure 4C.1.7

TYPICAL MECHANICALLY STABILIZED EARTH ABUTMENT
(Wingwalls not Shown)
Figure 4C.1.8
ABUTMENT JOINT WITH DECK

Deck joints are designed to accommodate various bridge-deck movements under live loading or during thermal expansion and contraction. Closed joints should prevent leakage to components below the deck and provide a smooth transition between the deck and approach roadway.

Open joints are not designed to be watertight; water and debris are free to pass through the joint where they may be diverted from other bridge components by use of a trough or similar device.

What To Rate

Rate the condition of the transverse deck joint between the backwall header and deck. In determining the rating, include the condition of the adjacent header concrete and smoothness of the transition to the deck. Baffles, troughs, plumbing, and joint-support framing should also be included in rating this item. Figure 4C.2.1 shows a typical joint with deck. Figure 4C.2.2 shows a detail of a joint with deck above the backwall. Sometimes, a functioning deck joint may be located behind a backwall. This too, should be rated under “Joint with Deck.” For ramp bridges with a transverse deck joint between the mainline and ramp bridges, rate the joint under the abutments section on form TP 349.

EXCEPTIONS: Some bridge types, such as rigid-frame, integral abutment, filled-arch, pips, and culverts have no joints with decks. Certain construction details have no joint with the deck.

Figure 4C.2.2 shows a detail having no joint with deck. This is a construction joint that was not designed to function as a deck joint. This joint is included in the rating for the approach pavement. The pavement construction joint is also rated with the approach pavement.
Typical Joints

Typical open joints include:

- Finger-plate joints (or tooth-plate joints), consisting of two steel plates with interlocking fingers or teeth. They are normally used on longer-span bridges where greater expansion is required.

- Sliding-plate joints, consisting of horizontally positioned flat steel plates anchored into the bridge deck along one edge. They are allowed to slide across an angle anchored to the opposite face of the opening. Though not watertight, they generally resist passage of debris.

- Formed joints simply provide a gap between the bridge deck and abutment backwall. They are generally found on short-span bridges and provide for less movement than other joint types. The joints may have unprotected concrete edges or may be armored with steel angles.

Some typical closed joints include:

- Elastomeric joints, generally consisting of steel plates and angles reinforcing a neoprene cover. The steel provides for anchorage and load transfer. The neoprene covers and protects steel components, prevents passage of water and debris, and, due to its elastomeric properties, allows movement of the bridge deck.

- Poured joint seals, consisting of two materials: a base composed of a preformed expansion joint filler topped by a poured sealant. This type of joint can accommodate only minor movements and is generally used on short-span structures.

- Compression seals, consisting of rectangles of neoprene. Sealer shape and elasticity allow for full recovery after being distorted by deck expansion and contraction. To function properly, the seal must be maintained in a partially compressed state.

- Cellular seals, similar to compression seals, allow for expansion and contraction both perpendicular and parallel to the joint. This joint type is generally used on curved or skewed structures where parallel movement (racking) may occur.

- Modular joint systems, consisting of individual seals (usually compression seals) interconnected with steel and supported by their own stringer systems. They are normally used where large movements are anticipated.

What To Look For

Check that the size of opening is reasonable and there are no vertical displacements of the joint or its elements. Check for debris in the joint or joint trough, and for deterioration of the joint materials. When under the deck, check for deterioration of the joint supports, deterioration or displacement of troughs and baffles, and leakage of joints intended to seal out water.
Abutments and Wingwalls

Joints designed to seal out water, but are leaking, should be rated 4 or lower for their failure to function as designed. If leakage is causing deterioration to the bearings, girders, pedestals, etc., then the joint should be further downrated.

Similarly, downrate clogged joint troughs and/or plumbing systems at least one number, depending upon the effects of clogging. Rate all exposed parts of the joint plumbing system under the joint item.

**Rating Examples**

7 – New Condition

5 – Joint components may show some deterioration such as minor asphalt raveling next to armor angles or filler material deterioration, but the joint is still watertight.

3 – If joint leakage is causing serious deterioration a 3 rating is appropriate.

1 – If parts of the joint are loose and protruding so that they could snag vehicular traffic, or a joint seal has become totally nonfunctional, then a 1 rating is appropriate.

*Figure 4C.2.4*

Rate 7

The joint shown in Figure 4C.2.4 is in new condition: Rate 7.
Figure 4C.2.5
Moderate Deterioration Below - Rate 4
Serious Deterioration Below - Rate 3

Figure 4C.2.5 shows a sealed armored joint. The sealer material has begun to pull away from the steel angles in the shoulder area. If this is an isolated condition with only moderate deterioration to the elements below, then rate the joint 4. If the condition is representative and serious deterioration of the elements below is occurring because of leakage, rate the joint 3.
Abutments and Wingwalls

Figure 4C.2.6
Rate 2

In the joint shown in Figure 4C.2.6, adhesion between sealer material and the armored angles has failed completely. Water and debris may freely enter the opening, leading to substantial damage to bridge elements below. Spacers have been installed as a temporary measure and should not be included in the rating. Rate this joint 2.

Figure 4C.2.7
Rate 2

Figure 4C.2.7 shows an open joint with the opening clogged with debris, thus restricting deck movement. Additionally, portions of the joint plate have been damaged and are missing. Riding quality over the joint is poor. This joint is rated 2.
Abutments and Wingwalls

Figure 4C.2.8
Rate 1

The concrete header shown in Figure 4C.2.8 has disintegrated. Broken chunks of concrete may fall into the travel lanes. The anchorage for the steel angle is no longer viable, which may allow the angle to protrude into traffic. Rate this joint 1.
BEARINGS, ANCHOR BOLTS, PADS

Bearings are designed to transmit and distribute superstructure loads to the substructure, while allowing the superstructure to undergo necessary movements.

They may be subjected to various forces. Vertical forces are produced by dead and live loads. Highly skewed or curved structures may induce transverse forces at bearings. Transverse forces may also develop from wind, earthquake, or other horizontal forces. Uplift forces may develop on cantilever anchor spans or curved structures.

Bearings are also subjected to various superstructure movements. Longitudinal movement due to thermal expansion and contraction usually must be accommodated. End rotation due to dead-load and live-load deflections may also need to be allowed. Shrinkage of concrete while curing or long-term creep effects should be accounted for. Lateral rotations on highly skewed or curved structures may be significant.

What To Rate
Rate the condition of bearings or bearing pads and anchor bolts. The rating should reflect the condition of the worst bearing at an abutment. Do not average conditions of all the bearings. For structures such as jack arches or prestressed concrete, where only parts of the bearing systems are visible, rate what can be seen. In deciding the rating, consider the bearing's ability to support the superstructure, and if required, allow superstructure translation and rotation.

EXCEPTIONS: This item is not applicable (Rating 8) to the following types of structures: concrete or masonry arches, integral abutments, rigid frames, slabs, box culverts, and pipes.

SPECIAL CASE: RAMP BRIDGES
Ramp bridges connected to mainline bridges are oriented such that the beginning of the ramp bridge is at the mainline bridge. If the beginning end of the ramp bridge is supported by a pier that also supports a part of the mainline bridge, the bearings, pedestals, and top of pier cap supporting the ramp structure should be rated on form TP 349 as begin abutment bearings and bridge seat and pedestals for the ramp bridge even though there is no beginning abutment. When this is done, a remark needs to be provided. If mainline pier deficiencies adversely affect the ramp bridge, cross-referenced remarks on the mainline and ramp inspection reports are necessary.

Typical Bearings
Bridge bearings are either fixed or expansion. The principal difference between the two is that fixed bearings do not allow for translation of the superstructure. Generally, both bearing types are designed to allow rotational movement of the superstructure due to deflections. This rotational movement may be accommodated by rollers, pins, hinges, curved surfaces, or by deformation of elastic materials.
Both fixed and expansion bearings are designed in several configurations: steel, neoprene, PTFE (Teflon), bronze, or some combination of these materials. Basic components generally include:

- **Sole Plate** – a steel plate attached to the bottom flange of a girder or beam or to the bottom chord of a truss. With concrete beams, girders, or slabs, the lower flange or bottom of the section may function as a sole plate.

- **Bearing or Bearing Surface** – secured to the sole plate and masonry plate and permits rotation and/or translation, and transmits forces from the sole plate to the masonry plate.

- **Masonry Plate** – a steel plate attached to the supporting member or abutment. A masonry plate serves to distribute vertical forces from the bearing and superstructure above to the substructure below. Bearing pads, acting as vertical load-transmitting devices, may be placed between the masonry plate and substructure.

- **Anchor Bolts** – hold the bearing to a substructure unit. They may provide restraint against transverse movement and for fixed bearings will provide restraint against longitudinal movement. Anchor bolts may also be designed to resist vertical (uplift) forces.

Not all bearings have these four distinct elements, but all do have a bearing or a bearing surface.

Several types of expansion bearings have been designed to accommodate superstructure movement:

- **Sliding-Plate Bearings** allow translational movement through action of one plate sliding on another. Because their use is generally restricted to shorter-span structures, allowance for rotational movement may not be required. These bearings are normally constructed of steel. Other materials, such as bronze, lead, asbestos, or PTFE (Teflon), may be incorporated to reduce friction.

- **Roller Bearings** allow longitudinal movement through rolling action of a cylinder (roller) or group of cylinders (roller nest) between a sole plate and masonry plate. Rotational movement may be accommodated by rolling action of the roller(s) or by rotation about a bearing pin. They are usually made of structural steel.

- **Rocker Bearings** perform similarly to roller bearings. They are generally used when either a large vertical load, a substantial amount of translation, or a combination of both is anticipated. Pintles are used to maintain alignment and resist transverse forces.

- **Elastomeric Bearings** allow horizontal movement by deformation of the bearing itself. They are commonly used for prestressed concrete or steel bridges of short and moderate span lengths. These bearings are composed of neoprene pads, and may be laminated by incorporating steel or fiberglass plates between stacked neoprene pads. To restrain horizontal movement, fixed elastomeric bearings may use anchoring dowels passing through the bearing from the superstructure to the substructure.
Abutments and Wingwalls

- Pot or Multi-Rotational Bearings allow horizontal movement through use of sliding plates and multidimensional rotation through deformation of a sealed elastomer. They are normally used where a large vertical load, a substantial amount of translation in two directions, or a combination of both is anticipated. These bearings are constructed of a steel cylinder (pot) which confines and seals a neoprene pad. A steel piston rests on the pad. Under high pressure, the pad acts in a manner resembling a hydraulic fluid and allows rotation of the piston. Sliding plates for translation are normally constructed of PTFE (Teflon) and stainless steel.

**What To Look For**

For all types of expansion bearings, look for signs of distress to other bridge components caused by frozen bearings, such as cracked or sheared pedestals.

**Steel Bearings:** Lateral or vertical displacement (uplift), sheared bolts, cracked welds, and presence of debris or heavy corrosion that may prevent free movement. If corrosion is present, assess the degree of deterioration and its effect on structural capacity of the bearing components. Check for bearing misalignment in the form of overextension toward the edge of or off the masonry plate, or tipping of the bearing beyond its proper position for the ambient temperature. Check for stress cracks that may develop if the bearings have frozen. If present, verify that masonry plates are anchored and not “walking.” When inspecting pot bearings, also look for cracking or splitting of the piston or pot, leaking of the piston seal, ripped or torn Teflon surfaces, or non-uniform compression across bearing.

**Elastomeric Bearings:** Debris buildup, delamination, cracking deterioration, cuts, and bond failure between the bearing element and top or bottom load plates. Check for excessive distortion, such as shearing beyond anticipated longitudinal displacement, or non-uniform compression or twisting of the bearing beyond anticipated rotational displacement. Look for excessive bulging of the elastomer, which may cause the bearing to roll.

**Anchor Bolts:** Missing or bent bolts. Each anchor bolt should be tapped with a heavy hammer to determine if it has been sheared off.

4C.16
### Rating Examples

When rating the condition of the bearing system (bearings or pads and anchor bolts) consider the bearing’s function as well as the condition. To function properly, a bearing system must support (or anchor) the superstructure and provide for end-of-span movement. If not functioning as designed, excessive stresses may be induced in the superstructure or substructure that could shorten the usable life. Improper positioning may lead to serious consequences. Additional superstructure movement may cause damage to other elements, such as backwalls, or may cause extension of the bearing beyond safe limits.

7 - Bearings are in new or like-new condition, in proper position for the ambient temperature.

5 - Minor deterioration, but still allow movement, if required. Bearings should be reasonably close to proper position for the ambient temperature.

3 - Serious deterioration or deformation of the bearings, improper positioning of the bearings, and/or frozen bearings. Secondary effects of frozen bearings, such as sheared anchor bolts and/or cracked pedestals may be evident.

1 - Bearing is completely disintegrated or has failed, or is extended in a position no longer providing support.

Figure 4C.3.1
Rate 7

The bearing shown in Figure 4C.3.1 is a pot bearing. Sliding plates have been incorporated to provide for translation. The bearing is in new condition and in the proper position for the ambient temperature. If all bearings at the abutment are in this condition, then rate them 7.
The sliding plate bearing shown in Figure 4C.3.2 was photographed when the ambient air temperature was 5 degrees F (-15 degrees C). The bearing should be in a contracted position, but not overextended. Though the bearing is in good condition, it should be rated 4.

Figure 4C.3.3 shows a steel fixed bearing designed to allow rotational movement of the superstructure by means of a pin connection. Heavy rust has formed on the bearing, which may be impeding movement about the pin and causing deterioration of the bearing itself. Rate the bearing 3.
Figure 4C.3.4
Rate 2

Figure 4C.3.4 shows a sliding plate bearing severely out of alignment and in a contracted position at an ambient air temperature of 80 degrees F (27 degrees C). The bearing should be in an expanded position. Winter temperatures will probably cause the bearing to contract further, possibly sliding off the masonry plate. Rate the bearing 2.

Figure 4C.3.5
Rate 2

Figure 4C.3.5 shows an expansion bearing. This bearing is heavily corroded, causing extensive deterioration to the keeper plates, rollers, and bearing component. Debris has infiltrated between the rollers, hindering rotation, which may be inducing excessive stresses in the superstructure or substructure. Rate the bearing 2.
Abutments and Wingwalls

Figure 4C.3.6
Rate 1

Figures 4C.3.6 and 4C.3.7 show sliding plate bearings that have failed completely. Anchor bolts have sheared and the masonry plates have "walked" off the pedestals.

Figure 4C.3.7
Rate 1

4C.20
BRIDGE SEAT AND PEDESTALS

Most commonly, the bridge seat is the top surface of an abutment on which the superstructure may be placed and supported and from which the backwall rises. It may have pedestals constructed on it to provide a specific bearing-seat elevation. For abutments without raised individual pedestals, the pedestal is considered the material directly below or adjoining individual bearings or superstructure elements (i.e., beams or girders) which represents the point of load transfer between the bearing (or superstructure) and stem. For rigid frames and concrete box-culverts with a construction joint between the leg of the abutment (stem) and the primary member, rate this bearing surface as a bridge seat.

What To Rate

Rate the condition of the abutment bridge seat and pedestals. The rating should reflect the condition of the worst pedestal at an abutment or condition of the bridge seat, whichever results in the lower rating.

EXCEPTIONS: Metal or concrete pipes and concrete or masonry arches do not have bridge seats or pedestals. Other bridge types that do not have bridge seats or pedestals include bridges with integral abutments, rigid concrete frames (without a construction joint), and precast box culverts (without a construction joint). Where bridge seats and pedestals do not exist, use the rating of 8.

SPECIAL CASE: RAMP BRIDGES

Ramp bridges connected to mainline bridges are oriented such that the beginning of the ramp bridge is at the mainline bridge. If the beginning end of the ramp bridge is supported by a pier that also supports a part of the mainline bridge, the bearings, pedestals and top of pier cap supporting the ramp structure should be rated on form TP 349 as begin abutment bearings and bridge seat and pedestals for the ramp bridge, even though there is no beginning abutment. When this is done, a remark needs to be provided. If mainline pier deficiencies adversely affect the ramp bridge, cross-referenced remarks on the mainline and ramp inspection reports are necessary.

Typical Types

Bridge seats and pedestals are usually made of concrete, although masonry, timber, or steel may be found.

What To Look For

If bridge seats and/or pedestals are concrete, look for such signs of deterioration as cracking, scaling, spalling, delamination, or leaching. Stroke with a hammer to determine concrete soundness. For masonry, look for cracks and deterioration of mortar joints or stones and bricks and loss of masonry. For steel, look for loss of section, bowing, or buckling. For timber, check for rotting by using a hammer, awl, or knife and visually inspect for insect attack. Look for debris buildup (soil, leaves, bird droppings, etc.) on top of the bridge seat or pedestals that can trap moisture and cause deterioration.

4C.21
Rating Examples

7 – New or like-new condition.

5 – The bridge seat or pedestal may have minor deterioration, such as minor map cracking without delamination, possible hairline shrinkage or temperature cracks (not stress cracks), and/or minor spalling or scaling that does not involve the area under the masonry plate of the bearing.

3 – There may be heavy map cracking and efflorescence with indications of hollowness or heavy scaling that involves most or all of the bridge seat or pedestal. A 3 rating would also be used for bridge seats or pedestals having significant debris buildup and/or spalling that results in the loss of bearing area. Working stress cracks caused by compressive overstress (splitting) or induced by frozen bearings that have not yet progressed to a critical state would also warrant a 3 rating.

1 – This represents deterioration or a stress crack so severe that failure of a bridge seat or pedestal has occurred or is imminent.

Figure 4C.4.1
Rate 5

The pedestal in Figure 4C.4.1 has fine map cracking on its face and has some wet debris on top, but the pedestal is still solid. Rate this pedestal 5.
Figure 4C.4.2
Rate 4

Figure 4C.4.2 shows a pedestal that has minor spalling at the top that has been painted over. The lower spall and cracking are a result of rebars corrosion. Tapping the pedestal with a hammer reveals delaminations in the concrete. Rate this pedestal 4.

Figure 4C.4.3
Rate 3

The pedestal in Figure 4C.4.3 is spalled with approximately 5 percent loss of bearing. The concrete has cracking, efflorescence and areas of total disintegration. Rate this pedestal 3.
Figure 4C.4.4
Rate 3

Figure 4C.4.4 shows a bridge seat that is spalled and covered with wet debris. This bridge seat is rated 3.

Figure 4C.4.5
Rate 2

The pedestal in Figure 4C.4.5 is spalled to the extent that 20-25% of the masonry plate is undermined exposing one of the anchor bolts. This pedestal is rated 2.
Aboutments and Wingwalls

Figure 4C.4.6
Rate 1

Figure 4C.4.6 shows a pedestal with a large shear crack extending across its entire face and behind the anchor bolts. This pedestal should be rated 1.
Abutments and Wingwalls

BACKWALLS

These are designed primarily as retaining walls, but may also support the end of the bridge deck or the approach slab.

What To Rate

Rate the backwall, but do not include the backwall header if there is one. Backwall headers are rated under Joint With Deck. For jack-arch bridges that do not have recessed backwalls, rate the abutment sections between the stringers as backwalls.

EXCEPTIONS: This item is not applicable (Rating 8) to the following structure types: box culverts, pipe culverts, integral abutments, rigid frames, slabs, filled arches, and some spill-through abutments.

The condition of protective coatings on the concrete is not included in the backwall rating.

Typical Types

They are usually concrete, but masonry, timber, and steel can be used.

What To Look For

Signs of deterioration, such as cracking, leaching, and delamination of the concrete. Sound the backwall for delamination by tapping with a hammer. For steel, look for loss of section or bulging. For timber, look for insect damage and rot. Whatever type, check for and document signs of tipping or other movement. A common problem is pavement show damage, usually showing as large cracks in concrete backwalls or bowing of steel or wooden backwalls.

Rating Examples

7 – New or like-new condition.

5 – There may be moderate scaling or minor spalling of concrete, minor rust of steel, or dampening of wood. Concrete backwalls would show no signs of hollowness or delamination when struck with a hammer.

3 – Serious deterioration or distress (signs of movement or large cracks, section loss of steel, or timber rot). Some minor amounts of embankment material may be spilling through backwall cracks.

1 – The backwall is either deteriorated so badly or cracked or moved so that it cannot retain backfill material or support the approach slab.
Figure 4C.5.1
Rate 7
Figure 4C.5.1 shows a newly constructed abutment. Rate the backwall 7.

Figure 4C.5.2
Rate 5
Figure 4C.5.2 shows portions of concrete exposed between girders of a jack-arch bridge that are to be rated under "backwalls." Concrete shown has fine cracks with light efflorescence. Testings with a hammer produced solid soundings. Rate this backwall 5.
The backwall shown in Figure 4C.5.3 has a moderate amount of spalling, cracking, and efflorescence with heavy scaling. Hammer testing generally produced solid soundings. Rate 4.

Figure 4C.5.3
Rate 4

Figure 4C.5.4 shows a seriously deteriorated backwall. No signs of distress or movement have been detected, but concrete condition is poor, extensively spalled and crumbly. This condition will worsen as the backwall is being continuously exposed to water and debris passing through a failing deck joint. Rate this backwall 3.

Figure 4C.5.4
Rate 3
ABUTMENT STEM (BREASTWALL)

This provides end support for the bridge and retains the approach embankment.

What To Rate

- Rate the stem of a solid abutment (Figures 4C.1.1 and 4C.1.2).
- Counterfort abutment (Figure 4C.1.3).
- Piles and lagging of a soldier pile abutment (Figure 4C.1.4).
- Columns and cap of a spill-through abutment (Figure 4C.1.6).
- Pile-cap of an integral abutment (Figure 4C.1.7).
- Face of mechanically stabilized earth abutments (Figure 4C.1.8).
- Legs of concrete rigid frames (Figure 7.2.1).
- Vertical supports (if any) for concrete or masonry arches and end walls of concrete culverts (Figure 7.2.1).

EXCEPTIONS: Round and elliptical-pipe structures and stub abutments do not have stems and this element thus should be rated 8. Arches framing directly into footings or rock also do not have stems. A special case is made for stems (and wingwalls) having a non-structural stone or brick facing. When rating such elements, facing material should be considered only to the extent that its condition indicates the condition of what it is covering. Problems such as loose facings should be explained in the remarks.

Typical Stems

Reinforced and plain concrete are the materials most commonly encountered, but stone, masonry, wood lagging in soldier beams, steel or timber sheeting, and mechanically stabilized earth abutments have also been used. In older (particularly smaller) bridges, it is common to find masonry stems with a poured or shot concrete structural or non-structural facing.

What To Look For

Deterioration of the stem is probably the most common problem. For concrete, check for cracking, leaching, spalling, and hollowness. Observation and use of an inspector's hammer are the methods most commonly used to detect material soundness. For masonry, check stones and joints for deterioration and note any missing stones. For steel, check for cracking, tearing, and if significant section loss has occurred, determine steel thickness. When timber stems are encountered, check for rotting with an inspector's hammer, awl, or knife, and thoroughly observe the stem for evidence of insect attack. Check all stems for evidence of vertical and horizontal movement. The joint or separation generally existing between stem and wingwalls is a good location to observe differential movement. A hand level or plumbline can be used to check for tilting, through comparison with the batter shown in the plans. Once any signs of movement are observed, they should be recorded in the inspection report so that monitoring can easily continue during subsequent inspections. More information on this topic can be found under "Footings and Piles."
Abutments and Wingwalls

Inspection should also include checking for lateral movement occurring when lateral forces acting on the wall exceed forces holding the structure in place.

The most common causes of lateral movement are foundation soil failure, seepage, changes in soil characteristics (e.g., frost action and ice), and long-term consolidation of the original soil. Inspection for lateral movement should include general overview of the structure for obvious movement, such as stem faces and wingwalls being displaced, displacement of curb faces, or bending of rail at abutment joints or piers. Check joints for a non-uniform dimension between the deck and approach slab. Check bearings for evidence of movement. Stem movement is often a result of scour under the footing. A detailed description of this condition can be found under “Erosion or Scour” later in this chapter.

Look for signs of movement, loss of embankment, and broken or cracked panels when inspecting mechanically stabilized earth abutments.

Evidence of foundation movement should result in downrating the stem because of its inability to adequately support the superstructure. Such movement also suggests an inability of the footing and pile systems to transmit substructure load to the foundation material, so they should also be downrated.

Rating Examples

7 – Use for a stem in a new or like-new condition.

5 – Indicates minor deterioration, such as mapcracking with efflorescence covering up to about 25% of the stem surface, but hammer-sounding would reveal little or no hollowness. Some spalling may be occurring, but would not cover more than about 10% of the stem nor would it encroach on the bridge seats or pedestals. The stem would show little or no signs of movement.

3 – Deterioration would be extensive and characterized by widespread mapcracking, efflorescence, spalling and/or scaling. There may be structural cracks that are active. If there is evidence of significant movement whether or not the stem is deteriorated, a 3 rating would be used to reflect the stem’s reduced ability to properly support the superstructure. If the condition appears to be stable, it may be appropriate to upgrade the rating to 4.

1 – Deterioration or movement is so severe that failure has occurred or is imminent.
The stem shown in Figure 4C.6.1 has one long horizontal crack that has been patched and has not re-cracked. There are a few other minor cracks and some minor efflorescence, but the stem is solid. This stem is rated 5.

Figure 4C.6.2 shows a stem that is generally solid, but has some horizontal cracks with efflorescence and rust staining. Rate this stem 4.
Abutments and Wingwalls

Figure 4C.6.3
Rate 3
The deterioration of the stem shown in Figure 4C.6.3 is significant. There are large areas of spalled concrete with heavy efflorescence. This stem should be rated 3.

Figure 4C.6.4
Rate 2
Figure 4C.6.4 shows a stem that is severely deteriorated with large horizontal and vertical cracks, spalling, and efflorescence. Rate this stem 2.
Figure 4C.6.5
Rate 1

The stem shown in Figure 4C.6.5 is made of large stone with a concrete facing that has large cracks. The vertical cracks indicate significant movement. This stem is rated 1.
WINGWALLS

These are retaining walls adjacent or attached to an abutment. They are intended to retain sideslope material of an approach roadway embankment. Wingwalls do not support any portion of the superstructure.

They may have several geometric configurations, depending on design requirements.

- straight: extensions of the abutment wall
- splayed (flared): forming an acute angle with the bridge roadway
- U-Wings: parallel to the bridge roadway

They may be cast monolithically with the abutment or separately from the abutment.

For very long wingwalls, consider the length of the retaining wall that can be associated with the bridge. Lacking any other logical criterion, use twice the height of the abutment as the length of wall to inspect. If a problem is evident beyond this limit, do not include it in the wingwall rating, but bring the problem to the Regional Structures Engineer's or the bridge owner's attention.

Wingwall Rating Items

The following elements, if applicable, are to be rated as parts of the wingwall:

- WALLS
- FOOTINGS
- EROSION OR SCOUR
- PILES

Each of these elements is described later in this chapter.
WALLS

These are retaining walls adjacent or attached to an abutment that retain the approach roadway embankment.

What To Rate

Rate condition of the wall and its ability to function properly. The rating for each end of the structure should not be an average of the two wingwalls at each abutment, but should represent the worst wingwall at each abutment.

EXCEPTIONS: A special case is made for walls having non-structural stone or brick facings. When rating such walls, facing material should be considered only to the extent that its condition may indicate condition of what it is covering. Problems with facing materials (such as loose brick) should be explained in the written description.

Typical Walls

Reinforced and plain concrete are the materials most commonly encountered, but stone, masonry, timber lagging in soldier beams, cribbing, steel or timber sheeting, and mechanically stabilized earth walls are also used.

What To Look For

For concrete, check for cracking, leaching, spalling, scaling, and delamination. Observation and use of an inspector's hammer are the most common methods to determine material soundness. For masonry, check stones and joints for deterioration and note any missing stones. For steel, check for cracking/tearing, and if significant loss of section has occurred, determine steel thickness. When timber walls are encountered, check for rotting by using an inspector's hammer, awl, or knife, and thoroughly observe the wall for evidence of insect attack. When inspecting mechanically stabilized earth walls, look for signs of movement, loss of embankment, and broken or cracked panels.

Inspection should also include checking for lateral movement occurring when lateral forces acting on the wall exceed forces holding the structure in place.

The most common causes of lateral movement are foundation soil failure, seepage, changes in soil characteristics (e.g., frost action and ice), and long-term consolidation of the original soil. Inspection for lateral movement should include general overview of the structure for obvious movement, such as stern faces and wingwalls being displaced, displacement of curb faces, or bending of rail at abutment joints or piers. Check joints for a non-uniform dimension between the deck and approach slab. Check bearings for evidence of movement. Wall movement is often a result scour under the footing. A detailed description of this condition can be found under "Erosion or Scour" later in this chapter.

Evidence of foundation movement generally should result in a downrating of the wall because of its inability to adequately retain the approach embankment. Such movement also suggests an inability of the footing and pile system to transmit the substructure load to the foundation material so they should also be downrated.
Abutments and Wingwalls

Rating Examples

7 – New or like-new condition.

5 – Indicates minor deterioration, such as mapcracking with efflorescence covering up to about 25% of the wall surface, but hammer-sounding would reveal little or no hollowness. Some spalling may be occurring, but would not cover more than about 10% of the wall. The wall would show little or no signs of movement.

3 – Deterioration would be extensive and characterized by widespread mapcracking, efflorescence, spalling and/or scaling. There may be structural cracks that are active. If there is evidence of significant movement, whether or not the wall is deteriorated, a 3 rating would be used to reflect the wall’s reduced ability to properly retain the approach embankment. If the condition appears to be stable, it may be appropriate to upgrade the rating to 4.

1 – Deterioration or movement is so severe that failure has occurred or is imminent.

Figure 4C.7.1
Rate 5

The wingwall shown in Figure 4C.7.1 shows almost no cracking, but there is some minor spalling along the top. This wingwall is still solid and should be rated 5.
Figure 4C.7.2
Rate 4

Figure 4C.7.2 shows a wingwall that is mapcracked over its entire surface and has efflorescence, but is still generally solid. This wall is rated 4.

Figure 4C.7.3
Rate 3

The wingwall shown in Figure 4C.7.3 has heavy scale and spalling over nearly the entire face. There is mapcracking and efflorescence. Although this wall is still functioning as designed, the extent of deterioration is serious. This wall is rated 3.
Figure 4C.7.4
Rate 2

Figure 4C.7.4 shows a wingwall with several missing and displaced stones. The wingwall is still retaining the embankment, but is very seriously deteriorated. The wall appears unstable. This wall should be rated 2.

Figure 4C.7.5
Rate 1

The wingwall in Figure 4C.7.5 has failed and embankment material is retained by a temporary repair that is not considered in the rating. This wall is rated 1.
EROSION OR SCOUR
(AButments and Wingwalls)

What To Rate
Two separate conditions are examined, depending on whether the substructure is located in water.

For those remote from bodies of water (and, thus not exposed to stream scour), this item is used to evaluate the erosion of the embankment material (and covering) in front of or under the substructure footing. Erosion is the wearing away of soil by flowing water. As used here, soil includes embankment covering as well as the embankment material itself. Flowing water here refers to runoff from the approaches or the bridge deck rather than the stream.

For substructures at the water's edge or founded in water (vulnerable to scour), this item is used to evaluate the extent of scour of the foundation material next to and under the footings. Scour is erosion of a riverbed area caused by stream flow. Scour must be documented in accord with Chapter 4, Section B. See also the description of underwater inspection in Appendix C.

For more information regarding scour caused by streams, see the introduction to Chapter 4, Section A.

What To Look For
Erosion: Disturbance or loss of embankment covering material and the embankment material above, in front of, and below the footing. An uneven surface on block paving may indicate loss of embankment material below. Other signs include soil marks at the face of abutments or wingwalls or other irregularities in the embankment surface. Comparison of existing conditions against earlier photographs often quickly indicates material loss or movement.

Scour: Loss of material from a streambed near a substructure resulting from stream flow. Included in the rating for this item is the loss of material above, around, and under the footing. The three types of scour that affect bridge substructures are general scour, contraction scour, and local scour. All three types of scour can seriously affect the performance of substructures. For additional information, refer to the introduction to Stream Channel, Chapter 4, Section A.

Careful comparison of information obtained over the course of several bridge inspections at the substructures is one of the best ways to detect how much scour has occurred. Finding the maximum extent of scour is difficult because it occurs during a flood and its true extent may be masked by sediment that refills the hole when flood waters recede. The inspector should use a rod where possible to probe loose sediments deposited along the bridge substructures. If the sediment is finer than the typical bed material, or if it is easily penetrated by the rod, this means that the present sediment has accumulated in the scour hole, and local scour is more severe than indicated by channel profile readings along the substructures. Details of required scour documentation are given in Chapter 4, Section B.
Abutments and Wingwalls

Rating Examples

7 - Dropline or rod readings show no scour, or for substructures remote from water, the embankment and its coverings are in "like-new" condition.

5 - Minor erosion or scour has occurred, such as displacement or loss of much of the block paving, or loss of embankment or streambed material where the top of the footing is partly exposed.

3 - Serious erosion or scour has occurred. This would include loss of embankment material including covering such as block paving or streambed material, to the extent that a substantial length of footing is undermined, but piles are present.

1 - Erosion or scour has progressed to the point where substructure failure has occurred or is imminent. This may include extensive undermining of a footing without piles, where the presence of piles is unknown, or with piles of questionable condition, even if the substructure has not yet failed.

Note: The presence and expected condition of piles is an important factor to consider in rating erosion and scour. Particularly for older bridges, the indication of piles on "as built" plans should be the only acceptable evidence, other than direct observation, that piles exist.

Figure 4C.8.1
Rate 7

Figure 4C.8.1 shows stone bank protection for the abutment and wingwalls with no evidence of erosion or scour. Rate 7.
Figure 4C.8.2
Rate 4

Figure 4C.8.2 shows slope protection movement that has exposed some of the abutment footing. The bottom of the footing is not yet exposed. Rate erosion 4.

Figure 4C.8.3
Rate 3

The erosion shown in Figure 4C.8.3 has displaced most of the block paving in front of the abutment due to undermining the embankment material. The erosion has exposed about 25% of the footing length and has begun a small amount of undermining. Erosion at this abutment is rated 3.
Figure 4C.8.4 shows an abutment undermined along most of its length. The horizontal extent of undermining varies from 0.1 m to 1.0 m, but the abutment still appears to be stable. Scour is rated 2.

Figure 4C.8.5 shows a scour condition that has severely undermined the abutment and wingwall. The horizontal extent of scour is nearly the entire footing width over most of its length resulting in the potential for abutment and wingwall failure. Rate scour 1.
FOOTINGS
(Alliments and Wingwalls)

These are designed to transmit substructure loads to the subgrade material or piles and to maintain the substructure at a particular alignment and grade.

What To Rate
Rate condition of the substructure footing and its ability to function properly. Also include any foundation material deficiencies that may be causing distress to the substructure or superstructure.

Typical Types
Footings are almost always concrete and may be the spread type or supported on piles. When included in "abutmentless" bridges, the footing may be a metal pipe filled with concrete and placed on crushed stone. When abutments or wingwalls are poured directly on rock, the area where the stem/wall meets the rock is rated as a footing.

What To Look For
Footings are usually visible only after erosion or scour has removed significant embankment material. When exposed, check for such signs of deterioration as cracking, leaching, spalling, and hollow-sounding concrete. Also check for signs of distress in the form of large cracks or spits, and document them for future reference. At locations where the footing is not visible, check for evidence of settlement or other movement; for example, if areas over footings are paved, these should be inspected for cracks following the periphery of the footing. Presence of such cracks may suggest that the spread footing had settled or rotated. For unpaved areas, lines in the soil could suggest the same.

Vertical movement can occur in the form of uniform or differential settlement. Uniform settlement of all bridge substructure units has little effect on the structure. Differential settlement, however, is the more common form, and may produce serious distress. The most common causes of vertical movement are soil bearing failure, soil consolidation, scour, or deterioration of footing material. A hand level or plumbline can be used to check for differential settlement.
Abutments and Wingwalls

Rating Examples

9 – This is the most frequently used rating. This code ("Unknown") is used when the footing is covered, with no signs of movement or settlement.

7 – Use when the footing is visible, functioning properly, and in a like-new condition.

5 – Indicates minor deterioration, such as minor cracking or spalling.

3 – Indicates significant movement of a substructure. A footing significantly deteriorated by cracking or heavy spalling is also rated 3.

1 – Indicates a failed substructure or a footing that has cracked or spalled to such an extent that it can no longer transfer load from substructure to subgrade material or piles.

Figure 4C.9.1
Rate 6

Figure 4C.9.1 shows a footing with only very minor surface scaling. Rate this footing 6.
Figure 4C.9.2
Rate 4

Severe scaling of the footing shown in Figure 4C.9.2 is occurring, but is still generally solid and functioning as designed. This footing is rated 4.
Abutments and Wingwalls

Figure 4C.9.3
Rate 3

The abutment and wingwall footings shown in Figure 4C.9.3 are heavily spalled and are rated 3.

Figure 4C.9.4
Rate 1 or 2

Figure 4C.9.4 shows an abutment and wingwall that were poured directly on rock. The interface between the stem or wall and the rock has deteriorated significantly resulting in a loss of bearing area. Rate the footing 1 or 2 depending on the depth of spalling and relative length of wall or stem affected. Erosion would be rated the same as the footings in this case.
PILES
(Abutments and Wingwalls)

Piles are generally used to transfer loads from the bridge substructure and footing to the underlying soil or rock. For bridges with integral abutments, piles transfer loads directly from superstructure to soil or rock.

What To Rate
Rate pile condition and ability to function properly. For pile bents, rate piles based on observed condition at existing ground or mudline if a deficiency is observed. Otherwise, rate 9 - Unknown.

Typical Types
Steel, Concrete, and timber piles all may be encountered.

What To Look For
Piles are generally not visible, but if they can be seen, this may indicate a serious structural defect that must be investigated. For deterioration related only to the piles, look for the following:

Steel: Look for loss of section due to corrosion, buckling, web crippling, and for improper placement and/or alignment.

Concrete: Look for concrete deterioration, such as cracking, splitting, spalling, or efflorescence.

Wood: Wood piles, like the other types, are generally not visible, but if exposed (particularly above water) are highly susceptible to rot and insect attack. Use a hammer, awl, or knife to check for rot.

If the piles are not visible, the inspector can stand on the ground above a pile-supported footing and if strong vibrations occur when traffic passes above, this suggests that soil around the piles' upper portion had lost some fines and the piles now act as columns instead of piles.

Rating Examples

9 – Unknown. This is a frequently used rating. Use if the inspector knows that piles exist, but are not visible, or if the inspector is not sure if piles exist.

8 – Not Applicable. Use this rating when the inspector is certain that piles do not exist.

7 – Use when piles are visible and are in like-new condition.
Abutments and Wingwalls

5 – Minor deterioration, but piles are functioning as designed. Use for steel piles with heavy rust but little section loss, or for concrete piles with minor spalling or cracking but basically solid.

3 – Serious deterioration; may involve significant loss of section in a steel pile, splitting or spalling in a concrete pile, or rotting of a timber pile.

1 – Extreme condition, one or more piles either critically deteriorated or completely failed.
ABUTMENT RECOMMENDATION

What To Rate
This is a one number rating used to describe the abutment’s overall condition and functional capability. This recommendation will normally reflect the scoring of the individual elements but it does not necessarily have to be the lowest of these ratings.

Rating
The inspector provides an overall evaluation of the abutment by using one of the rating numbers below:

8 – NOT APPLICABLE
7 – NEW CONDITION
6 – Used to shade between 5 and 7
5 – MINOR DETERIORATION BUT FUNCTIONING AS ORIGINALLY DESIGNED
4 – Used to shade between 3 and 5
3 – SERIOUS DETERIORATION OR NOT FUNCTIONING AS ORIGINALLY DESIGNED
2 – Used to shade between 1 and 3.
1 – TOTALLY DETERIORATED OR IN FAILED CONDITION
Abutments and Wingwalls
SECTION D

PIERS

This section includes the following rating items:

BEARINGS, ANCHOR BOLTS, AND PADS
PEDESTALS
TOP OF PIER CAP OR BEAM
STEM SOLID PIER
CAP BEAM
PIER COLUMNS
FOOTINGS
EROSION OR SCOUR
PILES
PIER RECOMMENDATION

PIER

This is a substructure supporting spans of a multi-span structure at an intermediate location between abutments. It should support the superstructure with minimal obstruction to the flow of traffic or water. Besides its own weight, the pier must carry vertical and horizontal forces transmitted by the ends of two superstructure spans, and restrain any span movement. A pier must also withstand impact from vehicular collision or from water-borne traffic and impact from ce and water flow.

Pier and Span Numbering

Each pier is associated with the end of a span looking in the direction of orientation. All elements of a pier are rated on form TP 350 for the span associated with that pier. Refer to figure 4D.1.1. The pier elements for the last span of a bridge are all rated 8 - not applicable because the substructure at the end of the last span of a bridge is an abutment. The only exception is a ramp bridge that connects two mainline bridges with the end of the last span supported by a pier.
PIER AND SPAN NUMBERING
Figure 4D.1.1
Typical Pier Types

See figures 4D.1.2 through 4D.1.19.

TYPICAL FRAME PIER
Figure 4D.1.2

TYPICAL PI (I) PIER
Figure 4D.1.3
Piers

BEARING, ANCHOR BOLTS, PADS

TOP OF PIER CAP OR BEAM PEDESTALS

CAP BEAM

PIER COLUMNS

FOOTINGS

TYPICAL HAMMERHEAD PIER
Figure 4D.1.4

BEARING, ANCHOR BOLTS, PADS

TOP OF PIER CAP OR BEAM PEDESTALS

CAP BEAM

PIER COLUMNS

SOLID PIER STEM

FOOTINGS

TYPICAL DOUBLE HAMMERHEAD PIER
Figure 4D.1.5
Piers

TYPICAL SOLID STEM PIER
(No Cap)
Figure 4D.1.12

TYPICAL SOLID STEM PIER WITH CAP
Figure 4D.1.13
Note: Driven pilings may be steel, timber or concrete

TYPICAL PILE BENT PIER
Figure 4D.1.14

TYPICAL STEEL FRAME PIER
Figure 4D.1.15
The following items are rated 8:
Bearing, anchor bolts, pods
Pedestals
Top of pier cap or beam
Pier columns
Cap beam

TYPICAL CLOSED MULTI-CELL BOX CULVERT
Figure 4D.1.18

The following items are rated 8:
Bearing, anchor bolts, pods
Pedestals
Top of pier cap or beam
Pier columns
Cap beam

TYPICAL MULTI-SPAN CONCRETE FRAME
Figure 4D.1.19
At pin and hanger pier, rate the following 8:

Pedestals
Top of pier cap or beam
Pier stem
Cap beam
Pier columns
Footings
Piles

Rate pin and hanger assembly as bearing, anchor bolts, pods

TYPICAL PIN AND HANGER
Figure 4D.1.20
Notes On Special Types

The multi-level pier is found primarily at interchanges with multi-level structures. It can be either steel or concrete or some combination of both materials. The lower portion is integral with the upper portion and must be inspected as a whole unit. Each superstructure carried by this frame may have upper and lower level BIns or entirely separate BIns.

The following procedure should be observed when inspecting each superstructure level and its supporting substructure:

Inspect all portions of the vertical elements that support the structure. When inspecting the pier columns of the upper structure, the condition of the columns in the lower portion also has to be considered. Include lower cap beams that are connected to columns even though they are not part of the superstructure being inspected.

Pier Elements

Depending on the type, the following elements are to be inspected and rated as part of the pier:

| BEARINGS, ANCHOR BOLTS, PADS | PIER COLUMNS |
| PEDESTALS | FOOTINGS |
| TOP OF PIER CAP OR BEAM | SCOUR |
| CAP BEAM | EROSION OR SCOUR |
| STEM SOLID PIER | PILES |

For piers in water, refer to Appendix C – Underwater Inspection for further inspection procedures.

Ramp bridges connected to mainline bridges are oriented such that the beginning of the ramp bridge is at the mainline bridge. If the ramp bridge is framed directly into the primary members of the mainline bridge, the components supporting the beginning of the ramp bridge are inspected as primary members for the ramp bridge. If the beginning of the ramp bridge is supported by a pier that also supports a part of the mainline bridge, the bearings, pedestals and top of pier cap supporting the ramp structure should be rated on form TP 349 as begin abutment bearings and bridge seat and pedestals for the ramp bridge even though there is no beginning abutment. When this is done, a remark needs to be provided.

When inspecting a pier on the mainline structure of a bridge that also supports a ramp structure, inspection should include the part supporting both the mainline and ramp structures. See figure 4D.1.21. All elements supporting the mainline structure should be included in the rating for the pier of the mainline structure. The cap beam, columns, footings and piles supporting both the main bridge and the ramp bridge should be inspected with the main bridge. If main line pier deficiencies adversely affect the ramp bridge, cross-referenced remarks on the main line and ramp inspection reports are necessary.
BEARINGS, ANCHOR BOLTS, AND PADS

Refer to Chapter 4, Section C for a complete description of the function and typical types of bearings as well as what to look for and rating examples.

What To Rate

Rate the condition of the bearing pads, bearings, and anchor bolts at a pier that is at the end of a span or at the end of a cantilever span. This rating should reflect the condition of the worst element rated. For a pier that supports two sets of bearings, the bearing, anchor bolts and pads for both spans should be included in the same rating (see figure 4D.2.1). The exception to this is the case where a pier supports both a main bridge and a ramp bridge (figure 4D.1.21).

Pin and Hanger connections are commonly used at expansion ends of suspended spans. Though not placed above any substructure, they function as bearings, in that they accommodate rotation and translation and also transmit vertical loads from the suspended span to the adjacent cantilever span. Pin and hangers are rated under the pier at the end of span (looking in the direction of orientation) they are attached to. All other pier elements are rated 8, not applicable for this span. See figure 4D.1.20.

Hangers may be fracture-critical (where a single fracture can lead to catastrophic collapse) or redundant, depending on the number of hangers supporting a member and the redundancy of the supported members. Refer to Appendix G for more information on inspecting fracture-critical elements.

All hangers are susceptible to failure by cracking because they are subjected to both direct tensile and bending stresses. Hangers with only one pin (either top or bottom) are especially prone to cracking failure. Hanger stresses are increased by corrosion at the pin/hanger interface by stress-risers (such as deep corrosion pits, notches, and tack welds) and by section loss from corrosion. These conditions should be observed and documented during inspection. Each hanger should be thoroughly inspected for any evidence of cracks or corrosion. Where hangers are decorated with ornamental covers, they must be removed for inspection of the pins and hangers. Alignment of the suspended member should be checked to ensure that hangers are not subjected to racking forces, and that any windlocks or guideplates are functioning properly. Frozen pin and hanger connections do not function as designed and should be rated no higher than 3. Cracks should be reported immediately. All problems should be documented by photographs, sketches, and comments. Look for misalignment of stringers and measure gaps.

EXCEPTIONS: Where stringers frame directly into the web of cap beams without seated connections, rate bearing, anchor bolts and pads 8.

These elements are also rated 8 for multi-span concrete arches, culverts, pipes, concrete frames, and some steel frame bridges.

Bridge bearing stools are extensions of beams or girders that compensate for beam/girder depth differences between two adjacent spans at a pier. The bearing stools transmit end reactions to supporting sole plates and bearing assemblies. The bearing stools are not inspected as bearings, but rather as primary members. Under certain circumstances, these details require special emphasis (100% hands-on) inspection. See Appendix G for more information.
Rating Examples

When rating condition of the bearing system consider the effect of the condition on the bearing's function as well as its condition. To function properly, a bearing system must support (or anchor) the superstructure and provide for end-of-span movement. If not functioning as designed, excessive stresses may be induced in the superstructure or substructure that could shorten the usable life. Improper positioning may lead to serious consequences. Additional superstructure movement may cause damage to other elements, such as backwalls, or may cause extension of the bearing beyond safe limits.

7 – Bearings are in new or like-new condition, in proper position for the ambient temperature.

5 – Minor deterioration, but still allow movement, if required. Bearings should be reasonably close to proper position for the ambient temperature.

3 – Serious deterioration or deformation of the bearings, improper positioning of the bearing and/or frozen bearings. Secondary effects of frozen bearings, such as sheared anchor bolts and/or cracked pedestals may be evident.

1 – Bearing is completely disintegrated and inoperative or has failed, or is extended in a position no longer providing support.
Figure 4D.2.2
Rate 7

Figure 4D.2.2 shows a bearing in excellent condition. This bearing is rated 7.

Figure 4D.2.3
Rate 5

Figure 4D.2.3 shows a rocker bearing that has a minor amount of corrosion that is not restricting bearing movement. Rate bearings 5.
Figure 4D.2.4
Rate 3

Figure 4D.2.4 shows two bearings that are heavily rusted around the base plates and pins. If there is no evidence of movement, the bearings are probably frozen. These bearings are rated 3.

Figure 4D.2.5
Rate 2

Figure 4D.2.5 shows a very heavily corroded rocker bearing. This bearing is clearly unable to allow expansion or contraction. Rate this bearing 2.
Figure 4D.2.6
Rate 1

Figure 4D.2.6 shows a pin and hanger assembly with a crack in the hanger. The pin and hanger is at the end of span 3. The pier bearings for span 3 should be rated 1.

Figure 4D.2.7
Rate 1

Figure 4D.2.7 shows a pair of bearings at a pier that are corroded and severely overextended. These bearings are rated 1.
PEDESTALS

The pedestal's function is to support the bearings, transfer loads to the substructure and to make up any differences in elevation between the top of the cap beam or pier stem and the bottom of bearing.

What To Rate

For raised pedestals, rate the entire pedestal, including the sides. For piers without pedestals, rate the condition of the area under the bearing including the horizontal and the vertical surfaces immediately next to the bearing. Base the rating on the condition of the worst pedestal. Comments should include the condition of all pedestals.

Typical Pedestals

Some typical pier pedestals are illustrated in figures 4D.3.1 and 4D.3.2.
What To Look For

An important consideration is how well the pedestal supports the superstructure.

For concrete pedestals look for such deterioration as spalling (particularly if resulting in loss of bearing area) or map cracking. Pedestal deterioration usually results from poor deck drainage and the presence of deicing salts. Also investigate for larger cracks, such as stress cracks (pedestal failure), shrinkage cracks and cracks caused by superstructure movement or pavement shove. For stepped pedestals check for cracking at the horizontal and vertical interface. Also, check pedestals for dampness.

For steel pedestals look for section loss due to corrosion, and check connections for cracks, and the accumulation of debris.
Piers

Rating Examples

7 – New or like-new condition.

5 – The pedestal may have minor deterioration, such as minor mapcracking without delamination, possible hairline shrinkage or temperature cracks (not stress cracks), and/or minor spalling or scaling that does not involve the area under the masonry plate of the bearing.

3 – There may be heavy mapcracking and efflorescence with indications of hollowness or heavy scaling that involves most or all of the pedestal. A 3 rating would also be used for bridge or pedestals having significant debris buildup and/or spalling that results in the loss of bearing area. Working stress cracks caused by compressive overstress (splitting) or induced by frozen bearings that have not yet progressed to a critical state would also warrant a 3 rating.

1 – This represents deterioration or a stress crack so severe that failure of a pedestal has occurred or is imminent.

Figure 4D.3.3
Rate 6 or 7

Figure 4D.3.3 shows a pedestal that is in excellent condition and would be rated 6 or 7.
Figure 4D.3.4
Rate 4
Figure 4D.3.4 shows a masonry pedestal on a solid pier. Note the crack beginning at the right edge of the masonry plate of the bearing. There is, however, still full bearing area. Rate this pedestal 4.

Figure 4D.3.5
Rate 3
Figure 4D.3.5 shows a severely scaled and delaminated pedestal in the foreground. Heavy deterioration such as this should be rated 3.
Figure 4D.3.6
Rate 2

Figure 4D.3.6 shows a pedestal that is seriously deteriorated with considerable loss of bearing area. This pedestal would be rated 2.
TOP OF PIER CAP OR BEAM

This is the area between and around pedestals.

What To Rate

Rate the condition of the top of cap beam (or pier cap) between pedestals. For solid piers, rate the top of the stem between pedestals. Do not rate the tops of crash walls or column struts. Where a floorbeam sits directly on top of a cap beam, rate the condition of the interface between the floorbeam and cap beam. For rigid frames and multi-cell box culverts rate the construction joint between the pier and slab. If there is no construction joint, rate 8.

What To Look For

Collection of debris and drainage from the deck onto the cap surface. Debris traps moisture that may lead to corrosion of structural steel members, corrosion of rebars and disintegration of the concrete surface. For concrete pier caps, look for signs of deterioration (spalling, mapseaking, efflorescence, and presence of de-icing salts). Also, check for stress cracks or cracks caused by movement of the superstructure. For steel, check for loss of section due to rusting. For masonry, look for loose stone, loss of mortar in joints, and breakup of stone. The condition of the top of pier cap or beam may indicate the condition of the deck joint above if it was designed as water-tight.

Rating Examples

7 – New or like new condition. No debris.
5 – Some deterioration of the top of the pier cap and/or presence of a minor amount of debris.
3 – The top of pier cap is heavily deteriorated and/or has a large amount of wet debris.
1 – The top of pier cap is extensively deteriorated and possibly also covered with a large amount of wet debris.
Piers

Figure 4D.4.1
Rate 7

Figure 4D.4.1 shows a like-new condition free from debris. Rate top of cap 7.

Figure 4D.4.2
Rate 5

Figure 4D.4.2 shows the top of a pier cap with a minor accumulation of blasting sand. Rate top of cap 5.
Figure 4D.4.3 shows the top of a pier cap that is spalled with a large amount of debris. Rate this top of pier cap 3.

Figure 4D.4.4 shows the top of a pier cap with considerable scaling and spalling. This top of pier cap is rated 1.
STEM SOLID PIER

This is either the stem of a solid pier, or crashwall of a frame pier that resists forces from the superstructure and transfers those forces to the foundation.

What To Rate

Rate the condition of the pier stem, the crash wall below the column of a frame or column pier, the vertical portion of the piers of multi-span arches, and the wall between cells of multi-cell box culverts. Include the condition of the top horizontal surface for crash walls.

Typical Stems

For typical types see figures 4D.5.1 and 4D.5.2.

TYPICAL PIER STEMS

Figure 4D.5.1
What To Look For

Look for typical signs of concrete deterioration: mapcracking, leaching, spalling, cracks, and hollow or dead-sounding concrete. For masonry stems, look for loose or missing stones and deteriorating mortar joints. Look for impact and fire damage. For timber piers look for splitting, crushing, decay, insect damage and fire damage. Examine all stems for lack of stability indicated by tilting or lateral or vertical movement. Defects and working cracks should be documented in terms of length, width, and location to monitor the progress of these conditions. When rating a solid-stem pier, it is important to check for proper vertical alignment and its ability to support superstructure loads.
Rating Examples

7 – Use for a stem in a new or like-new condition.

5 – Indicates minor deterioration, such as mapcracking with efflorescence covering up to about 25% of the stem surface, but hammer-sounding would reveal little or no evidence of hollowness. Some spalling may be occurring, but would not cover more than about 10% of the stem nor would it encroach on the top of pier cap or pedestals. The stem would show little or no signs of movement.

3 – Deterioration would be extensive and characterized by widespread mapcracking, efflorescence, spalling and/or scaling. There may be structural cracks that are active. If there is evidence of significant movement whether or not the stem is deteriorated, a 3 rating would be used to reflect the stem’s reduced ability to properly support the superstructure. If the condition is stable, it may be appropriate to upgrade the rating to 4.

1 – Deterioration or movement is so severe that failure has occurred or is imminent.

Figure 4D.5.3
Rate 7

Figure 4D.5.3 shows a crashwall in near-new condition. Stem solid pier should be rated 7.
Figure 4D.5.4
Rate 5

Figure 4D.5.4 shows a solid pier with only minor scaling and efflorescence. The concrete sounds solid when struck with a hammer. Rate this stem 5.

Figure 4D.5.5
Rate 3

Figure 4D.5.5 shows a pier stem with extensive spalling, mapcracking, efflorescence and delaminations. The location of the deterioration with respect to the bearing area is a consideration in rating the stem. This stem is rated 3.
Figure 4D.5.6 shows widespread spalling, exposed rebar, efflorescence and concrete delamination. The concrete in the stem is almost totally deteriorated. The stem is rated 1.
CAP BEAM

This is generally the uppermost portion of a pier bent. The cap beam transfers concentrated loads from the superstructure to pier columns or stem. Sometimes it also helps hold pier columns in proper position relative to each other.

What To Rate
Rate structural integrity of the cap beam or the strut between columns. Include the condition of the top surface for struts.

Typical Cap beams
For typical cap beams see figure 4D.6.1 and 4D.6.2.
What To Look For

Concrete: Most concrete cap beams have considerable reinforcement in the top face, bottom face, or both. Since this steel has only minimal cover, it is susceptible to corrosion damage from water, salt, and debris falling through deck joints. Early stages of corrosion damage are cracking and delamination, with spalling in the final stage. Check for rebar corrosion, loss of bond, and characteristics of fire damage such as discoloration, heavy concrete granulation and chalking. Strike concrete cap beams with a hammer to find areas of delamination or unsound concrete. The concrete must also be checked for map cracks, stress cracks, and efflorescence.
Steel: Steel cap beams must be checked for section loss, buckling, distortion, and connections. Refer to Appendix G for more detailed discussion on the inspection of fracture critical and non-redundant bridge components. For steel box girders, check for accumulation of debris or water. Any significant accumulation should be noted in the report.

Timber: Check timber cap beams for splitting, crushing, decay and insect damage. Connections are likely locations for deterioration such as splitting or rotted. They should also be checked for tightness and hardware condition.

Rating Examples

When rating cap beam condition, consider structural action of the member, as well as the extent of deterioration compared to the cap beam dimensions.

7 – New or near-new condition.

5 – For concrete cap beams, haircracking and efflorescence may be evident on the faces and bottom of the cap, but not exceeding about 25% of the cap, and hammer sounding indicates little or no delamination. For steel, corrosion may be present, but if so, section loss in high stress areas is minor. A timber cap beam may show some checking and minor splitting with some discoloration, but hammer tapping and checking with an awl show little or no hollowness or decay.

3 – Deterioration of concrete would be significant and characterized by wide-spread haircracking, efflorescence, spalling and/or scaling. Corroding rebars may be delaminating the bottom cover. There may also be active structural cracks. Steel cap beams would have significant section loss in high stress areas and may have cracks or local buckling. Timber caps would have hollow areas and awl penetration would show significant decay. There may also be heavy checking or splitting.

1 – Deterioration or impact damage is so severe that structural integrity is in doubt. Failure may have occurred or may be imminent.
Figure 4D.6.3 shows a cap beam with no indications of deterioration. Rate this cap beam 7.

Figure 4D.6.4 shows a cap beam with a few small areas of efflorescence and map cracking, but the entire cap sounds solid when struck with a hammer. Rate this cap beam 5.
Figure 4D.6.5
Rate 4

Figure 4D.6.5 shows a cap beam with a moderate amount of staining, spalling, mapcracking and efflorescence. There are several, but not widespread hollow areas indicating the start of spalling. Rate this cap beam 4.

Figure 4D.6.6
Rate 2

Figure 4D.6.6 shows a cap beam with extensive spalling and mapcracking. The timber shoring is a temporary repair that is not considered in rating the pier cap. Rate 2.
Figure 4D.6.7
Rate 1

Figure 4D.6.7 shows a steel pier cap with extreme section loss in the web, approaching 100%. The timber shoring and the steel beam at the left under the floorbeam are temporary repairs that are not considered in the rating of the pier cap. This cap beam is rated 1.
PIER COLUMNS

These are the vertical members resisting bending and compression forces and transferring them to the foundation.

What To Rate

The rating should reflect the condition of the worst column in the pier and comments should include condition of all columns. For steel or timber pile bents, consider the bracing condition in determining the column rating. At a double column pier, consider the pier column for both spans in column rating for the pier (see fig. 4D.7.2).

Typical Types

See figure 4D.7.1 and 4D.7.2 for typical types of pier columns.
What To Look For

General: All pier columns should be examined for tilting, settlement, overstress due to load, or impact damage. Check for deterioration, especially near the waterline, at the ground line, and where the columns are exposed to roadway drainage, either from leaking deck joints or from vehicle splash. For brick-faced or shotcreted piers, look beyond the facing for evidence of leakage or cracks. For pier columns with guidernal protection, document the railing condition and effectiveness. However, do not reflect the condition of the rail protection in the column rating.
Concrete: Look for map cracking, efflorescence, cracks and spalling. Check especially for vertical cracks caused by frozen bearings or compression failure. All concrete should be sounded with a hammer to check for delaminations or soft concrete. Check also for bonding loss and rebar section loss.

Steel: Look for section loss of members and connections due to rust, including hanger plates and cross bracing. Also check for local and column buckling, and cracks. In particular check the column base. If present, include the condition of column base plate anchor bolts.

Timber: Check for splitting, crushing, decay and insect damage. Connection hardware and connection areas are frequent problems. Look for evidence of fire damage.

Rating Examples

In determining the numerical condition of a column, consider the degree and extent of deterioration as compared with the column dimensions. Judge the condition as compared to what the column was like when new:

7 - New or near-new condition.

5 - For concrete columns, map cracking and efflorescence may be evident, but not exceeding about 25% of the column surface and hammer sounding indicates little or no delamination. For steel, corrosion may be present, but section loss in high stress areas is minor. A timber column may show some checking and minor splitting with some discoloration, but hammer tapping and checking with an awl show little or no hollowness or decay.

3 - Deterioration of concrete would be significant and characterized by widespread map cracking, efflorescence, spalling and/or scaling. Corroding rebars may be delaminating the rebar cover. There may also be active structural cracks. Steel columns would have significant section loss in high stress areas and may have cracks, local buckling or web crippling. Timber columns would have hollow areas and awl penetration would show significant decay. There may also be heavy checking or splitting.

1 - Deterioration or impact damage is so severe that structural integrity is in doubt. Failure may have occurred or may be imminent.
Figure 4D.7.3
Rate 7

Figure 4D.7.3 shows two adjacent steel columns with no signs of deterioration at all. Rate these columns 7. Note that the columns support separate spans, but are rated together. The rating is for the span that is before the pier, looking in the direction of orientation.

Figure 4D.7.4
Rate 5

Figure 4D.7.4 shows a two-column pier with a strut (pier cap). The column in the foreground has some mapcracking and efflorescence mainly in the pedestal area. The column below the pedestal has very little staining, cracking and efflorescence. This column illustrates a 5 rating.
Figure 4D.7.5
Rate 3

Figure 4D.7.5 shows major deterioration of the concrete column. Spalls, exposed rebars, efflorescence delaminations and mapcracking are evident in the upper half of the left column. The right column is in excellent condition. The worst column governs the column rating. Rate columns 3.

Figure 4D.7.6
Rate 1

Figure 4D.7.6 shows a column that has been destroyed. The steel columns are temporary supports that are not considered in rating the column. Rate this column 1.
FOOTINGS

These are designed to transmit substructure loads to the subgrade material or piles, and to maintain the substructure at a particular alignment and grade.

What To Rate

Rate the condition of the pier footing and its ability to function properly. Also include any foundation material deficiencies that may be causing distress to the pier or superstructure.

Typical Footings

Footings are either continuous or individual. The individual footings could be spread or on piles. When a pier stem or column is poured directly on rock, the area where the stem or column meets the rock is rated as a footing.

What To Look For

Footings are usually visible only after erosion or scour has removed significant embankment material. When exposed, check for signs of deterioration, such as cracking, leaching, spalling, and hollow-sounding concrete. Also check for signs of distress in the form of large cracks or splits, and document them for future reference. At locations where the footing is not visible, check for evidence of settlement or other movement; for example, if areas over footings are paved, these should be inspected for cracks following the periphery of the footing. Presence of such cracks may suggest that the spread footing had settled or rotated. For unpaved areas, lines in the soil could suggest the same.

Vertical movement can occur as uniform or differential settlement. Uniform settlement of all bridge substructure units has little effect on the structure. Differential settlement, however, is the more common form, and may produce serious distress. The most common causes of vertical movement are soil bearing failure, soil consolidation, scour, or deterioration of footing material. A hand level or plumpline can be used to check for differential settlement.

Rating Examples

9 – This is the most frequently used rating. This code ("Unknown") is used when the footing is covered, with no signs of movement or settlement.

7 – Use when the footing is visible, functioning properly, and in a like new condition.

5 – Indicates minor deterioration, such as minor cracking or spalling.

3 – Indicates more significant movement of a substructure. A footing significantly deteriorated by cracking or heavy spalling is also rated 3.

1 – Indicates a failed substructure or a footing that has cracked or spalled to such an extent that it can no longer transfer load from substructure to subgrade material or piles.
EROSION OR SCOUR

What To Rate

Two separate conditions are examined, depending on whether the pier is located in water.

For those remote from bodies of water (and, thus not exposed to stream scour), this item is used to evaluate the erosion of the embankment material (and covering) next to or under the pier footing. Erosion is the wearing away of soil by flowing water. As used here, soil includes embankment covering as well as the embankment material. Flowing water here refers to runoff from the bridge superstructure or approach roadway rather than the stream.

For piers at the water's edge or founded in water (vulnerable to scour), this item is used to evaluate the extent of scour of the foundation material above, around and under the footings. Scour is erosion of a riverbed area caused by stream flow. Scour must be documented in accord with Chapter 4, Section B. See also the description of underwater inspection in Appendix C.

For more information about scour caused by streams, see the introduction to Chapter 4, Section A.

What To Look For

Erosion: Disturbance or loss of embankment covering material and the embankment material above, around, and below the footing. An uneven surface on block paving may indicate loss of embankment material below. Other signs include soil marks at the face of pier stems or columns or other irregularities in the embankment surface. Comparison of existing conditions against earlier photographs quickly indicates material loss or movement.

Scour: Loss of material from a streambed in the immediate vicinity of a pier resulting from stream flow. Included in the rating for this item is the loss of material above, around, and under the footing. The three types of scour that affect bridge substructures are general scour, contraction scour, and local scour. All three types of scour can seriously affect the performance of a pier. For additional information, refer to the introduction to Stream Channel, Chapter 4, Section A.

Careful comparison of information acquired over the course of several bridge inspections at the piers is one of the best ways to determine how much scour has occurred. Determining the maximum extent of scour is difficult because it occurs during a flood and its true extent may be masked by sediment that refills the hole when flood waters recede. The inspector should use a rod where possible to probe loose sediments deposited along the bridge substructures. If the sediment is finer than the typical bed material, or if it is easily penetrated by the rod, this means that the present sediment has accumulated in the scour hole, and local scour is more severe than indicated by channel profile readings along the substructures. Details of required scour documentation are given in Chapter 4, Section B.

4D.45
Piers

Rating Examples

7 - Dropline or rod readings show no scour, or for piers remote from water, the embankment and its coverings are in "like-new" condition.

5 - Minor erosion or scour has occurred, such as displacement or loss of much of the block paving, or loss of embankment or streambed material where the top of the footing is partly exposed.

3 - Serious erosion or scour has occurred. This would include loss of embankment material including covering such as block paving or streambed material, to the extent that a substantial length of footing is undermined, but piles are present.

1 - Erosion or scour has progressed to the point where pier failure has occurred or is imminent. This may include extensive undermining of a footing without piles, where the presence of piles is unknown, or with piles of questionable condition, even if the pier has not yet failed.

Note: The presence and expected condition of piles are important factors to consider in rating erosion and scour. Particularly for older bridges, the indication of piles on "as built" plans should be the only acceptable evidence, other than direct observation, that piles exist.

Figure 4D.8.1
Rate 7

Figure 4D.8.1 shows several pile bents with heavy stone fill around the columns. The stone adjoining the columns is excellent condition. Rate scour 7.
Figure 4D.8.2
Rate 5
Figure 4D.8.2 shows minor erosion at the base of a column. Most of the paving bricks have been removed, but the underlying embankment material is largely undisturbed. Erosion should be rated 5.

Figure 4D.8.3
Rate 2
Figure 4D.8.3 shows pier scour that has exposed the end of the footing founded on rock. Rate scour 2.
Figure 4D.8.4
Rate 1

Figure 4D.8.4 shows a pier that has been scoured to below the bottom of footing. The footing has no piles and is not founded on rock. Rate scour 1.
PILES

These are generally used to transfer loads from the bridge substructure and footing to the underlying soil or rock. For pile bents, the piles are the portions below existing ground or mudline.

What To Rate

Footings on piles: Rate the condition of the piles when visible.

Pile Rend: Rate piles based on observed condition at existing ground or mudline if a deficiency is observed. Otherwise, rate 9 – Unknown.

What To Look For

Piles are generally not visible, but if they can be seen, this usually indicates a serious structural defect that must be investigated. For deterioration related only to the piles, look for the following:

Steel: Look for loss of section due to corrosion, buckling, web crippling, and for improper placement and/or alignment.

Concrete: Look for concrete deterioration, such as cracking, splitting, spalling, or efflorescence.

Wood: Wood piles, like the other types, are generally not visible, but if exposed (particularly above water) are highly susceptible to rot and insect attack. Use a hammer, awl, or knife to check for rot.

If the piles are not visible, the inspector can stand on the ground above a pile-supported footing and if strong vibrations occur when traffic passes above, this suggests that soil around the piles' upper portion has lost some fines and the piles now act as columns instead of piles.

Rating Examples

9 – Unknown. This is a frequently used rating. Use if the inspector knows that piles exist, but are not visible, or if the inspector is not sure if piles exist.

8 – Not Applicable. Use this rating when the inspector is certain that piles do not exist.

7 – Use when piles are visible and are in like-new condition.

5 – Minor deterioration, but piles are functioning as designed. Use for steel piles with heavy rust but little section loss, or for concrete piles with minor spalling or cracking but basically solid.

3 – Serious deterioration; may involve significant loss of section in a steel pile, splitting or spalling in a concrete pile, or rotting of a timber pile.

1 – Extreme condition, one or more piles either critically deteriorated or completely failed.
Figure 4D.9.1
Rate Piles 4
Rate Columns 4

Figure 4D.9.1 shows a column pile of a pile bent. A moderate amount of section loss has occurred at the bottom of the column. This can be assumed to represent the pile condition. Rate piles 4. The same rating would be used for pier columns.
PIER RECOMMENDATION

What To Rate
This is a one number rating used to describe the pier's overall condition and functional capability on an individual span basis. This recommendation will normally reflect the scoring of the individual elements but it does not necessarily have to be the lowest of these ratings.

Ratings
The inspector evaluates the entire system comprising "Pier Elements" by using the rating number that best describes his opinion of the system's condition and ability to function.

8 – NOT APPLICABLE
7 – NEW CONDITION
6 – Used to shade between 5 and 7
5 – MINOR DETERIORATION BUT FUNCTIONING AS ORIGINALLY DESIGNED
4 – Used to shade between 3 and 5
3 – SERIOUS DETERIORATION OR NOT FUNCTIONING AS ORIGINALLY DESIGNED
2 – Used to shade between a rate of 1 and 3
1 – TOTALLY DETERIORATED OR IN FAILED CONDITION
CHAPTER 5

APPROACHES

This chapter includes the following rating items:

DRAINAGE
EMBANKMENT
SETTLEMENT
EROSION
PAVEMENT
GUIDE RAILING

The items on each approach are rated separately, but only the lower ratings are entered on the inspection form.

Approach Length Definition

Bridge approach length is the transitional distance from a typical highway section to a bridge. It is not a fixed distance, and each approach inspection item may have its own unique length. These approach lengths will probably vary from bridge to bridge depending on bridge design, location, and the roadway carried. An approach length, for each inspection item, should be based upon its original design function and its influence on the bridge. This chapter gives general guidance on acceptable length of each approach item to be inspected, but the inspector should decide the actual appropriate length at the site.
DRAINAGE

What To Rate
Rate the effectiveness of the approach drainage system in preventing water from running onto the bridge, and in removing water from the bridge if scuppers are not present, and in removing water from the approach surface.

What To Look For
Normally, approaches are drained by crowning the roadway and sloping the shoulders to side ditches, gutters, catch basins, or embankment slopes.

Check for:
- Lack of crown in approach pavement.
- Low areas in pavement that pond water (causing hydroplaning and pavement deterioration).
- Eroded ditches or gutters.
- Gutters filled with debris.
- Clogged catch basin inlet grates.
- Sand and debris deposits in catch basin and plugged outlet pipes.
- Sand buildup along shoulder edge at guardrail posts.
- Water running onto the high end of the bridge from a continuous grade.
- Low areas along shoulders that pond water.
- Areas that concentrate water causing erosion or diverting water onto bridge abutments and wingwalls.
- Lack of drainage structures or gutters to remove collected water or prevent embankment erosion.

Rating Examples
The numerical rating should indicate the condition and effectiveness of the approach drainage system. Consider its effects on vehicular traffic, pavement, embankment, abutments, or the bridge structure.

- **7** – A 7 rating indicates a fully effective drainage system with no deficiencies.
- **5** – A 5 rating indicates a drainage system with minor deficiencies not causing a serious problem. This could include moderate sand and debris buildup along curb lines, gutters, and guardrails and in catch basins and inlet grates.
- **3** – A 3 rating indicates a drainage system with major deficiencies causing serious problems. This could include deterioration of pavement and shoulders, embankment erosion, deterioration of bridge abutment items and bridge structure items.
- **1** – A 1 rating would indicate a drainage system that would allow ponding of water on the approach pavement and possible contribution to ponding on the bridge deck. The approach drainage system may also be causing severe erosion of the embankment and possibly causing severe deterioration to the abutment and/or bridge superstructure.
Approach Length Guidelines For Drainage

Items to consider:

- Length of curb from abutment to end of curb at the embankment slope gutter.
- Length from abutment to drainage structure inlet.
- Length of approach slab plus pavement relief joint.
- Length of approach railing.
- In the absence of curbs, approach slabs, or drainage structures, the inspector determines a suitable approach length.

Figure 5.1.1
Rate 4 or 5

Figure 5.1.1 shows a localized low area ponding water next to the backwall with a disintegrated paved shoulder. Depending on severity of ponding and leakage onto the abutment, the drainage rating could be 4 or 5.
Approaches

Figure 5.1.2
Rate 4

Figure 5.1.2 shows sand buildup along the approach curb allowing water to pond on the bridge deck shoulder. Rate drainage 4.

Figure 5.1.3
Rate 4

Figure 5.1.3 shows shoulder settlement adjoining the approach slab and abutment backwall. This low area allows water to pond. Rate drainage 4.
Figure 5.1.4 shows a low shoulder area adjoining the approach slab and ponding water without a catch basin in this area. Rate drainage 3.

Figure 5.1.5 shows a bridge on a 7 percent grade without drainage structures on the high or low ends of the bridge. Water flows along the entire bridge span length. Gully erosion takes place on the shoulders at the low end of the bridge. Rate both drainage and erosion 3.
EMBANKMENT

What To Rate
Rate the approach embankment for settlement and/or sloughing of the side slopes. Do not include settlement of approach pavement or subgrade.

What To Look For
Stability of the embankment is the main consideration. Settlement results in a convex appearance of the side slope and abrupt changes in side slopes suggest failures. Check for soil cracks perpendicular to the slope indicating imminent failure. Guiderail posts out of plumb and leaning outward down the slope may indicate embankment settlement or slope failure. Vertical displacement of guiderail and posts may also indicate similar slope deficiencies. Investigate further.

Settlement and failure of an approach embankment is shown in Figure 5.2.1.
Rating Examples

7 – No signs of distress.

5 – Some settlement may be occurring or the presence of a few soil cracks perpendicular to the slope may indicate minor shifting of embankment.

3 – Sloughing indicating soil shear failure, but not in close proximity to the roadway.

1 – Severe sloughing that is causing significant loss of embankment support for the roadway.

A rating of 8 will very rarely occur. Even for a roadway in an earth or rock cut, there will be some depth of embankment fill (refer to Standard Sheet 203-2R1).

A 9 rating should be used only when the embankment cannot be visually or physically inspected as when extremely heavy or dense embankment vegetation prevents the inspector from determining its condition. A 9 rating requires a comment in the inspection report.

Approach Length Guidelines For Embankment

Use length from bridge abutment to a location of 15 to 25 m beyond the end of the wingwalls.

Figure 5.2.2

Figure 5.2.2 shows a gulderail post leaning downslope and longitudinal cracks in paved shoulder resulting from embankment settlement. Rate embankment 5.
Figure 5.2.3
Rate 3

Figure 5.2.3 shows localized embankment failure with apparent sloughing due to excessive wetness of soil. Rate embankment J.
SETTLEMENT

What To Rate
Rate any settlement of the approach pavement subgrade and the smoothness of transition between the approach roadway and bridge. The rating should include settlement of both pavement and shoulders. Pavement heave that results in the approach pavement higher than the bridge deck should be rated as settlement.

What To Look For
Check riding quality of the transition by driving over the bridge. A smooth transition will minimize impact and vibration forces that contribute to deck and wearing surface deterioration. Look for cracking and breaking of concrete approach slabs that might be due to settlement of the subgrade. Asphalt patches used to ramp a difference in elevation between the approach and bridge should be rated as to their ability to reduce the impact caused by difference in elevation. Observe vehicles entering and exiting the bridge for any excessive vertical movement or bounce. Observe the approach pavement markings, which may highlight a dip or settlement. A straight edge laid across the bridge abutment longitudinally over the approach pavement is useful in observing settlement. Observe shoulder settlement below the approach pavement and bridge abutment backwall header.

Rating Examples
The numerical rating should reflect smoothness of the transition between approach pavement and bridge deck wearing surface. The emphasis is placed on vehicular impact to the bridge structure and safety of the vehicular traffic. If an asphalt ramp is used to correct a settlement problem, its rating should reflect its effect on smoothness of transition.

7 – A 7 rating indicates a smooth transition with no difference in elevation between approach pavement and deck and no pavement cracking.
5 – A 5 rating indicates a minor difference in elevation just noticeable when driving over.
3 – A 3 rating indicates a difference in elevation producing significant impact on the bridge. Approach slabs may not always be cracked in this situation due to subgrade settlement. The vehicles bounce noticeably.
1 – A 1 rating indicates a major difference in elevation causing severe impact on the bridge and creating a major obstacle to vehicular traffic.

Approach Length Guidelines For Settlement
1) Length of approach slab plus pavement relief joint.
2) If no approach slab is present or visible, use 15 m.
Figure 5.3.1
Rate 7

Figure 5.3.1 shows a newly constructed bridge and approaches; all approach items are rated 7.

Figure 5.3.2
Rate 5

Figure 5.3.2 shows an asphalt shim patch in a previously settled area, improving riding quality and reducing impact forces on the structure. A very slight bounce is noticeable. Rate settlement 5.
Figure 5.3.3
Rate 4

Figure 5.3.3 shows a dip in the approach along the wheel path nearest the pavement edge, producing a noticeable bounce as the vehicle enters the bridge. Rate settlement 4.

Figure 5.3.4
Rate 2

Figure 5.3.4 shows settlement at the far end of the concrete approach slab. This low end is about 130 mm below the deck elevation. The slab acts as a ramp, producing a bumpy ride with large impact forces on the structure. Rate settlement 2.
EROSION
(Approaches)

What To Rate
Rate erosion of embankment material from behind abutment wingwalls and along the top of slope near the bridge. Hatched areas in Figure 5.4.1 should be rated under this item.

![Diagram of U-Walls and Splayed Walls]

What To Look For
Look for gullies forming behind the wingwalls and along the top of the embankment slope. The closer gullies and other material loss are to the roadway, the more critical they are. Look for original dirt lines on the back of wingwalls indicating loss of material. Erosion from the front of abutments and wingwalls is rated under abutment and wingwall items and not rated under this item.

Investigate sod and paved gutters along embankment slopes, which may erode severely, especially in gravel soils.
Rating Examples

7 – No loss of embankment material.

5 – Gallies or small voids occurring away from the roadway.

3 – Large voids or gullies close to the roadway.

1 – Large loss of material encroaching significantly upon the roadway.

Approach Length Guidelines for Erosion

For U-Walls and Splayed Walls, approach length would extend 15 to 25 m beyond the ends of wingwalls.

Figure 5.4.2
Rate 4

Figure 5.4.2 shows slope erosion up to the edge of the paved shoulder. Loss of embankment has exposed part of the guardrail post anchor plate. Rate approach erosion 4.
Approaches

Figure 5.4.3
Rate 4

Figure 5.4.3 shows erosion along curb line displacing the end section of a granite curb. Slope gully erosion exposed an electrical conduit. Rate approach erosion 4.

Figure 5.4.4
Rate 2

Figure 5.4.4 shows serious embankment erosion behind and beyond the end of the wingwall. Erosion extends to within 0.7 m of the guardrail post; asphalt concrete shoulder is missing. Rate approach erosion 2.
PAVEMENT
(Approaches)

What To Rate
Rate the approach pavement and the joint between the abutment header and approach pavement (pavement joint), if applicable. If applicable, also include transverse pavement relief joint between the concrete approach slab and concrete highway pavement.

Figure 5.5.1 shows a joint rated under this item. It is a cross section of an abutment backwall.
What To Look For

Check for:

- Pavement riding quality – smoothness or roughness.
- Cracking, delamination, and spalling of concrete pavement.
- Cracking, rutting, potholes, and general disintegration of bituminous pavement.
- Wearing surface worn smooth, exposed polished aggregate can be slippery when wet in both concrete and bituminous pavement.
- Pavement joint water leakage as indicated by dampness and wetness of the abutment backwall.
- Deterioration of joint sealer or filler and joint riding quality.
- Loose pavement armor angles, if applicable. Broken anchors can be detected by tapping an angle with an inspection hammer.
- Deterioration of pavement relief joint, cracking, rutting, potholes, and uplift due to pavement shove.
- Washboarding, rutting, potholes, and loss of crown of gravel roadway.
- Cracking and loss of individual bricks or cobblestones of brick roadway.
- Wearing of pavement grooving in wheel tracks may trap water and can lead to hydroplaning.
- Loss or wearing away of gravel roadway near bridge deck resulting in pavement dip and/or exposed vertical edge of deck.

Rating Examples

Consider the effect of material condition, riding quality, and safety.

Concrete Approach Pavement

7 – Indicates no cracks, delaminations, or spalls with only minor surface wear.

5 – Indicates beginning of a spalling problem with no more than two or three isolated, moderate spalls or delaminations. Pavement with only scattered tight cracks and moderate surface wear with good riding quality would also be rated 5.

3 – Indicates a more serious spalling and delamination problem with about 25 percent of one lane affected and poor riding quality. Pavement with no cracks or spalls but with a well-worn wearing surface of polished aggregate could also be rated 3.

1 – Indicates a spalling and delamination problem with about 50 percent or more of one lane affected. The ride would be extremely rough.
Bituminous Approach Pavement

7 – Indicates no cracks or rutting with only minor surface wear.

5 – A few minor tight longitudinal and/or transverse cracks with moderate surface wear and good riding quality.

3 – Some or all of the following: heavy alligator cracking, longitudinal pavement joint separation, rutting in wheel paths, and serious raveling of the pavement surface. A pavement with poor riding quality would also be rated 3.

1 – A 1 rating would indicate a pavement with extremely poor riding quality.

Gravel Approach Roadway

7 – Indicates a proper blend of well-graded gravel and soil that has proper crown for drainage and has a smooth ride.

5 – A few potholes, some surface wearing, and some grooving in wheel paths but still drains well and has a fairly smooth ride.

3 – Some of the following: many potholes, wash boarding, grooves in wheel paths, exposed vertical edge of deck due to loss of gravel paving, buildup of gravel along shoulders preventing proper drainage and poor drainage due to loss of crown. A pavement with poor riding quality would also be rated 3.

1 – A 1 rating would indicate a pavement with extremely poor riding quality.

Brick or Cobblestone Pavement

7 – Indicates a non-skid, properly crowned surface possibly with minimal surface wear.

5 – Has minor brick cracking and displacement with some loss of grout with moderate surface wear but good riding quality.

3 – Has some or all of the following: General vertical and horizontal displacement with some actual loss of individual bricks. Rutting in wheel paths and polishing of wearing surface. Loss of crown resulting in poor drainage. A pavement with poor riding quality caused by multiple patching would also be rated 1.

1 – A 1 rating would indicate a pavement with extremely poor riding quality.

Approach Length Guidelines For Pavement

1) Length of concrete approach slab plus pavement relief joint.
2) Length of bituminous pavement about 15 m from bridge pavement joint.
Figure 5.5.2
Rate 5

Figure 5.5.2 shows asphalt concrete pavement relief joint with alligator cracking and raveling in the wheel path producing a bumpy ride. The concrete approach slab at right of the relief joint is in excellent condition. Rate approach pavement 5.

Figure 5.5.3
Rate 4

Figure 5.5.3 shows a concrete approach slab with exposed aggregate, a few tight transverse cracks and patched spall area. Rating could vary from 3 to 5 depending upon the amount of aggregate exposed and its smoothness. Rate approach pavement 4.
Figure 5.5.4 shows an asphalt concrete pavement that has heavy alligator cracking with scattered raveling. Cracks are wide. Water ponds in the recessed areas and drains into the roadway subbase. Rate approach pavement 3.

Figure 5.5.5 shows an asphalt concrete approach pavement with heavy alligator cracking and raveling with patched potholes along the lane wheel path. Pavement deterioration allows water to drain into the subbase and causes a rough ride. Rate approach pavement 2.
GUIDE RAILING
(Approaches)

What To Rate
Rate the approach guiderailing and approach median barrier, if applicable. Rate individual posts with no cable or railing, if such a system was part of the original design.

What To Look For
The primary function of any guiderail/barrier is to minimize loss of life. The objectives are: hazard elimination, vehicle retention, and vehicle redirection.

Look for ability of the approach guiderail and/or median barrier to function as originally designed. Do not rate adequacy of the railing type to meet current design standards.

Check for:
- Impact damage to rails and posts.
- Missing bolts at posts and splices.
- Excessive sagging or bending of rails.
- Post bent out of plumb.
- Any loss of post anchorage.
- Continuity and connection of approach guiderail at transition to bridge rail, where applicable.
- Railing terminus anchorage.
- Cables unraveling, loss of tension, continuity, and anchorage.
- Steel member corrosion and section loss.
- Concrete barrier impact damage, alignment, cracking, and salt attack.
- Wood member rot, insect attack, and splitting.
- Aluminum member cracks.
- Tears and ragged edges on metal rail extending outward toward oncoming traffic.
- Correct lapping of corrugated beam rail sections; blunt ends of rails should not be exposed to oncoming vehicles (i.e., lane nearest guiderail).
- Pockets along damaged rail that could capture a vehicle rather than redirecting it.
Rating Examples

8 – For approaches with no guiderailing and no evidence that it ever existed. This is also used when railing has been deliberately removed by the owner of the bridge because the railing was determined to be unnecessary.

7 – No deterioration or misalignment.

5 – Some minor deterioration of the posts and/or rails, but all components still in original position and functioning as originally designed.

3 – Major deterioration, impact damage, serious misalignment, significant looseness in the connections, resulting in weakening the railing well below original design.

1 – Severe impact damage or deterioration resulting in a totally ineffective system. This includes railings that are missing because of impact or deterioration.

Note: Approach railings that have an ineffective height because of multiple approach overlays should be rated 3 or lower.

Approach Length Guidelines For Guide Railing

- For bridge approach guiderail installed solely to protect vehicles from striking the bridge components, consider the entire rail length to be the appropriate approach length.
- For bridge approach guiderail continuous with the highway guiderail, look for an obvious transition to use as the appropriate approach length.
- For bridge approach guiderail continuous with the highway guiderail but without obvious transition, use the approach slab length or a length of about 15 m as the appropriate approach length.
- When different guiderail systems exist at the same approach end, each should be inspected based on these guidelines. It is thus possible to have more than one approach length, per approach, for guiderail.

5.21
Approaches

Figure 5.6.1
Rate 5

Figure 5.6.1 shows one post bent and detached from boxbeams guiderail at splice location. No impact damage to boxbeams rail. Rate guiderailing 5.

Figure 5.6.2
Rate 4

Figure 5.6.2 shows impact damage only to posts, resulting in three weak posts. No impact damage to boxbeam. Rate guiderailing 4.
Approaches

Figure 5.6.3
Rate 3

Figure 5.6.3 shows approach concrete median barrier with heavy spalls along a length of 3 m cue to impact damage. Rate guiderailing 3.

Figure 5.6.4
Rate 3

Figure 5.6.4 shows approach guiderail with horizontal impact damage to the W-beam. Impact resulted in a pocket being formed along the rail between posts. Rate guiderailing 3.
CHAPTER 6
DECK ELEMENTS

This chapter includes the following rating items:

WEARING SURFACE
CURBS
SIDEWALKS & FASCIAS
RAILINGS & PARAPETS
SCUPPERS
GRATINGS
MEDIAN
MONOLITHIC DECK SURFACE

WEARING SURFACE

What To Rate

This is either an overlay or the top surface of the deck that vehicles drive on. The wearing surface must provide an adequate driving surface. Concrete or asphalt wearing surfaces (whether overlays or integral surfaces) must also protect the structural deck and its rebars from the effects of traffic and weather.

Rate the condition of the separate overlay or the top surface of the structural deck. This does not include the approach pavements. Consider riding quality, skid resistance and how watertight the wearing surface is.

Typical Wearing Surfaces

• Concrete wearing surface, including bonded overlay that is integral with concrete structural deck.
• Separate asphalt or concrete overlay wearing surface on concrete structural deck.
• Steel grating, open or filled.
• Timber, integral or separate planking.
• Asphalt concrete wearing surface on orthotropic steel decks or corrugated metal flooring.
• Gravel wearing surface used in fill configurations such as pipes or culverts.
Deck Elements

What To Look For
When evaluating skid resistance, examine the condition of sawcutting or grooving and check for exposure of aggregate, glossy or shiny surface, etc. Look for areas of the wearing surface that pond water. This could be a serious deficiency if the wearing surface is not watertight.

For integral and concrete overlays, check for exposed polished aggregate, loss of grooving, scaling, spalls, cracking, wheel path ruts, and exposed rebars or mesh.

For asphalt concrete overlays, check for exposed polished aggregate, cracking, raveling, wheel path ruts, pot holes, washboard surface, and drying out of asphalt cement. Look for a lack of a good seal against the curb.

For steel grating decks, check for profile misalignment and wear on the tops of the grating bars that reduces skid resistance. For filled steel grating, check for concrete wear or loss between grid bars. This exposes the grid to direct wheel contact that reduces skid resistance. “Cupping” of the concrete between the bars can hold water, further reducing skid resistance. Pack rust can cause some filled grating to warp and bow.

For timber, check for wear, rot, impact damage, insect attack, fire damage, splitting and inadequate fastening. Where separate planking is used, whether full width, or in strips where wheels ride, listen for “slapping” under traffic.

For gravel, check for loss of crown, loss of stone, pot holes, wheel ruts, and washboard surface.

Rating Examples

CONCRETE WEARING SURFACE

7 – Indicates no cracks, delaminations, or spalls with only minor surface wear.

5 – Indicates beginning of a spalling problem with no more than two or three isolated, moderate spalls or delaminations. There may be only scattered tight cracks and moderate surface wear with good riding quality.

3 – Indicates a more serious spalling and delamination problem with about 25 percent of one lane affected and poor riding quality. A wearing surface with no cracks or spalls but with a well worn and polished aggregate could also be rated 3.

1 – Indicates a spalling and delamination problem with about 50 percent or more of one lane affected. The ride would be extremely rough.
ASPHALT WEARING SURFACE

7 – Indicates no cracks or ruts with only minor surface wear.

5 – A few minor tight longitudinal and/or transverse cracks with moderate surface wear and good riding quality. Some minor raveling may be occurring at the curbs.

3 – Some or all of the following: heavy alligator cracking, ruts in wheel paths, potholes, and serious raveling of the wearing surface especially at the curbs. A wearing surface with poor riding quality would also be rated 3.

1 – A 1 rating would indicate a pavement with extremely poor riding quality.

STEEL GRATING

7 – Indicates good alignment and skid resistance with only minor surface wear.

5 – Moderate surface wear but riding quality is still good.

3 – Some or all of the following: serrations worn smooth resulting in a slippery surface, heavily cupped concrete (for concrete filled grating), and vertical misalignment between grating sections.

1 – A 1 rating would indicate significant dips, depressions or other vertical misalignments resulting in an extremely poor riding quality.

TIMBER

7 – Indicates no cracks, splits or checks with only minor surface wear.

5 – Some wood deterioration, moderate surface wear but riding quality is still good. All hardware and connections are still intact.

3 – Some or all of the following: loose or missing planks, heavily worn surface, considerable wood deterioration. There may be loud noises with passing vehicles.

1 – A 1 rating would indicate extensive timber deterioration, many loose or missing planks and/or connections, loud noises with passing traffic, with an extremely rough riding surface.
GRAVEL

7 – Indicates a proper blend of well-graded gravel and soil that has proper crown for drainage and has a smooth ride.

5 – A few potholes, some surface wearing, and some grooving in wheel paths but still drains well and has a fairly smooth ride.

3 – Some of the following: many potholes, wash boarding, grooves in wheel paths, less of crown. A wearing surface with poor riding quality would also be rated a 3.

1 – A 1 rating would indicate extremely poor riding quality.

Figure 6.1.1
Rate 7

Figure 6.1.1 shows a new concrete wearing surface with sawcut grooves. Rate 7.
Figure 6.1.2
Rate 5

Figure 6.1.2 shows a wooden wearing surface with some minor wear. It is somewhat uneven. Rate this wearing surface 5.

Figure 6.1.3
Rate 3

Figure 6.1.3 shows a worn, cracked and raveled asphalt wearing surface. The flush concrete is included in the rating also. Rate the wearing surface 3.
Figure 6.1.4
Rate 3
Figure 6.1.4 shows a wearing surface that is cracked, patched and potholed. The riding quality is poor and the wearing surface is not watertight. Rate 3.

Figure 6.1.5
Rate 3
Figure 6.1.5 shows a wearing surface that is heavily raveled along the edge of travel lane. The shoulder area is heavily deteriorated and covered with debris thus trapping moisture. Rate the wearing surface 3.
Figure 6.1.6
Rate 1

Figure 6.1.6 shows a completely disintegrated wearing surface with loose material, potholes, rough ride and puddles that could freeze. This wearing surface is rated 1.
CURBS

What To Rate
These are raised components on bridge decks that mark the edge of the roadway, redirect errant vehicles, and channel deck surface runoff to removal points. Include curb cutouts that are intended to drain the surface of the deck.

EXCEPTIONS: Curbs on medians are rated with medians. Curbs on bridge approaches are rated with approach drainage. The "curb" area on safety shapes used as bridge railing is rated with parapets.

Typical Curbs
- Cut stones such as granite, backed up by a concrete sidewalk.
- Steel curbs attached to steel sidewalks or structural members that may also be backed up by concrete sidewalk.
- Concrete curbs either precast and set similarly to granite, or integral with a cast-in-place concrete sidewalk or parapet.
- Timber curbs can be single timbers or built-up members, generally attached to the deck. Such curbs do not usually have a backup sidewalk.

What To Look For
Check alignment and end treatments, and be aware that successive deck overlays may reduce the effectiveness of the curb. Blunt ends and misalignments may cause problems for snowplows and errant vehicles. Dirt and debris along the curbside reduce the curb’s visibility and effectiveness, and cause drainage water to extend onto the wearing surface.

If curbs have slots or openings allowing drainage water to pass through, they must be checked.

Cut Stone: Check for loose or broken sections and integrity of the mortar joints or seals at the top, bottom, and between sections.

Steel: For concrete-backed curbs, check the seal at the top between the curb and the sidewalk. Check the welds between individual plates if used, and check the seal at the gutter line. For curbs welded to sidewalks, brackets, or structural steel members, check welds carefully. Cracks in these welds may propagate into structural steel members.

Concrete: Check for spalls, cracks, scaling and exposed rebars. Keep in mind that sharp edges or exposed rebars may be a hazard to oncoming traffic. With precast sections, check as for cut stone. Any steel facing or scrub strips protruding from proper alignment should be considered a serious deficiency.

Timber: Check for splitting, rot, insect attack and anchorage. Sometimes, the curb is mounted on blocks to provide drainage; make sure these openings are clear of debris.

6.8
Rating Examples

7 – Curbs are in new or like-new condition.

5 – Curbline has been reduced by than less than 20% due to debris, has minor scaling, or has some mortar missing in joints.

3 – Curb reveal has been reduced by 50% or less due to debris or wearing surface overlays (becomes mountable), is heavily spalled with exposed rebars, or lacks seal at the wearing surface.

1 – Curb does not redirect traffic and/or channel drainage, is extensively deteriorated, has loose or missing sections, or has rebars or facing strips exposed to vehicle tires. May be level with the pavement (no reveal) and be ineffective.

Rate curbs 8 if there are no curbs present. Sometimes, curbs may be paved over intentionally and should be rated 8, with explanatory comments.

Figure 6.2.1
Rate 7

Figure 6.2.1 shows a newly reconstructed concrete curb and sidewalk. Rate curbs 7.
Figure 6.2.2
Rate 5

Figure 6.2.2 shows a timber curb with drainage cutouts. There are some minor checks and splits, but otherwise, the timber is sound and the connections are good. Rate curbs 5.

Figure 5.2.3
Rate 4

Figure 6.2.3 shows a granite curb with missing mortar and slight misalignment indicating weak curb anchors. Rate this curb 4.
Figure 6.2.4
Rate 4
Figure 6.2.4 shows a curb that is in excellent condition, but the heavy deposit of sand and silt prevents proper drainage along the curb. Rate this curb 4.

Figure 6.2.5
Rate 3
Figure 6.2.5 shows a heavily spalled concrete curb with a minor amount of debris in the gutter line. Rate this curb 3.
SIDEWALKS & FASCIAS

What To Rate
Rate the sidewalk for its ability to provide a safe walking area, and the fascia for ability to support attachments. Inspect sidewalks and fascias on both sides of the bridge, but rate the condition of the element that is in the worst condition. If both sidewalks and fascias are rated 4, provide comments on both. The condition of approach sidewalks is included in the sidewalk rating for the span nearest the approach.

EXCEPTIONS: The condition of the sidewalk support members is included in the rating for primary members. Some structures do not have not able fascias, such as through-girders, trusses, pipes and box culverts. The ends of wooden decks are not rated as fascias.

Typical Sidewalks and Fascias
Most sidewalks and fascias are concrete.

SIDEWALKS:
- Concrete overlay placed on top of the structural deck, generally together with the fascia and curb.
- Structural concrete generally placed outside the deck. Sometimes partly supported by the deck (curb area) and sometimes separate from the deck (through girders and trusses).
- Steel, such as diamond plate or grating, used either as safety walks or full sidewalks.
- Timber
- Asphalt overlay on concrete or timber walks.

FASCIAS:
- Concrete
- Occasional use of steel.

What To Look For
Check fascia concrete for cracks, scaling and spalls. Be aware that on bridges spanning roadways, pedestrian areas, navigable waterways, or railroads, fascias must be checked carefully for signs of material that has fallen or is likely to fall and cause accidents or injuries. Check all attachments such as rail posts, light standards and signs. Look for loose or missing anchor bolts, and for cracks and spalls in concrete that may admit moisture to anchorages systems. Check also for loss of concrete that reduces anchorage effectiveness. Rate only the condition of the concrete and its ability to secure the anchorage system.

Sidewalks should be checked for the quality of the walking surface. Look for deterioration, tripping hazards, accumulation of debris, or ponding water.

6.12
Concrete: Check for cracking, scaling, spalling and misalignment at joints. Consider patches of dissimilar material temporary and note them in the report. Check the underside of structural sidewalks for soundness, dampness, cracking, spalls and efflorescence.

Steel: Check welds and connections. If cracks are detected, make sure they do not propagate into structural steel members. Occasionally, steel plates are used as a fascia with attached posts for the bridge railing. If the posts are welded to the primary members, the welds may require 100% hands-on inspection (see also appendix G).

Timber: Check for splitting, checking, rot, insect attack and anchorages.

Rating Examples

SIDEWALKS

7 – All sidewalks are in new or like-new condition.

5 – Walking surface is intact. The sidewalk may have permanent patches of similar material with perhaps some minor scaling.

3 – Large areas are deteriorated with shallow spalls (approx. less than 15 mm). There may be temporary patches. The underside of structural sidewalks would be heavily cracked, possibly with spalls, dampness and efflorescence.

1 – Surface is unsafe for walking. The material is extensively deteriorated with large areas of spalling and delamination on the underside.

FASCIAS

7 – Both fascias are in new or like-new condition.

5 – Minor cracking and perhaps some spalling at joints, but should sound solid when struck with a hammer. Anchorages are good.

3 – Heavy cracking with efflorescence, large spalls with exposed rebars. Attachment anchorages may be partly exposed.

1 – Inadequate support for rail posts, signs, parapets, etc., and/or danger of concrete falling on roadway or pedestrians.
Figure 6.3.1
Rate 6

Figure 6.3.1 shows a steel fascia with attached rail posts. Check the special emphasis section of the inspection binder for locations of critical details. This fascia is only lightly rusted with no section loss. Rate the fascia 6.

Figure 6.3.2
Rate 5

Figure 6.3.2 shows a concrete fascia with moderate scaling. There are no other signs of concrete deterioration. Rate the fascia 5.
Figure 6.3.3
Rate 3

Figure 6.3.3 shows a severely spalled fascia with exposed rebars. The rail post anchorage is still good. The bridge crosses a stream. Rate this fascia 3.

Figure 6.3.4
Rate 1

Figure 6.3.4 shows a concrete safety walk with loose, spalling concrete over an active roadway. Rate this fascia 1.
Figure 6.3.5
Rate 1

Figure 6.3.5 shows a sidewalk that is very uneven, cracked, spalled with exposed rebars, and partially patched with asphalts. This sidewalk is rated 1.
RAILINGS & PARAPETS

What To Rate
Inspect the railing and/or parapet attached to both sides of the bridge superstructure or deck. Rate the worst side. If there are both railings and parapets, rate the lower of the two elements. If both elements are rated 4 or lower, comment on both. Include the rails, posts and anchorages. Some bridges have separate railings for vehicles and pedestrians. If this is the case, rate the worst of the two types of railing or parapet. Include the condition of fencing if used.

The primary function of any guardrail/barrier is to minimize loss of life. The objectives are: hazard elimination, vehicle retention, and vehicle redirection.

Rate the ability of the bridge railing and/or parapet to function as originally designed. Do not rate adequacy of the railing type to meet current design standards.

LIMITS OF INSPECTION: If there is a transition section between the bridge and approach railing, rate the bridge railing up to this point. For bridge railing carried across the abutment and supported on U-type wingwalls, this transition can occur at the approach, well beyond the abutment backwall. Rate the portion of the bridge rail attached to the U-type wingwall with the bridge railing for the adjoining span.

Typical Railings and Parapets

Metals: Usually steel or aluminum, supported on posts or attached to primary members. Can be fabricated shapes, pipe, W-sections, box-beam, spindles and many other manufactured types. Steel members may be painted, galvanized or bare weathering steel. Cable railings are sometimes used for pipes or culverts with fill.

Concrete: Usually in the form of parapets with or without a metal rail on top, various cast-in-place shapes, and safety shapes (Jersey barriers).

Masonry: Laid up stone or brick. Some masonry walls may actually be a veneer on a concrete core.

Timber: Common on local bridges

What To Look For
Check vertical and horizontal alignment, continuity (if applicable), deterioration, impact damage, rail-to-post support, anchorage systems, and broken or missing rails or posts.

Metals: Check for cracks, broken components, cracked welds and missing or loose bolts. Look for section loss (especially at the bottom of the posts), bent rails, broken hangers, missing nuts and missing or rusted anchor bolts. Consider the condition of paint or galvanizing when rating the railing. For unpainted weathering steel, consider how effective the oxide film is in protecting the steel from further corrosion.
Deck Elements

Concrete: Check for spalling, cracks and anchorage for rails that may be attached on the top or sides. Look for evidence of spalling on the outside of the railing or parapet similar to fascias that may fall onto highway traffic or pedestrians below. For safety shapes, rate the “curb” area with the parapet. Check for tipping. This may indicate poor anchorage.

Masonry: Check for loose or missing stones and failed mortar joints. If supplemented with another rail system, also check anchorages.

Timber: Check for splits, checks, rot, insect damage, and connections.

Rating Examples

7 – New or like-new condition

5 – Minor concrete spalls, mortar loss in stone work, minor section loss or bent members, or a few non-critical fence ties missing.

3 – Concrete spalled with rebars exposed, stones loose or missing, bolts missing, small parts on rails or fence missing, measurable section loss, or impact damage hindering full function of the rail or parapet. Concrete parapets and rails tipped from vertical

1 – Broken or missing sections of rail or parapet so that it is totally ineffective.

Figure 6.4.1

Rate 7

Figure 6.4.1 shows a new bridge rail system. Rate this railing 7.
Figure 6.4.2
Rate 6

Figure 6.4.2 shows a masonry parapet that is in very good condition. There is only a very minor amount of mortar deterioration. This parapet is rated 6.

Figure 6.4.3
Rate 5

Figure 6.4.3 shows a wooden pedestrian railing with a somewhat uneven top surface and some minor splitting of the posts. The hardware is all intact. Rate this railing 5.
Figure 6.4.4
Rate 3

Figure 6.4.4 shows a steel “W” railing with 100% paint failure, some section loss and bolt corrosion. Rate this railing 3.

Figure 6.4.5
Rate 1

Figure 6.4.5 shows impacted railing with a missing rail section and end vertical, and a post sheared from its base. This railing is rated 1.
SCUPPERS

These are openings in the bridge deck for bridge drainage.

What To Rate

Rate the effectiveness in removing water and small debris from the deck, and in directing flow away from bridge components. Include the condition of all discharge piping that may be attached to the scuppers.

EXCEPTIONS: Plumbing systems associated with joint or trough drains at abutments or piers are rated with joints. Some decks with a separate wearing surface have small deck drains with weep pipes resembling scupper pipes. Do not rate these as scuppers, but as part of the deck. Horizontal deck drains (curb cutouts) that outlet at the fascia are rated with curbs.

Typical Scuppers

- Round or square pipe that simply allows drainage to pass through the deck. It may have a bar across the top.
- Cast in the deck with bars or grates in the opening. These scuppers are usually cast or fabricated metal boxes.
- Drop-inlet frame and grate cast in the deck with a pipe outlet box attached

What To Look For

Check to see that all scuppers and grates used as scuppers are securely attached to the deck. Check for openings free of debris and dirt, allowing deck runoff water to flow. Check the seal between the inlet and surrounding deck. Deterioration around the inlet allows runoff water to penetrate the deck concrete. All piping associated with the system must be checked for broken or missing hangers, loose joints, separated connections, and split or missing pipes. Short scupper pipes that do not discharge away from structural members, should be rated low. Also, look at the discharge point for signs of causing erosion at a substructure or the embankment.
Deck Elements

Rating Examples

7 – A new or like-new system.

5 – Some minor restriction at the inlet or minor deficiencies in the plumbing, but the system still functions as designed.

3 – Serious problems such as one totally plugged inlet, a burst or disconnected pipe, discharge point not releasing water, broken concrete or seal at the inlet, broken or missing hanger, or misdirected outlet causing embankment erosion or damage to structural members.

1 – Indicates an extreme level of ineffectiveness. This could be all scuppers plugged, one or more plugged scuppers causing water to pond on the deck, broken gratings or bars exposed to traffic, or broken grating support bars.

If scuppers are intentionally plugged as part of a rehabilitation that provides for other means of deck drainage, rate scuppers 8.

Figure 6.5.1
Rate 7

Figure 6.5.1 shows a new scupper rated 7.
Figure 6.5.2
Rate 3
Figure 6.5.2 shows a broken scupper outlet pipe that allows water to fall on the primary member. Rate scuppers 3.

Figure 6.5.3
Rate 1
Figure 6.5.3 shows all scuppers totally plugged, allowing standing water on the deck. Rate scuppers 1.
GRATINGS

What To Rate
These are large open drainage devices in the deck. They may extend the full length or nearly the full length of the span or may be intermittent. Gratings are designed to support wheel loads. They collect and remove water from the deck and are generally installed in the shoulder area adjoining the curb. Gratings are open on the underside and are supported by steel bridge members. Rate gratings for ability to drain deck runoff, support wheel loads, and ride smoothly.

EXCEPTIONS: Structural members that support the gratings are rated as primary members. Individual gratings used with drop inlets as scuppers are rated as scuppers.

What To Look For
Check that openings and grates are free of debris and dirt and allow deck runoff to enter. Check the seal between the grate frame and the surrounding deck. A poor seal allows water to penetrate the deck concrete. Check for corroded, broken, cracked or missing parts. Check all support connections, and in particular, look for cracks in welds. See also Chapter 7 for additional information and rating guidelines regarding grating decks.

Water and debris discharge onto structural bridge components is not considered in rating gratings because gratings are not designed to protect structural bridge members. Any deterioration to individual bridge components caused by leakage from gratings should be reflected in the ratings for primary and/or secondary members as appropriate.

Rating Examples

7 – New or near-new condition.
5 – Indicated minor deterioration such as two or three broken bearing bars.
3 – Significant section loss or 10 percent or more broken bearing bars.
1 – Indicated extreme deterioration or large number of broken bearing bars possibly exposed to traffic. The grating’s ability to support wheel loads may be in doubt.
Figure 6.6.1
Rate 5

Figure 6.6.1 shows intermittent grates that are moderately rusting, but without any appreciable section loss. The seal between the grate frame and the adjoining deck is good. Rate gratings 5.

Figure 6.6.2
Rate 4

Figure 6.6.2 shows a continuous grate that is heavily rusted with localized section loss. This grating is rated 4.
MEDIAN

What To Rate
Rate ability to separate opposing traffic on multi-lane bridges. Include the condition of curbs and traffic barriers if any.

EXCEPTIONS: Flush medians without a traffic barrier, consisting solely of paint or reflective pavement markings are not rated as medians. Their condition is included in the rating for wearing surface. Lighting, signs or utilities located on medians are rated under their respective rating items.

Typical Medians
- Flush median with a traffic barrier such as guiderail, boxbeam or safety shape.
- Raised median, either mountable or non-mountable. May have a traffic barrier.
- Flush median with stone-chip surface or open grating. No barrier.

What To Look For
If the median is raised concrete, inspect as for concrete sidewalk and curb. Check all rail systems for alignment, impact damage, missing hardware, and post anchorage. For safety shapes, check alignment, misplaced sections due to impact, and concrete deterioration. If present, check the condition of the drainage slots. For all types of medians, check the longitudinal joint, if present, for the quality of seal. Inspect as for transverse joint, but rate with median.

For flush medians with open steel grating, inspect the same as deck drainage gratings.

Deficiencies in median material that affect the support for lighting standards, sign or utility supports should be considered in the rating for medians.

Rate the poorest component of the median. Add a remark in the inspection report indicating which component is being rated.
Figure 6.7.1
Rate 7

Figure 6.7.1 shows a raised concrete median with a mountable curb and box beam railing. All components are in excellent condition thus the median is rated 7.

Figure 6.7.2
Rate 7

Figure 6.7.2 shows a flush median with a box beam railing. The railing is the only component to rate. This median is rated 7.
Figure 6.7.3
Rate 5
Figure 6.7.3 shows a raised concrete median with minor spalling along the edges. The longitudinal joint was not designed to be watertight. Rate this median 5.

Figure 6.7.4
Rate 4
Figure 6.7.4 shows a raised median with a double "W" railing that has been impacted. The rail is bent on one side and the posts are still intact. Rate this median 4.
MONOLITHIC DECK SURFACE

What To Rate

Rate the extent of spalling on monolithic decks only. For all other decks, this item is Not Applicable, Code 8.

What To Look For

The purpose of this item is to monitor the need for rigid overlay repairs due to spalling and delamination of monolithic decks.

Rating Examples

7 - Indicates a monolithic surface in good condition with no spalls or delaminations.

5 - Used to indicate the beginning of a spalling problem. No more than two or three isolated, moderate spalls or delaminations are present.

3 - Indicates a more serious spalling problem, although large areas of the span are still unaffected. This could be one large area affected by spalls, but still less than half the span area, or a larger number of smaller, isolated spalls than indicated for a 5-Rating.

1 - Used where the area affected in any lane approaches half the total area of the lane.

The ratings for wearing surface and monolithic deck surface may or may not be the same. If the wearing surface is downrated for reasons other than spalling, such as rutting or low-skid resistance, the monolithic deck item would still be rated high. A smooth-riding asphalt patch in a spall could be cause for a fair wearing surface rating, but the patch should be ignored for the monolithic deck surface item, which would be rated low. The presence of a monolithic deck is determined from the bridge plans found in the BIN folder. A monolithic deck surface is concrete that is placed in unison with the concrete deck on steel girders or on prestressed concrete sections. Concrete riding surfaces that are placed separately from the deck are NOT rated as monolithic deck surfaces.
Introduction

Figure 6.8.1
Rate 7
Figure 6.8.1 shows a monolithic deck with no spalls or delaminations. This is rated 7.

Figure 6.8.2
Rate 4
Figure 6.8.2 shows a deeply spalled area along with a couple of isolated spalls. This condition would be rated 4.
Figure 6.8.3
Rate 3

Figure 6.8.3 shows several areas of spalling, asphalt patched areas with slight rebar exposure. Monolithic deck surface would be rated 3.

Figure 6.8.4
Rate 1

Figure 6.8.4 shows the majority of the monolithic deck covered with potholes and deeply spalled areas which have been repeatedly patched with asphalt. This condition would be rated 1.
SECTION 7
SUPERSTRUCTURE

This section includes the following rating items:

DECK STRUCTURAL
PRIMARY MEMBERS
SECONDARY MEMBERS
PAINT
JOINTS
RECOMMENDATION
DECK STRUCTURAL

What To Rate
The structural deck is the member or members transmitting loads from the wearing surface to the primary members. Sleepers and crossbeams are also included in the rating for Deck Structural.

EXCEPTIONS: Where all loads are carried directly by the primary members (such as adjacent box girders, slabs, frames, box culverts, filled arches) there is no structural deck and the item should be coded 8. Additionally, integral and separate wearing courses such as concrete overlays with temperature control reinforcement are considered and rated as wearing surfaces. Rate flanges of precast T-beams or tops of precast box beams under the primary member item. For decks without a separate wearing course, rate surface characteristics such as riding quality and skid resistance under the wearing surface item.

Typical Decks

Common types of structural decks are:
- Reinforced concrete with separate wearing surface
- Reinforced concrete with integral wearing surface
- Timber planks, nail-laminated timber, glue-laminated timber, stress-laminated timber
- Open and filled steel grating
- Jack Arch

Other types include:
- Precast concrete planks
- Metal orthotropic deck plates and ribs
- Asphalt filled metal S.I.P forms
- Structural steel plates

Rate the three most common deck types as follows:

REINFORCED CONCRETE

The rating is generally determined by inspecting the bottom of the deck. If the top of the structural deck can be seen (not the top of a separate wearing surface), the assessment will be more accurate. When rating concrete decks, remember that concrete deterioration normally starts at the top of the deck and along its periphery. From these locations, deterioration progresses downward and inward until the entire deck is involved. Thus, when minor deterioration is observed on the bottom of a deck, deterioration is probably much worse within the deck.

What To Look For

Look for signs and extent of leakage through the deck (rust stains on girders, dampness, map-cracking and efflorescence). Look for cracks, spalls, delaminated areas (by sounding), rust stains on S.I.P forms, and check the condition of haunches, if present. Dampness on the deck underside may sometimes be caused by condensation from a cold deck or a stream below. Do not confuse this with leakage through the deck.
Review documentation of any core results (in the BIN folder) and inspect any open core holes.

Where there is a separate wearing surface, water will often accumulate between the wearing surface and deck. Check for increased signs of leakage where the water should drain such as along curblines or near joints at the low end of the span.

The inspection should include both a general view of the deck for the entire span and a close view with sounding where appropriate. The general view will show the extent of deterioration. Areas where heavy leakage and spalling have occurred, or concrete appears saturated, should be sounded with a masonry hammer and findings documented. Temporary removal of planking installed to catch falling concrete may be necessary for access to inspect the deck.

Areas of mapcracking, wetness, efflorescence and spalls should be expressed in percentages of the deck area. For decks rated 4 or lower, sketch the deck underside showing the extent of these deficiencies.

Pay special attention to areas such as haunches or soffits where fragments may fall on vehicle or pedestrian traffic below.
Superstructure

Rating Examples

7 – Deck is new or near new, almost no sign of deterioration.

5 – Only localized areas of leakage (e.g., single longitudinal crack with leakage, or deck edges showing only spotty leakage).

3 – 75 percent or more of the deck has leakage
   Only localized spalled areas
   Efflorescence along the girder top flanges

1 – Heavy spalling
   Heavy efflorescence
   Punch through has occurred or is likely
   Deck saturated to point that concrete is rubble

TIMBER

What To Look For

Look for loose individual planks or boards, dampness, decay, splitting, loss of material through wear, checking (longitudinal cracks due to drying of timber), and separation of glue or nail laminations. Look for wood crushing at bearing locations. A 10 percent loss of material due to rot will reduce section modulus, thus lower the bending capacity by 20 to 30 percent or more.

If a single plank is in poor condition, judge whether adjacent planks will carry the traffic loads safely.

EXCEPTIONS: Many bridges have longitudinal planks running over transverse timber decking. Running planks should not be rated with the deck but are rated as wearing surface.
INSPECTION INTENSITY: A timber deck can generally be inspected from both top and bottom. Visual inspection of the overall deck will give a good indication of the rating. Areas of dampness and random dry areas should be checked for soundness using a hammer, awl, knife, or drill with a small bit.

Rating Examples

7 - Deck is new or near new, almost no sign of deterioration.

5 - Capacity is not affected, but there may be:
   - Less than 5 percent of area with partially deteriorated planks.
   - Minor checking caused by drying timber.
   - A few warped individual planks.

3 - Timber is decayed or otherwise deteriorated in more than 20 percent of area.
   - Broken planks such that capacity may be affected.
   - Delaminations of glue or nail laminated decks.

1 - Deck appears to be unsafe for posted or legal loads.
   - Significant holes in decks.
   - Extensive rotting of deck members.
GRATING DECK

What To Look For

Grating (grids) can break, or become loose, or missing due to wear, section loss, and/or impact loading. Primary bar wear and section loss caused by corrosion often occurs directly over the supporting floor system. Impact loadings by snowplows blades, etc., cause gouges, berds, and tears.

When inspecting welded or riveted open steel grating, look for broken welds especially between bases of primary bars and top flanges of the supporting floor system. Grating with many broken welds can shift under passage of traffic. Listen to the response to traffic loads to determine if the grating is loose. Rivets connecting bars can shear or drop out.

When inspecting filled grating, look for spalling/abrasion of the concrete filler. Look for bar distortion caused by corrosion.

Include the condition of sleepers transversely spanning the primary members with the deck rating. Check extent of section loss on these members. Accumulation of sand and salt on sleeper flanges often accelerates deterioration of these members.

![Diagram of Open Grating Deck](image)

**Figure 7.1.3**
Rating Examples

7 – Deck is new or like-new; no broken welds, loose components, or mechanical wear.

5 – Minor localized mechanical wear, isolated broken welds, no loose components, no grating bar section loss. Sleepers may have minor section loss.

3 – Bars have significant section loss, many broken welds, loose and noisy grating under traffic. There may be a few missing bars. Sleepers may be corroded to the point that ability to carry design loads is questionable.

1 – Large areas of missing bars, permanent loss of profile due to section loss from mechanical wear and/or corrosion.

Figure 7.1.4
Rate 7

Figure 7.1.4 shows the bottom of a concrete deck in like-new condition. Rate the deck 7.
Superstructure

Figure 7.1.5
Rate 5

Figure 7.1.5 shows the underside of a deck with metal stay-in-place forms with isolated leakage and efflorescence. Rate this deck 5.

Figure 7.1.6
Rate 4

Figure 7.1.6 shows a jack arch deck with corrugated forms that are corroded. There is evidence that the deck is leaking. Efflorescence appears along the seams between the form panels and along the bottom flange concrete encasement. Rate this deck 4.
Figure 7.1.7
Rate 3

Figure 7.1.7 shows the underside of a concrete deck mapcracked over the entire area, with leakage along the girder tops and at transverse cracks. Rate this deck 3.

Figure 7.1.8
Rate 3

Figure 7.1.8 shows the underside of a timber deck that is heavily discolored by leakage. The entire deck area is deteriorated, with up to 10 percent awl penetration, but there are no broken or missing planks. Rate this deck 3.
Figure 7.1.9
Rate 3

Figure 7.1.9 shows a grating deck with widespread corrosion and isolated areas of severe section loss. Some main bearing bars have holes. Rate this deck 3.

Figure 7.1.10
Rate 2

Figure 7.1.10 shows a jack arch deck with extensive spalling and leakage. The stay-in-place forms have nearly disintegrated. Rate this deck 2.
Figure 7.1.11
Rate 2

Figure 7.1.11 shows a steel grating deck with main bars parallel with the stringers. There are no transverse sleepers and a permanent 50 mm deformation is evident in the wheel paths. Rate this deck 2.

Figure 7.1.12
Rate 2

Figure 7.1.12 shows a timber deck that is heavily deteriorated with several loose planks. This deck is rated 2.
Figure 7.1.13
Rate 2

Figure 7.1.13 shows the underside of a timber deck severely stained with widespread rot. Awl penetration is 30 percent. Rate this deck 2.

Figure 7.1.14
Rate 1

Figure 7.1.14 shows a concrete deck with large spalls, exposed rebars, cracks with efflorescence and a hole through the deck. This deck is rated 1.
PRIMARY MEMBERS

These are structural members that are designed to resist applied deadload and/or live load forces. They are the main members of the bridge that transmit loads generally from the deck to the bearings. Some components of a bridge do not precisely fit this definition but are nonetheless rated as primary members. They are explained further later in this chapter.

What To Rate

The physical condition and functional capability of the primary members and connections (including fasteners) between primary members. Primary members must be rated as a system on a span-by-span basis. For example, on a girder-floorbeam-stringer span, consider all three components and their connections.

Typical Primary Members

- Reinforced concrete I beams, T beams, slabs
- Prestressed concrete box beams, I beams, slabs, hollow slabs
- Steel multi-girder
- Two & Three Girder (with or without floorbeams and stringers)
- Steel box-beam
- Steel or timber trusses
- Timber slab or stringer
- True arch
- Spandrel arch, open and filled
- Concrete rigid frame
- Diaphragms attached to curved girders
- Grating support members
- Sidewalk support members
- Other bridge types (see figure 7.2.1)
### Superstructure

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<td>Knee Braces</td>
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<td>Truss/Floorbeam connections</td>
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<td>Stringer/Floorbeam connections</td>
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<td>Gusset plates</td>
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**BRIDGE MEMBERS**

Table 7-1
BRIDGE TYPES

FILLED ARCH
(Type - 2)

FILLED ARCH

PARALLEL PIPES

JACK ARCH
(Transverse section)

RIGID FRAME

DOUBLE BOX CULVERT

SPANDREL ARCH

CONCRETE T-BEAM

PRECAST T-BEAM

PRIMARY MEMBERS IN DIFFERENT TYPES OF BRIDGES

Figure 7.2.1
What To Look For

All primary members should be examined for signs of overstressing, fire damage, impact damage, improper profile or alignment, deterioration, or excessive movements with passage of live loads.

Behavior of primary members can best be observed during the passage of heavy live loads. Look for the cause of any unusual sounds or excessive movements with the passage of live loads. If it involves a deficiency in the primary members, it should be considered in the rating.

Rating Examples

7 – The primary member system shows no evidence of deterioration, performing at full-design capacity.

5 – The primary member system exhibits isolated areas of minor types of deterioration/damage without significant effect on the system’s ability to perform at the full original design capacity.

3 – The primary member system has extensive, serious material deterioration or can no longer achieve its full original design capacity. However, the system is still able to react elastically to loadings but perhaps at a reduced capacity.

1 – The primary member system is ineffective in sustaining the original design loadings due to deterioration and/or damage and may not be capable of safely supporting even minimum live loads.

Rating Considerations

The inspection rating is closely tied to the primary member deterioration or damage and also how well the primary member system retains its original design structural capacity.

Base primary member rating on the performance of the primary member system as a whole for the span being rated. An individual primary member may be in poor condition because it has impact damage or is significantly deteriorated. The primary member rating for that span may be higher if the deteriorated member is not critical for the performance of the span as a whole, i.e., the entire span continues to function elastically.

A low rating for primary members is justified where a deficiency for even one component is so critical as to significantly reduce the bridge load capacity.

Downrate primary members only for distress exhibited in the primary member system. Do not downrate if a span's structural effectiveness is reduced by deterioration or failure of another bridge element, such as frozen roller bearings, spalled pedestals, or even failed substructure columns unless the problem directly affects the primary members.
Except in very rare cases, a rating of 9 (unknown) must not be used for primary members. If a metal primary member is partially or completely encased in concrete, it should still be rated other than 9. In these cases, condition of the encasement and any exposed areas will be the basis for the rating, i.e., describe condition of encasements and partially exposed primary members. Lower flange corrosion will result in deterioration of concrete encasements. Request further investigation if serious deterioration appears to affect load capacity.

A legitimate use of 9 for primary members is for a totally enclosed span with no means of access. One example is an end span of a bridge with a solid pier and full-height curtain walls that totally enclose the span. The bridge owner should be notified about the need to provide a means of access. The 9 rating is expected to be a temporary one until access is provided. If access cannot be provided, or poses too great a hazard to inspectors, the 9 ratings will be allowed to stand. Written permission from the Deputy Chief Engineer (Structures) must be obtained for continued use of 9 ratings for primary members.

**REINFORCED CONCRETE MEMBERS**

**What To Rate**

The physical condition and functional capability of the primary members are rated under this item. For filled arches, spandrel walls should be included in the primary member rating even though they do not directly carry live load. Loss of a spandrel wall would result in loss of the fill and failure of the bridge.

**Typical Reinforced Concrete Primary Members**

The following concrete elements are considered Primary Members:

- Rigid frames
- Filled arches Type I (no stems) and Type 2 (with stems)
- Arch ribs, spandrel columns, and spandrel walls
- Cast-in-place slabs
- Precast reinforced concrete slabs
- Cast-in-place through girders
- T-Beams (stem portion if cast-in-place, entire unit if precast)
- Channel Beams

**What To Look For**

Generally, alignment and profile of concrete elements should be examined for damage due to impact, overstressing, or substructure movement. Note any excessive vibrations or movement with passage of live loads. The inspection should determine the cause of any unusual sounds, excessive movement, or vibrations with passage of heavy loads. The inspection should cover the following:

7.17
Superstructure

- Near bearing areas at the ends of slabs, girders, T-beams, channel beams, etc., for spalling and cracked concrete. Any diagonal cracking in spandrel columns or at the ends of beams, girders, etc., is serious.

- Areas near supports for diagonal (shear) cracks occurring on exposed vertical surfaces and projecting diagonally toward the top of the girder, beam, etc.

- Tension areas at midspan of simple spans for flexural cracks extending transversely across the underside of the primary member. Longitudinal flexural cracks in the deck when the primary rebars are transverse. Transverse flexural cracks in tops of beams (slab portions) at or near piers on continuous spans.

- Areas with efflorescence indicating contaminated concrete and with rust stains indicating rebar corrosion. Spalling, delaminations, and popouts commonly associated with deterioration. In severe cases, rebars will be exposed; determine the section loss of any exposed rebars.

- Longitudinal cracks between adjacent channel or T-beams indicating possible broken shear keys, differential detections under passage of live loads, leakage, etc.

- Shear or torsional cracks at open spandrel arch floor systems, bent cap interfaces, or in spandrel bent caps or columns. Cracks in tension areas of spandrel bent caps (i.e., midspan at the bottom and ends at the tops)

- Deterioration of closed spandrel arches and spandrel walls to include cracks, discoloration, spalling, exposed rebars, etc. Differential movement, change of alignment/profile or loss of fill.

- Shear cracks in rigid frame beams (beginning at the frame legs and propagating toward the adjacent span), in the frame legs (beginning at the top and propagating downward), and in the ends of frame beams at end spans.

- Flexural cracks in tension areas of rigid frames at the bottom of the frame beam at midspan, inside faces of frame legs at midheight, the base of each frame leg, and the outside corners of a simple-span slab frame.

- Areas at, near, or under drainage features such as scuppers, weeps, curb lines, etc., for the loss of fill or deterioration of concrete.

- Areas of previous repairs, impact damage, honeycombing, scaling, and any other conditions indicating potential deterioration of concrete or rebars.
Rating Examples

Non-prestressed steel reinforced concrete members are rated based upon both degree of material deterioration and extent to which the member retains its original design structural capacity. Rate for distress exhibited in the member itself, not for problems related to other elements rated separately such as deteriorated pedestals, frozen bearings, or failed substructure columns.

7 – No spalling, scaling, cracking, efflorescence, etc., or other signs of deterioration. The primary members perform at full-design capacity. Original form lines or minor staining from rebar chairs do not affect the rating.

5 – Isolated minor scaling, spalling, delamination, or dampness. Isolated areas of minor cracking such as light mapcracking or hairline tension cracks that do not compromise the primary member’s ability to function as designed.

3 – Extensive scaling, spalling, efflorescence, cracking, or delamination and possible exposed corroded rebars at isolated locations. The primary member system may no longer achieve its full original design capacity, although still reacting elastically to loadings. Extensive leakage with efflorescence and dampness are usual indicators of this condition.

1 – Severe or extensive deterioration rendering the primary member system potentially ineffective, i.e., it has lost almost all capacity to sustain the original design loadings.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition depicted in the photo is the controlling condition in a load path non-redundant system, the rating would be used for the primary member system. Similarly, if the condition in the photo typifies the primaries in a redundant system, that rating would be used for the span being rated.
Figure 7.2.2 shows a precast concrete T-beam bridge in near new condition. Rate primary members 7.

Figure 7.2.3 shows the underside of a concrete T-beam span with some evidence of leakage, but no cracking. The stems and the underside of the slab section sound solid when struck with a hammer. Rate primary members 5.
Figure 7.2.4
Rate 4

Figure 7.2.4 shows the underside of a reinforced concrete slab with evidence of staining and leakage. Rate primary members 4.

Figure 7.2.5
Rate 3

Figure 7.2.5 shows the underside of a slab that has leakage and efflorescence throughout. There is also spalling with exposed and corroded rebars. Rate primary members 3.
Superstructure

Figure 7.2.6
Rate 3

Figure 7.2.6 shows a concrete T-beam span with heavy efflorescence, leakage, mapcracking and areas of delamination detected by hammer sounding the concrete. The primary members in this span are rated 3.

Figure 7.2.7
Rate 2

Figure 7.2.7 shows a severely deteriorated T-beam span with widespread leakage, efflorescence, delaminations and cracks. The spalling at the bottom of the stems is so extensive that rebar bond is seriously reduced. Rate primary members 2.
PRESTRESSED CONCRETE MEMBERS

What To Rate
Physical condition and functional capability of the primary members are rated under this item.

Typical Prestressed Concrete Primary Members
- Box beams
- Voided slabs
- I-beams and T-beams
- Box girders (segmental)

Figure 7.2.8
Superstructure

What To Look For
Examine alignment, profile, and impact damage with all primary members. Inspect and document any cracks in the members. Because prestressed members are under high compressive forces, cracking is significant. Vertical or diagonal tension cracks in prestressed members are signs that the prestressing steel has failed or is failing, and the loads are being carried by adjoining beams. This is a serious condition and steps should be taken to ensure the stability of the bridge as soon as possible.

The two most common causes of losing prestressing forces are impact and corrosion. Generally, deterioration occurring in prestressed concrete members is evident to the inspector, but in some cases, serious but latent corrosion of the prestressing strands may exist without many outward signs of problems. Be sure to check for concrete delamination, hairline cracks, efflorescence or rust stains at the level of the prestressing strands, which can indicate strand corrosion. Longitudinal cracks may be the result of expansion forces caused by prestressing steel corrosion.

At the time of this manual’s writing, the earliest prestressed bridges are approaching the end of their design life. Two prestressed concrete T-beams were removed from a bridge and loaded to failure. One beam was moderately deteriorated and the other was heavily spalled. Both failed before reaching the ultimate design load, and one failed at a load less than deadload plus design live load. Other recent research has suggested that once outward signs of prestressing steel corrosion are visible, deterioration occurs very rapidly. The inspector should pay particular attention to areas where the concrete is spalled. In such cases, the Regional Structures office should try to get information on the condition of the prestressing steel from those who did the repairs. This information, if available, should be included in the BIN folder. Another recently observed problem is cracking at the ends of prestressed concrete box beams. This can be serious enough to warrant complete bridge replacement.

Additional possible problems include:

- Any sagging by individual members could indicate overloading or loss of prestress.
- Horizontal deflections (sweep) may indicate asymmetric loading from either non-uniform prestressing forces or tendon failure.
- Efflorescence, leakage, and staining indicate the likelihood of prestressing steel corrosion and a diminished load carrying capacity.
- Concrete delamination or spalling are more definitive signs of prestressing steel corrosion and diminished capacity.
- Check for tendon damage if any of the beams have been impacted. Cracks spreading from the damaged area indicate extent of prestress loss.
- Longitudinal cracks in the wearing surface may indicate that the shear keys of the primaries have failed or are not working as designed.
- Check drain holes on box beams for rust stains possibly indicating deterioration not visible until it becomes more serious.
Rating Examples

Prestressed concrete primary members are rated on both physical condition and structural capacity as compared to the original design capacity. These are same criteria as reinforced concrete primary members. However, physical deficiencies (cracks, spalls) are usually more serious in prestressed members. The members are rated as a system.

7 – No spalling, scaling, cracking, or efflorescence. No signs of vertical or horizontal misalignment. Members show no physical limitations to perform at full-design capacity.

5 – Isolated scaling. Minor vertical deviations, but little or no leakage between adjoining members and only a few reflective cracks in the wearing surface.

3 – Web shear, flexural shear, and flexural cracks on isolated members indicate loss of strength in those members, and that the other beams are carrying the loads for these members. Leakage between adjoining members, and reflective longitudinal cracks in the wearing surface indicate the members are not functioning as originally designed and could mean loss of prestress or overload condition. Efflorescence, delamination, and moderate spalling may indicate corrosion of tensioning strands or concrete deterioration.

1 – Web shear, flexural shear and flexural cracks on many beams indicate prestressed members are not functioning as originally designed and may have lost much of their original capacity. Horizontal deflections in members, vertical deflections, and/or severe or extensive deterioration (such as excessive deflection, tendon failure or spalling) indicate the system has lost much of its original capacity.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition depicted in the photo is the controlling condition in a load path non-redundant system, the rating would be used for the primary member system. Similarly, if the condition in the photo typifies the primaries in a redundant system, that rating would be used for the span being rated.
Figure 7.2.9
Rate 7

Figure 7.2.9 shows the underside of a prestressed concrete T-beam span in like-new condition. Rate primary members 7.

Figure 7.2.10
Rate 6

Figure 7.2.10 shows prestressed concrete box beams in very good condition with only slight leakage between beams. Rate primary members 6.
Figure 7.2.11
Rate 5

Figure 7.2.11 shows prestressed concrete box beams in very good condition but with moderate leakage between beams. Rate primary members 5.

Figure 7.2.12
Rate 4

Figure 7.2.12 shows impact damage to prestressed concrete T-beam exposing some tendons. Rate primary members 4.
Superstructure

Figure 7.2.13  
Rate 4

Figure 7.2.13 shows the bottom of prestressed concrete slab units with moderate leakage between the slabs. Note staining, efflorescence and minor spalling at the lower edges of the slabs. Strand corrosion is causing some cracking and rust stains. Rate primary members 4.

Figure 7.2.14  
Rate 3

Figure 7.2.14 shows an interior prestressed concrete box beam with severe spalling with exposed and corroded rebars. Rate primary members 3.
Figure 7.2.15 shows extensive spalling along the bottom of an interior prestressed concrete T-beam stem exposing rebar and tensioning strands. The other beams in this span are in much better condition. The spalled beam might itself be rated 2, but the primary member system in this span is rated 3.
STEEL MULTI-GIRDER

What To Rate
Refer to Table 7-1.

Typical Steel Multi-Girder Primary Members
Steel multi-girder bridges are load path redundant structures with four or more of any of the following types of members:
• Rolled beams (including concrete encased)
• Welded plate girders
• Riveted plate girders

What To Look For
Base the primary member rating on the girders' condition and their ability to carry the loads for which they were designed. Since they should be rated as a system, an important consideration is how any material deterioration or reduced capacity in individual structural elements affects performance of the bridge as a whole.
For non-encased steel members, look for corrosion and section loss, cracking of the base metal or welds, buckling, impact damage, signs of overstress, and condition of welds and rivets. Of primary concern should be the following:

- Corrosion and section loss, particularly of webs in high shear areas or flanges in high moment areas.
- Cracks in welds or girders in any tension or stress reversal area, most likely to occur at fatigue-prone locations where stress concentrations are high, at out-of-plane bending locations, impact damage sites, plug welds, or tack welds.
- Distortions in the girders caused by heavy loads, section loss, or impact damage.
- Crevice corrosion causing weld or rivet overstress.

For concrete-encased steel members, base the rating on condition of the concrete and any exposed portion of the girder. Look for signs of leakage through the concrete and for cracking, spalling, efflorescence, and rust staining. Use a masonry hammer to determine if the concrete encasement is delaminated.

See Appendix G for inspection intensity requirements.

**Rating Examples**

- **7** – New or near new condition; no section loss, no distortions.
- **5** – Localized section loss or minor impact damage without cracks in the base metal, localized concrete encasement cracking and staining.
- **4** – Occasional minor cracks in weld metal only, or some small, stable cracks in the base metal of steel primary members in compression, but not widespread.
- **3** – Serious section loss, several cracks in base metal, but not yet critical, serious impact damage with cracks in the base metal, heavy concrete encasement cracking, spalling, and rust staining indicating section loss of the steel members.
- **1** – Critical base metal cracking, severe widespread section loss in high stress areas, severe impact damage to several adjacent members.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition in the photo typifies the primaries in a redundant system, that rating would be used for the span being rated.
Figure 7.2.17
Rate 6

Figure 7.2.17 shows insignificant bottom flange encasement with only superficial staining from the stay-in-place forms. This indicates only very minor girder corrosion. Rate primary members 6.

Figure 7.2.18
Rate 5

Figure 7.2.18 shows multi-stringers with minor corrosion; negligible section loss. Rate primary members 5.
Figure 7.2.19
Rate 4

Figure 7.2.19 shows bottom flange concrete encasement with cracking, leakage and heavy efflorescence, but the encasement is still intact. Corrosion of the primaries is likely. Rate primary members 4.

Figure 7.2.20
Rate 3

Figure 7.2.20 shows very heavy corrosion with section loss at the web and bottom flange. The condition is typical throughout the span and section loss is 20%. Rate primary members 3.
Figure 7.2.21
Rate 3

Figure 7.2.21 shows bottom flange encasement heavily cracked with leakage and efflorescence. The encasement at the fascia girder has separated from the bottom flange and is a falling object hazard. The exposed steel is heavily corroded with section loss. Rate primary members 3.

Figure 7.2.22
Rate 2

Figure 7.2.22 shows an interior stringer with severe section loss. The web, in a high shear area, has several holes. Rate primary members 2.
Figure 7.2.23
Rate 2

Figure 7.2.23 shows a crack in a girder web, near the bottom flange resulting from out-of-plane bending. This crack is over 50 mm in length and is considered a working crack likely to propagate. The other girders are in good condition, therefore, considering the load-path redundancy of a multi-girder system, rate primary members 2.

Figure 7.2.24
Rate 1

Figure 7.2.24 shows a severe crack in a fascia stringer. The entire bottom flange is fractured near center span. The load capacity of this member is severely reduced. Rate primary members 1.
TWO AND THREE-GIRDER

What To Rate
Refer to Table 7.1.

Typical Two and Three-Girder Primary Members
- Girder-floorbeam system
- Girder-floorbeam-stringer system

What To Look For
Just as for any primary member, check alignment and profile for deviation that could result in undesirable stresses.

- Check webs near supports at abutments and piers (including pin and hanger "piers") for any indications of crippling or section loss.
- Examine flanges in both compression and tension zones for corrosion and section loss.
Superstructure

- Spalled deck areas adjoining girders indicate that some section loss of the primaries should be expected. Girder webs adjoining sidewalks are also subject to accelerated corrosion and section loss.

- Short or rusted skimmer downspouts can concentrate road salts on bottom flanges and contribute to significant section loss.

- Pin and hanger locations are especially prone to problems — give the primary members careful attention. Pin and hanger assemblies are rated as bearings, but malfunctions could reduce primary capacity.

- Riveted, built-up members typical of thru-girder design are susceptible to crevice corrosion. Visually check the alignment for a ripple-like effect and note extent of rivet section loss or overstress.

- Check for cracks in welds or girders especially at fatigue prone areas.

- Check for poor details such as coped members.

**INSPECTION INTENSITY:** The non-redundancy of two/three girders structures alerts the inspector that inspection should be done with greater intensity than a multi-girder system. Hands-on inspection is required per Appendix G.

**Rating Examples**

Two/three girder primary members are rated on both physical condition and ability to handle original design loading. The same criteria exist for multi-girder primaries, but the condition of individual elements is more critical because there is reduced load path redundancy.

1. **7** — New or like-new condition. No signs of section loss or distortions.
2. **5** — Minimal section loss—member can still function at full capacity, little or no crevice corrosion. Damage from impact that does not reduce load carrying capability.
3. **3** — Heavy corrosion with substantial section loss, or impact damage resulting in a reduction of load carrying capacity.
4. **1** — Severe and extensive section loss in critical areas, or major impact damage resulting in a substantial reduction of load carrying capacity. Any crack in girder tension zone.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition depicted in the photo is the **controlling condition** in a load path non-redundant system, the rating would be used for the primary member system. Similarly, if the condition in the photo typifies the primary members, that rating would be used for the span being rated.
Figure 7.2.26
Rate 6

Figure 7.2.26 shows girder/floorbeam system with only spotty surface corrosion; no section loss. Rate primary members 6.

Figure 7.2.27
Rate 5

Figure 7.2.27 shows a girder with widespread surface corrosion. Although the paint has failed, there is less than 5% section loss. Rate primary members 5.
Figure 7.2.28
Rate 5

Figure 7.2.28 shows a girder/floorbeam/stringer system with some minor section loss along the lower part of the floorbeam webs. Rate primary members 5.

Figure 7.2.29
Rate 3

Figure 7.2.29 shows the inside web surface of a thru-girder with a hole through the web at the top of the sidewalk. The hole is near the neutral axis. Rate primaries 3.
Figure 7.2.30
Rate 3

Figure 7.2.30 shows a thru-girder with heavy corrosion of the web, bottom angles and rivet heads with about 20% section loss. Rate primary members 3.

Figure 7.2.31
Rate 2

Figure 7.2.31 shows severe crevice corrosion along the bottom flange at midspan of a recently rehabilitated 2-girder bridge. Rate primary members 2.
METAL TRUSSES

What To Rate
The most common truss type used for bridge construction is two-dimensional with members designed to withstand axial forces. The primary member rating is based on the ability of the superstructure to carry the loads for which it was designed. Truss members, floorbeams, and their connections are generally non-redundant, and integrity of the entire superstructure system is dependent upon condition of each individual element. A single member or connection in poor condition can dramatically influence primary member rating for the affected span.

Refer to Table 7-1 for a list of bridge elements rated as primary members.

Typical Trusses
- Simple truss
- Continuous truss
- Pin-connected truss
- Pony truss
- Through truss
- Deck truss
What To Look For

All members and connections should be inspected for the following:

- **MEMBER CONDITION**

  Truss members are designed for axial forces. It is important to know whether a member acts in tension, compression, or both. Section loss in only one truss member results in loss of load carrying capacity for the entire truss. Likely areas of corrosion are around pockets that can hold debris and moisture, especially near bearings and within gusset plates at panel points. Debris should be removed to facilitate inspection. Corrosion can also occur between plates of built-up members. Check areas vulnerable to deicing salts such as lower chords, floorbeam connections, end floorbeams and their connections to stringers.

  Damage can occur by direct impact or indirect impact transmitted by an attachment such as guidetral or overhead bracing. Check members closely for cracks and steel yielding near areas of impact or damaged attachments.

  Improper modifications to truss chords (such as plug welds) can greatly affect load carrying capacity by initiating cracks, especially for tension members. Check areas of welded repairs or attachments for undercut slag, porosity, or cracked welds. Check bolted retrofits for excessive section removal due to drilling, flame cutting or punching.
Check for proper tension in truss rods. Looseness in one member may result in excessive force in another member.

Inspect the flooring system by the same criteria used for a flooring system in a two or three-girder system.

**ALIGNMENT**
Proper alignment of individual truss members can significantly affect their ability to carry axial loads.

Check truss alignment by sighting down the truss. Look for tilt, bends, kinks, dips, and sag. They may be signs of other problems not immediately evident. Check individual members for proper shape and position. Bowed or buckled compression members may severely reduce the capacity of the entire truss.

**OVERSTRESSED MEMBERS**
It is important to classify members as tension or compression members and those that may control truss capacity. Some may be over-designed for simplicity and to simplify construction.

Check for local or lateral buckling in compression members. Wrinkles or waves in flanges, webs, or coverplates may be signs of overstress. Check for necking down of cross-sectional area in ductile tension members. This indicates yielding steel before strain hardening occurs, and is usually accompanied by paint flaking. Higher strength steels may be less ductile than carbon steels. Overstress in a non-ductile tension member is difficult to recognize and failure may be sudden. Many early trusses were constructed of wrought iron with cast iron fittings at panel points. These members should be closely examined for small cracks and notches. Critical crack length for fracture may be very short.

Early eyebars were manufactured by forging eyes onto bar stock. Loop rods were made by bending and forging a loop into a straight rod. Eyebars and loop rods are tension members. Check their ends closely for forging discontinuities.

**CONNECTIONS**
Those between individual truss members and flooring system members may be critical to the integrity of the entire structure. Look for stress indications in the paint. Check for loose or missing pin caps, pin nuts, rivets, or bolts. Listen for noises with the passage of vehicles. Look for cracks in the web where flanges have been coped for connections. Check for section loss of threaded connections at the bolt-nut interface which can occur at turnbuckles and floorbeam U-bolts. Eyebar and loop rod spacing at pins can greatly affect bending stresses in the pin. Look for corroded or missing spacers and bent pins. Check for corrosion at lower panel points, especially where desiccating salts may wash onto trusses and connections.

**INSPECTION INTENSITY:** Bridge inspection intensity requirements are detailed in Appendix G. The Appendix identifies the structural components that must receive a 100 percent close-up, hands-on visual inspection during each biennial and interim bridge inspection.
Rating Examples

Consider ability of the entire system to carry the loads for which it was designed. A non-redundant member or connection in poor condition will greatly affect the load carrying capacity of the superstructure.

7 - New or near new condition; no significant deficiencies in truss members, floorbeams, stringers, or connections.

5 - Corrosion with minor section loss (5 percent or less), minor misalignments with little significant impact. Superstructure can safely carry the loads for which it was designed.

3 - Serious corrosion (exceeding 10 percent) to one or more critical members or connections, corroded or missing bolts in one or more critical members. Ability of superstructure to carry design loading is doubtful.

1 - Critical crack in any truss tension member or stress reversal member, severely impacted end post, severe widespread section loss in truss members, connections, floorbeams and/or stringers, or severe truss member misalignment seriously reducing load capacity.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition depicted in the photo is the controlling condition in a load path non-redundant system, the rating would be used for the primary member system.
Figure 7.2.34
Rate 6

Figure 7.2.34 shows a pony truss in very good condition. Only very minor corrosion is evident along the bottom of the web plate. There is no section loss. Rate primary members 6.

Figure 7.2.35
Rate 5

Figure 7.2.35 shows a pony truss with localized minor corrosion along the bottom chord, gusset plate and vertical. Section loss is minimal. Rate primary members 5.
Superstructure

Figure 7.2.36
Rate 4

Figure 7.2.36 shows a deck truss with widespread corrosion that is particularly evident along the bottom chord, gusset plate and the diagonal member web. Section loss does not exceed 10%. Rate primary members 4.

Figure 7.2.37
Rate 4

Figure 7.2.37 shows an impacted truss end post. The channel flange is locally buckled, but the member overall is not out of alignment. Rate these primary members 4.
Figure 7.2.38
Rate 4

Figure 7.2.38 shows a close-up of a truss vertical with 15% flange loss. Rate primary members 4.

Figure 7.2.39
Rate 3

Figure 7.2.39 shows a truss vertical with 35% flange loss. Rate these primary members 3.
Figure 7.2.40
Rate 3

Figure 7.2.40 shows a truss bottom chord with severe localized section loss to the channel legs and web near a tie plate connection. Rate primary members 3. Note that the condition of the tie plate is rated under secondary members.

Figure 7.2.41
Rate 3

Figure 7.2.41 shows holes in the web of a diagonal truss member. Rate primary members 3.
Figure 7.2.42
Rate 2

Figure 7.2.42 shows a truss end post with severe section loss resulting in several holes in the web. Rate primary members 2.

Figure 7.2.43
Rate 1

Figure 7.2.43 shows the top chord of a thru-truss with a loose splice plate. Note the loose rivets and the misalignment between the spliced top chord channels. Rate primary members 1.
Figure 7.2.44 shows a loop bar after a dye penetrant test. The test reveals a curved transverse crack in the bar. Rate primary members 1.

Figure 7.2.45 shows a truss panel point where the retaining nut for the eyebar connection is missing. Rate primary members 1.
TIMBER

Wood is an excellent material for bridge construction, with medium to high strength-to-weight ratio, and for short periods, it can handle a high degree of overstress (impact). Wood is readily available and wooden structures can be economical to build and maintain. Wood is resistant to attack from most chemicals.

Typical Timber Primary Members

- Glue-Laminated (Glulam) Girder
- Nail Laminated Deck Slab
- Solid Sawn Multi-Beam
- Timber Arch
- Timber Truss

What To Look For

Untreated wood is vulnerable to damage from fungi and insects. All wood is vulnerable to damage from checking and splitting because of drying and wetting cycles, and to damage from fire and exposure to extreme heat. Timber structures are also vulnerable to the more typical causes of damage such as normal wear, collision, and overload. Inspectors must be able to identify signs that damage has or is occurring, and assess its effect on the ability of the member to function as intended.

- DECAY
  
  This is a result of attack by microscopic organisms called fungi. Decay occurs when conditions of moisture content, oxygen level, and temperature are favorable. Pay special attention to areas where wood members are in direct contact with other members. Treating the wood kills the fungi and stops decay. Discoloration is often (but not always) evident in early stages. In later stages, decay causes easily noticeable changes in both wood color and texture. Later stages are accompanied by substantial decrease in structural capacity of the member, which must be reflected in the rating.

- INSECTS
  
  For some insects, wood is both a source of food and as a place of shelter. The most destructive is the termite. Other potentially destructive insects are powder post beetles, carpenter ants, and marine borers. Since most damage caused by insects is inside the wood members, often the only sign of damage is accumulation of sawdust at the base of the member or white mud shelter tubes indicating termites. The inspector may have to probe the member with an awl or other suitable tool to properly assess the extent of damage. Do not probe excessively, since probe holes will allow moisture penetration thus initiating decay. Tapping the member with a hammer can also detect hollow areas.
Superstructure

- **CHECKING/SPLITTING**
  Checking results from rapid decrease in wood moisture content combined with moisture differential between the inner and outer portions of the member. Splitting is commonly called through-checking. A nominal amount of checking is considered when establishing basic working stresses, but excessive or cross-grain checks or splits that enter connection areas may be serious and require closer evaluation. Checks have less effect on strength of laminated members. Splitting could indicate possible overstressing.

- **FIRE/HEAT**
  Remove any charred material and/or take core samples to determine extent of damage and section loss.

- **WARping**
  This is caused by differential shrinking caused by uneven moisture loss. This can induce very high stresses into the wood.

**Rating Examples**

7 - New or near new condition; no decay and only minor discoloration, no evidence of insect damage, minimal checking/splitting, no evidence of fire damage.

5 - Minor deterioration but still functioning as designed; minor decay, no appreciable penetration, minimal insect damage or hollow sounding areas, moderate checking/splitting; 5 percent or less section loss caused by fire, no visual evidence of sagging or warping.

3 - Serious deterioration or not functioning as designed; loss of section more than 20 percent from any cause, isolated areas of deterioration as evidenced by adi penetration and hollow sound.

1 - Totally deteriorated; widespread decay or insect damage, broken connections, severe section loss, extensive splitting or severe impact damage.

Since the primary member rating represents the condition and functional capacity of the main members of the bridge span as a system, the sample photos below illustrate localized primary member ratings that may or may not represent the actual primary member rating for the span. If the condition depicted in the photo is the controlling condition in a load path non-redundant system, the rating would be used for the primary member system. Similarly, if the condition in the photo typifies the primaries in a redundant system, that rating would be used for the span being rated.
Figure 7.2.46
Rate 6

Figure 7.2.46 shows timber stringers that have only slight surface discoloration. The stringers sound solid when tapped with a hammer and there is no awl penetration. Rate primary members 6.

Figure 7.2.47
Rate 5

Figure 7.2.47 shows timber truss bottom chord that is checked but not cracked. Rate primary members 5.
Figure 7.2.48
Rate 4

Figure 7.2.48 shows timber stringers with widespread surface decay, checking and splintering, but awl penetration is less than 10%. Rate primary members 4.

Figure 7.2.49
Rate 3

Figure 7.2.49 shows timber stringers with large areas of checking, discoloration, and rot. Several areas can be penetrated with an awl to a depth exceeding 10%. The transverse timber attached to the bottom of the stringers and the timber diaphragms are rated as secondary members. Rate primary members 3.
Figure 7.2.50
Rate 3

Figure 7.2.50 shows the underside of a timber slab span. The primary members are timber boards that are laid on their side. The planks are held together with transverse timber members that are rated as secondary members. There are three adjoining boards extensively deteriorated with awl penetration exceeding 10%. Rate the primary members 3.

Figure 7.2.51
Rate 2

Figure 7.2.51 shows a timber floorbeam that has severe rot which has hollowed out the center of the beam at the connection to the vertical truss member (steel threaded rods). Rate the primary members 2.
Superstructure

Figure 7.2.52
Rate 2

Figure 7.2.52 shows a timber stringer that is severely rotted and splintered. Rate primary members 2.

Figure 7.2.53
Rate 1

Figure 7.2.53 shows a timber floorbeam that has failed. The steel plate is a temporary repair that should be ignored when rating the primaries. Rate primary members 1.
Figure 7.2.54
Rate 1

Figure 7.2.54 shows the underside of a timber slab span with extensive rotting and splitting. Many consecutive timbers have 100% section loss due to rot. Rate these primary members 1.
STONE MASONRY ARCHES

What To Look For

Stone Masonry should be rated as a primary member only when it is structural masonry. Do not rate stone facades on concrete arches.

Some of the world’s oldest bridges are stone masonry arches. In rating primary members, consider condition of the stone, condition of the masonry, and overall behavior of the arch and spandrel walls.

In assessing stone condition, look for weathering, splits, delaminations or cracks in individual stones, spalling, and crumbling.

Mortar should be examined for soundness, signs of leakage, and associated efflorescence and percentage missing should be estimated. If the masonry was originally laid without mortar and it can be determined that it was added later for cosmetic reasons, give less weight to mortar condition in establishing the primary member rating.

The masonry arch and spandrel walls should be examined as a system for signs of distress such as moving or shifting stones, cracks, or splits through adjoining stones, and leakage that hastens deterioration. If movement has occurred, find out the extent and whether it is progressive or has stabilized by measurement and comparing to photographs.

![Diagram of Stone Masonry Arch](image-url)
INSPECTION INTENSITY: Stone masonry bridges can generally be inspected from the ground where the entire arch is visible. If deterioration is observed, closer inspection is necessary to sound with a hammer and assess the mortar condition.

Rating Examples

7 – New or near new condition; almost no sign of deterioration of stones or mortar, arch lines and spandrel wall lines are true and as-built.

5 – Occasional stones may be cracked, up to 10-25 percent of mortar may be missing, leakage may be occurring but not seriously or causing progressive deterioration, minor weathering of stones.

3 – Loss of a significant amount of mortar where it is structural, serious weathering of the stones, adjoining stones split, signs of slight movement along arch or wall lines, heavy leakage causing deterioration of stones and mortar.

1 – Significant stone movement so that arch stability is in question.

Figure 7.2.56
Rate 5

Figure 7.2.56 shows the underside of a masonry arch that has been repointed. Only a few joints have missing mortar. The stones are in good condition and are in proper position. Rate primary members 5.
Figure 7.2.57 shows the inside of an arch barrel with a missing stone. The stone above is unsupported. Rate primary members 4.

Figure 7.2.58 shows the underside of an arch with widespread missing and soft mortar in the joints. Rate the primary members 3.
Figure 7.2.59
Rate 2

Figure 7.2.59 shows a spandrel wall with several missing and loose stones. The arch appears to be intact. Rate primary members 2.

Figure 7.2.60
Rate 1

Figure 7.2.60 shows a masonry arch with interior barrel stones that have dropped below the level of the intrados of the arch. Stability is in doubt. Rate primary members 1.
OTHER BRIDGE TYPES

What To Look For

Other bridge types include suspension bridges, steel arches, cable stayed bridges, corrugated steel arches, a variety of proprietary bridge types, and structures retrofitted to carry loads in a manner different than the original design. For these bridges, the inspector must first determine the load path from the structural deck (or wearing surface if there is no deck) to the abutments or the piers. Members on this load path are primary members. An assessment must be made whether individual members are redundant or non-redundant.

Once the load path has been determined, condition of individual components should be assessed and a rating given that represents primary members in the span as a system. For steel and concrete members, look for the same signs of deterioration as described earlier in this chapter. Chapter 21 of the Federal Bridge Inspector’s Training Manual 90 explains items to look for on suspension bridges, cable stayed bridges, and segmented concrete bridges. Other cables should be inspected for loose strands, signs of wear, and loss of section. Corrugated steel arches should be inspected in a similar manner as corrugated metal pipes (see Chapter 8).

INSPECTION INTENSITY: For load path non-redundant members, “hands-on” inspection is required. These areas should be noted and documentation of the hands-on inspection should be included in the special emphasis section (see appendix G). Other members should be inspected with an intensity appropriate to adequately determine their condition and ability to function as designed.
SECONDARY MEMBERS

These are members that brace or stiffen individual primary members against buckling, provide lateral or torsional rigidity to the primary system, or hold components of a primary member in proper relative position. Refer to Table 7-1 for a list of secondary members. Secondary members are connected to primary members but do not resist traffic loads. They do, sometimes, resist lateral forces such as wind.

What To Rate

The condition and ability to function are rated under this item. Include the condition of the connections. Rate the secondary members as a system relative to the primary member system and its level of load-path redundancy. For example, rate a secondary member deficiency lower if it adversely affects the performance of a truss member than one that affects a stringer in a multi-girder system.

Typical Secondary Members

Secondary members are normally constructed of metal, concrete, or wood. Some of the more common secondary members are:

- Diaphragms (except those attached to curved girders)
- Lateral bracing
- Portals
- Lateral and sway struts and sway bracing on through trusses
- Lacing bars, stay plates, and tie plates on trusses
- Knee bracing

What To Look For

Look for signs of overstressing, impact damage, improper alignment due to buckling, bowing, or kinking, deterioration, and excessive movement. Behavior of secondary members can best be observed with passage of heavy live loads. Determine the cause of any unusual sounds or excessive movements.

For concrete members, inspect for scaling, spalling, delamination, cracking, efflorescence, dampness, staining, exposed rebar or tendons, or other signs of concrete deterioration. Sound concrete with a hammer.

For prestressed concrete box beams tied together laterally with post-tensioned tie rods or strands, the transverse ties are not considered secondary members. If no external diaphragms exist, secondary members should be rated 8.

For steel members, inspect for loss of section due to corrosion, cracking, improper alignment, and for secure connections (welds, bolts, and/or rivets).
Superstructure

The actual location of secondary members and the details of connection of secondary members should be compared and verified against existing plans or sketches in lieu of plans. Variations observed between field conditions and plans/sketches should be noted on the plans/sketches.

Erection aids such as rebars attached transversely across the bottom flanges of stringers of jick arches, either by bent up hook or tack weld are not considered secondary members.

Rating Examples

7 - Steel: No section loss due to corrosion, connections are sound, and the alignment of bracing is good. No unusual sounds or excessive movement under live load.

Concrete: No spalling, scaling, cracking, efflorescence, etc., or other signs of deterioration. No unusual sounds or excessive movement under live load.

5 - Steel: Minor bends or misalignment due to impact damage. Negligible section loss of members or connectors (rivets, bolts, or welds) due to corrosion.

Concrete: Isolated moderate surface scaling or minor spalling with negligible efflorescence. Hairline cracking associated with minor map cracking or isolated tension cracking that does not compromise the member’s ability to function as designed.

3 - Steel: Serious deterioration or loss of functional capacity due to corrosion, improper erection, improper repair, impact damage, or misalignment. Some limited functional capacity may exist.

Concrete: Pervasive scaling/spalling/efflorescence/cracking and possible exposed corroded rebar with section loss with hollow sounding areas at many locations. The members may still retain a limited ability to function as designed.

1 - Steel: Members ineffective due to severe section loss of members or connections, or from severe impact. Large movements observed with the passage of heavy live loads.

Concrete: Members ineffective due to severe cracking, deep spalling, pervasive exposed corroded rebar with severe loss of section, and severe hollow sound/delamination at many locations.

7.64
Figure 7.3.1
Rate 7

Figure 7.3.1 shows cross bracing and diaphragms in excellent condition. Rate secondary members 7.

Figure 7.3.2
Rate 4

Figure 7.3.2 shows batten plates and a bottom lateral connection plate with areas of severe section loss in isolated locations. Rate secondary members 4.
Figure 7.3.3 shows a popped rivet with two distorted lacing bars on a truss compression member. Rate these secondary members 4.

Figure 7.3.4 shows a concrete diaphragm extensively spalled and scaled. Rate this secondary member 3.
Figure 7.3.5
Rate 2

Figure 7.3.5 shows a truss sway frame severely damaged from impact. Rate the secondary members 2.
SUPERSTRUCTURE PAINT

SUPERSTRUCTURE PAINT - NON WEATHERING STEEL

What To Rate

Rate the physical condition of the paint or protective coatings of the steel superstructure excluding railings, signs, lighting or utilities.

Typical Paints And Coatings

Paints vary primarily with age of the bridge. Older steel bridges were painted either with oil/alkyd paints or mastic-like coatings. More recently constructed steel bridges use hot dip-galvanization, or coatings such as polyurethane or epoxy. Rehabilitated structures often have an organic epoxy coating covering a lead-based paint. Aliphatic, polyurethane, and organic epoxy coatings are used because they are free of lead and chlorine. Newer types of paint include vinyl and latex. Zinc-rich paints are used as primers.

What To Look For

Inspect paint and/or coating for signs of chalking, alligating (checking), cracking, blistering, hollies (thin areas), pitting, saponification (alkaline chemical attack), loss of adhesion, wrinkling, or other deterioration. Application defects often include thin areas, scuppers, and peeling (lack of adhesion) due to improper surface preparation or handling. Thinner areas of paint or coating are noticeable due to differences in appearance such as coloring or shading.

Knowing where to inspect is as important as knowing how to inspect. Paint or coating deterioration typically starts in a few characteristic places, then spreads to adjoining areas. Areas to inspect for initial deterioration are at rivets and bolts, sharp edges or corners, moisture retention locations (example, at sand and salt accumulations), roadway splash zones and at hard-to-reach areas.

The paint rating should reflect the condition of the current paint or protective coating system. Existing section loss in the base metal after painting should be reflected in the primary or secondary member rating.
Rating Scale for Paint

7- The paint or coating system is in new or like-new condition. Galvanized steel surface is hard and either shiny spangled or dark gray matte finish in appearance.

6- The paint or coating system is in generally good condition with isolated areas requiring touch-up, such as along top flanges adjoining stay-in-place metal deck forms or in roadway splash zones. There may be some thinner areas of paint/coating. Isolated areas of wrinkling due to excessive paint thickness or temperature during application might be observed.

5- The paint or coating system shows signs of deterioration at isolated locations. Typical signs of deterioration include peeling of the finish coat, bleeding with localized areas of rust staining, alligator cracking, and chalking. Galvanized steel surfaces show signs of localized sacrificial action in the uppermost free zone layer especially at minor scrapes or shallow scratches.

4- The paint or coating system has localized areas in poor condition. Bleeding of soluble pigments from the undercoat, peeling, minor blistering, and/or light pinpoint rusting may be present. Reconditioning normally would require local sand blasting and touch-up. Galvanized steel surfaces have undergone sacrificial loss usually observed as dulling of the once shiny surfaces. Surface texture is dull and matte-like throughout with localized areas of base steel exposed by scratches or scrapes.

3- The paint or coating system is generally in poor condition throughout the structure. Many areas of peeling, blistering, bleeding, chalking, shallow pinpoint rusting, rust undercutting at scratches, and surface scale are common. Reconditioning would require the entire superstructure be sand blasted, cleaned, primed, and re-painted/re-coated. Galvanized steel surfaces have lost much of the free zinc layer with noticeable stains at scratches, loss of shine, and a general dull matte finish.

2- The paint/coating is often peeling, chalking, and/or bleeding and very widespread. Galvanized steel surfaces have little or none of the uppermost free zinc layers with serious loss of the underlying zinc-iron alloy layers. Localized areas of the base steel are exposed. Section loss measurements should be taken to confirm the extent.

1- Large areas have no paint/coating remaining and where it is present, paint/coating is faded, peeling, and/or chalking. Galvanized steel surfaces have many areas of exposed corroded base steel. Little or none of the free zinc or zinc-iron alloy layers remain at many locations. Severe embrittlement of remaining zinc layers is present. Section loss measurements shall be taken.
Figure 7.4.1
Rate 7

Figure 7.4.1 shows paint in new condition. Rate 7.
Figure 7.4.2
Rate 6

Figure 7.4.2 shows paint in very good condition with no corrosion on the truss members. A small spot on the vertical member needs touch-up. Rate paint 6.

Figure 7.4.3
Rate 6

Figure 7.4.3 shows repainted members with paint nearly in like-new condition. The underlying section loss is reflected in the primary and bearings ratings. Rate paint 6.
Figure 7.4.4
Rate 5

Figure 7.4.4 shows paint that is faded and charked with isolated minor steel corrosion. Rate paint 5.

Figure 7.4.5
Rate 4

Figure 7.4.5 shows weathering steel with corrosion along the bottom of the web exceeding the expected oxidation that would form a protective coating. Rate paint 4.
Figure 7.4.6
Rate 4

Figure 7.4.6 shows paint in poor condition along bottom flanges. Minor corrosion is present. Rate paint 4.

Figure 7.4.7
Rate 3

Figure 7.4.7 shows paint that is in poor condition throughout the span. Minor section loss is widespread. Rate paint 3.
Figure 7.4.8
Rate 2

Figure 7.4.8 shows galvanizing in very poor condition below the high water line on a corrugated metal culvert. There is serious section loss at the water line. The rest of the barrel has none. Rate paint 2.

Figure 7.4.9
Rate 1

Figure 7.4.9 shows widespread corrosion with serious section loss exceeding 10 percent of the flanges and web. Rate paint 1.
SUPERSTRUCTURE PAINT - WEATHERING STEEL

What To Rate

Rate the effectiveness of the iron oxide coating (patina) on the steel superstructure excluding railings, signs, lighting or utilities. The effectiveness should be determined based on the color and texture of the surface of the steel.

Theory Of Weathering Steel

“Weathering Steel” refers to a carbon base steel that is alloyed with approximately 2% copper, nickel, chromium, and silicon. These additions are intended to inhibit the steel’s natural tendency to continuously rust in the outside environment. When used in a suitable environment, this steel eliminates the need for painting because the steel “weather’s” to form a patina, or thin layer of protective oxide coating, that prevents or minimizes further rusting. The patina will not form properly if the steel remains wet for extended periods of time or is contaminated with salt or other chemicals, especially if the bridge is exposed to these conditions soon after construction. Patina formation time will vary according to many factors and may take 2-3 years or more to form completely. If the patina has not properly formed, the steel will continue to corrode. This will appear as either continuous flaking of the plates and/or by plate delamination. The plate delamination will appear as open cracks along the vertical edges of the flange plates or by blistering (bulging) on flat surface areas.

What To Look For

Inspect the formation of the patina by observing its color and texture. The color of a properly formed or forming patina will vary with the age of the steel and its chemical composition. Generally, the color will change over time from light yellow orange to dark chocolate or purple. An improperly formed patina will generally appear dark black. A properly formed patina has tight mill scale or a tight granular consistency which will not be adversely affected by vigorous brushing with a wire brush. An improperly formed patina will generally have flakes and/or delaminations which can be removed with a hammer tap, a wire brush or chipping hammer.

Section loss in the base metal of the steel girders should principally be indicated in the primary or secondary member rating.

Rating Scale for Paint (Patina)

7. The patina is tight. The color of the surface will range from light yellow orange (new steel) to dark chocolate or purple (steel exposed under good conditions with proper wetting and drying cycles). The texture of the surface is either mill scale or granular in nature, both adhering tightly when subjected to vigorous wire brushing. Some minor loss of the mill scale or granular surface material is normal under vigorous brushing.
The patina is generally tight with proper color and texture as described for the 7 rating on the majority of the surface. Isolated areas (e.g. under bridge joints) may have different darker colors or non adhering textures. This may be the early signs of future problems or just portions of the patina forming at different rates.

The overall surface may show signs of possible patina formation problems. The surface contains portions that are dark black indicating that the protective oxide layer is not forming. The surface in these isolated areas has a coarse texture or is granular with small flakes (under 6mm dia.) that are not adhering when subjected to a vigorous wire brushing.

The surface is typically dark black indicating that the protective oxide layer is not forming and probably will not form. The surface also typically has a coarse texture with non-adhering small flakes (under 6mm dia.) and may have some evidence of plate delamination. There may be continuous rusting evidenced by occasional accumulations of flakes on the top of the bottom flange or on the ground or by the ability to remove much of the flaking with vigorous wire brushing.

The surface is uniformly dark black indicating that the protective oxide layer has not formed. The surface has a coarse texture that is principally non-adhering medium flakes (under 12mm dia.) with some plate delaminations. There is continuous rusting of the steel evidenced by frequent accumulations of flakes or sheet delaminations on the top of the bottom flange or on the ground or by the ability to easily remove much of the flaking and delaminated sheets with a wire brush or chipping hammer.

The majority of the surface is black, indicating a significant failure of the protective oxide layer formation. The surface has a coarse texture that has large flakes (greater than 12mm dia.) with little or no adhesion and there is extensive plate delamination. There is continuous rusting of the steel evidenced by consistent and extensive accumulations of flakes or sheet delaminations on the top of the bottom flange or on the ground or by the ability to easily remove much of the flaking and delaminated sheets with a wire brush or chipping hammer. These are indications that advanced section loss may have taken place. Section loss measurements should be taken to confirm the extent.

The entire surface is black indicating a complete failure of the protective oxide layer formation. The entire surface has a coarse texture of large flakes (greater than 12mm dia.) that demonstrate no adhesion and there is significant plate delamination. There is continuous rusting of the steel evidenced by consistent and extensive accumulations of flakes or sheet delaminations on the top of the bottom flange or on the ground or by the ability able to easily remove much of the flaking and delaminated sheets with a wire brush or chipping hammer. Section loss measurements shall be taken.
Figure 7.4.10
Rate 7
Figure 7.4.10 shows the orange-colored, tight patina of new steel. Rate paint 7.

Figure 7.4.11
Rate 3
Figure 7.4.11 shows delaminating steel with a dark black color. Rate paint 3.
SUPERSTRUCTURE JOINTS

What To Rate
Joints in the deck at piers and above hangers for suspended spans are rated under this item. On multi-span structures, the joint at the end of the first span is rated with the first span of the bridge, and the joint between the second and third spans is rated with the second span of the bridge, etc.

Always rate this 8 (not applicable) for the last span of the bridge since the joint at the end of the last span is the abutment joint.

Rate this 8 when there is no joint in the structural slab at the end of a span, as on a continuous structure.

Rating
Superstructure joints are rated in the same manner as joint with deck for abutments. See Chapter 4, Section C.
SUPERSTRUCTURE RECOMMENDATION

What To Rate
This is the rating used to describe the superstructure's overall condition and the ability to function on an individual span basis. It should be based on the ratings for all the elements comprising Superstructure Elements. Do not include the superstructure paint condition in the superstructure recommendation. This number will normally reflect the rating for deck, primary and secondary members, and joints, but it does not necessarily have to be the lowest of these ratings.

Ratings
The inspector evaluates the system comprising the Superstructure Elements by using the rating number that best describes his opinion of the system's condition and ability to function.

- 8 — NOT APPLICABLE
- 7 — NEW CONDITION
- 6 — Used to shade between 5 and 7
- 5 — MINOR DETERIORATION BUT FUNCTIONING AS ORIGINALLY DESIGNED
- 4 — Used to shade between 3 and 5
- 3 — SERIOUS DETERIORATION OR NOT FUNCTIONING AS ORIGINALLY DESIGNED
- 2 — Used to shade between 1 and 3
- 1 — TOTALLY DETERIORATED, OR IN FAILED CONDITION
CHAPTER 8

CULVERT-STYLE BRIDGES

The term culvert as used throughout this chapter is limited to any culvert large enough to meet the legal criteria defining a bridge, as stipulated in the Uniform Code of Bridge Inspection (see Appendix F). To be a single-span bridge, the span must be greater than 20 feet (6.10 m). Multiple pipes are bridges when the sum of all spans, plus spaces between them, is greater than 20 feet and each inter-span space is less than half of the smallest adjoining span diameter. These dimensions are measured along the centerline of highway.

What To Rate: The Primary Member

This chapter is divided into two sections. The first describes metal culverts that are flexible, and therefore rely on the interaction of the culvert and the surrounding soil. Because of this flexibility, the shape, and more importantly, the change in shape of the culvert over time indicate the primary member condition. The second section of this chapter covers concrete culverts that are rated solely on the condition of the materials and alignment of the elements.

For all culverts, concrete or metal, rate physical condition and functional capability of primary members and connections between primary members. For the primary member rating, consider also elements that contribute to strength and service life of primary members, such as the supporting soil, bracing elements, etc.

For round or elliptical concrete or metal culverts, the entire pipe or barrel is the primary member. Because of soil involvement, the soil condition is part of the primary member’s rating and the culvert’s General Recommendation. This also applies to headwalls if the headwalls retain backfill material that interacts with the culvert. Note that for metal culverts, the only superstructure elements rated are “primary member” and “paint.”

For concrete box culverts, however, rate only the upper slab as the primary member. Rate other elements of concrete barrels, such as stems, piers, and footings as described in other chapters of this manual.
What To Rate: Other Elements

Inlet and outlet aprons or end sections are scour protection devices, therefore they should be rated as stream channel bank protection.

Slope protection placed on the embankment fill around the pipes is rated under approach embankment.

If aprons, headers, or end sections have attached walls that retain embankment not directly involved with culvert-soil interaction, these walls may be rated as abutment wingwalls.
METAL CULVERTS

Shapes And Sizes
Metal culverts generally are corrugated and may be multi-plate or of one-piece construction. External concrete longitudinal stiffeners or metal transverse stiffeners are often added to strengthen the flexible barrel and/or improve distribution of compressive backfill forces.

Extensive dimensional details on span, thickness, etc., are available from industry publications such as those published by the American Iron & Steel Institute and the Aluminum Association.

The Time Rate-Of-Change Of Dimensions
Metal culvert deformation often occurs during installation. Some variations between in-place measurements and the culvert's design values may be acceptable, if the changes have occurred mainly during compaction of fill. However, if dimensional changes are actively occurring, even if measurements are the same as initial design values, there is a problem.

Although changes in dimensions are important, for metal culverts, the rate of change is more important than amount of change.

Routine Measurements
There must be enough measurements taken routinely, to have a meaningful database so that any future deformations can be compared to previously recorded dimensions at or at least near the location of the deformation. Cross-section measurements must be taken and recorded at locations along the barrel, spaced close enough to ensure detecting changes from one inspection to the next. The dimensions AD, BE, AF, FE, and CF in Figure 8.1.2 are the minimum set of measurements required at intervals not greater than approximately 16m, but no fewer than three locations along the barrel of the culvert. These dimensions are defined by the actual location of bolt rows. If there is no line of bolts at C, measure to the corrugation peak at the highest point at the cross-section, and so note in the inspection report.

Permanent reference points are essential to ensure that the measurements can be accurately repeated in future inspections. If permanent reference hooks were installed during construction, they may be used and should be compared to any dimensions that may be included in the as-built plans, if available. If permanent reference hooks do not exist, the inspector should use reference points such as bolt ends that should be permanently marked as reference points. A precise description of the reference points must be provided in the inspection report. This description needs to give future inspectors the exact location of the reference points and clearly define to what part of the bolt, nut or hook the measurements should be taken. Station numbering or longitudinal dimensions locating the sections where barrel dimensions are taken should start at the left of the bridge looking in the direction of orientation.
Culvert-Style Bridges

Problem-Area Measurements

In addition to the routine measurements taken at regular intervals along the length of the barrel as described above, field measurements as shown in Figure 8.1.2 are required where any of the following conditions exist:

- The section is not symmetrical.
- There is noticeable sag in the top arch (an extreme case might even display reverse curvature because of partial collapse.)
- There is significant distortion and/or deflection.

The Team Leader will decide the number and spacing of additional cross-section measurements as warranted by field observations.

Any distortion in the upper 2/3 of the circumference is always significant, and always critical to the structure’s safety. In the lower 1/3, distortion is also always significant, but may not be critical to safety.

Special Cases

Some culverts that are very long, very high, submerged, or in some other way present unusual problems in obtaining barrel measurements may need to be evaluated in ways that are different from the approach used for most culverts. Such special cases should be judged on a case-by-case basis by the Regional Structures Engineer. Factors to be considered include safety, cost of special access, depth of fill, age and condition of the culvert, soil ph, hydraulics, etc.

\[ A, B, C, D \text{ and } E \text{ are bolt lines. If no bolt line at } C, \text{ use the highest point at cross-section. } F \text{ is located by dropping a vertical from } C. \]

TYPICAL METAL CULVERT CROSS-SECTION DIMENSIONS

Figure 8.1.2

8.4
RATING METHODOLOGY FOR “PRIMARY MEMBERS”

There are several factors to consider when evaluating a metal culvert. Since the condition of a metal culvert is generally reported by a single rating for “primary members”, it can be useful to rate each of these subordinate factors by using the standard 7 to 1 rating scale. Each factor has a weight relative to the overall condition of the culvert that will vary from culvert to culvert depending on culvert type, construction details, and field conditions. The factors to consider when rating the Primary Members for metal culverts are:

- Upper arc drop
- Localized deflection (shape)
- Leaning
- Barrel Condition
- Seam condition
- Headwall condition
- Backfill

Each factor should be evaluated and can be given a condition rating ranging from 1 through 7 using the standard rating scale. These factor ratings are not entered into the BIS database, but are used in determining the “primary member” rating, and should be included in written remarks in the inspection report. The General Recommendation for the bridge should follow the same methodology. Details of what to look for in evaluating these factors are provided below.

UPPER ARC DROP

This refers to the flattening effect of vertical loads on the upper arc of the culvert. A corresponding effect is bulging of horizontal dimensions, increasing the span AE.

Measure CF and calculate the percent change from initial baseline value.

<table>
<thead>
<tr>
<th>FACTOR RATINGS FOR UPPER ARC CHANGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ordinate % Change</td>
</tr>
<tr>
<td>Less than 15%</td>
</tr>
<tr>
<td>15% to 20%</td>
</tr>
<tr>
<td>20% to 25%</td>
</tr>
<tr>
<td>25% to 30%</td>
</tr>
<tr>
<td>Over 30%</td>
</tr>
</tbody>
</table>

8.5
LOCALIZED DEFLECTION (Primary Member)
This reflects the extent of shape irregularity. It includes kinks, dings, peaking, flattening, and inversion (an extreme case flattening.) Inversion is the formation of reverse curvature, usually seen at the top, it may also occur at the bottom. When localized deflection occurs, leaning may also be present. Measurements AD and BE may be useful in quantifying the degree of localized deflection.

### FACTOR RATINGS FOR LOCALIZED DEFLECTION (SHAPE)

<table>
<thead>
<tr>
<th>Observations</th>
<th>Factor Rating</th>
<th>Backfill Soil Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has good appearance, with smooth, symmetrical curvature.</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Curvature is generally smooth but with some slightly non-symmetrical sections, and/or top arch has noticeable sag.</td>
<td>5–6</td>
<td>5–6</td>
</tr>
<tr>
<td>Significant distortion and deflection exist in one section and the top arch shows slight flattening.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Significant distortion and deflection exist throughout the structure.</td>
<td>2–3</td>
<td>2</td>
</tr>
<tr>
<td>Extreme distortion and deflection exist in one section.</td>
<td>1–2</td>
<td>1</td>
</tr>
<tr>
<td>Extreme distortion and deflection exist throughout the structure.</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Structure is partially collapsed; arch is either flat or has a reverse curve.</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

8.6
LEANING
Leaning is a shift of the vertical centerline to an inclined position. In Figure 8.1.2, percent leaning is defined as:

\[
\text{percent leaning} = \frac{AF-PE}{AE} \times 100
\]

The leaning factor rating guidelines below are for static conditions. If leaning is dynamic, use lower factor ratings.

FACTOR RATINGS FOR LEANING

<table>
<thead>
<tr>
<th>Percent Leaning</th>
<th>Factor Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>For Span &lt; 3.6 m</strong></td>
<td><strong>For Span &gt; 3.6 m</strong></td>
</tr>
<tr>
<td>0 to 4</td>
<td>0 to 2.5</td>
</tr>
<tr>
<td>4 to 8</td>
<td>2.5 to 5.0</td>
</tr>
<tr>
<td>8 to 12</td>
<td>5.0 to 7.0</td>
</tr>
<tr>
<td>12 to 16</td>
<td>7.0 to 10.0</td>
</tr>
<tr>
<td>16 to 20</td>
<td>10 to 12.0</td>
</tr>
<tr>
<td>20 to 25</td>
<td>12.0 to 15.0</td>
</tr>
<tr>
<td>Over 25</td>
<td>Over 15</td>
</tr>
</tbody>
</table>
BRAVEL CONDITION
What To Look For
Metal culverts can fail as a result of metal loss without any noticeable prior deflection. For this reason, inspection for section loss by corrosion or abrasion needs to be given a high priority. Compare section loss with design thickness. If there is excessive corrosion, note the location(s) in the inspection report with a recommendation for further investigation and/or a flag as appropriate. Document the water level in pipe at time of inspection (i.e., 1/4 full, 1/2 full, etc.), and if it appears that water level is constant or varies throughout the year. This will help in judging the extent of corrosion. The locations of corrosion need to be noted in the inspection report. Metal loss due to corrosion above the lower quarter points is much more critical to the stability of a culvert than similar metal loss in the invert. When serious corrosion is observed or suspected, it may be necessary to call for further investigation to better quantify the extent of section loss.

FACTOR RATINGS FOR BARREL CONDITION

<table>
<thead>
<tr>
<th>Observed Barrel Condition</th>
<th>Factor Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generally good condition; no noticeable corrosion or other defects</td>
<td>7</td>
</tr>
<tr>
<td>Minor defects and/or damage exists; some superficial corrosion is present, with no pitting</td>
<td>5–6</td>
</tr>
<tr>
<td>Fairly severe corrosion exists at certain locations, with slight pitting.</td>
<td>4–5</td>
</tr>
<tr>
<td>Fairly severe corrosion exists at certain locations, with moderate pitting.</td>
<td>4</td>
</tr>
<tr>
<td>Severe local corrosion and pitting exists.</td>
<td>2–3</td>
</tr>
<tr>
<td>Severe corrosion and pitting exists throughout the structure.</td>
<td>2</td>
</tr>
<tr>
<td>The barrel has sufficient corrosion to be potentially hazardous</td>
<td>1</td>
</tr>
</tbody>
</table>
SEAM CONDITION

Check for tightness of joints between plates and between longitudinal sections. Note broken, loose, rusty, or missing bolts. Look for signs of leakage through joints.

Check for cracks, paying particular attention to bolt locations. The areas requiring the closest scrutiny are bolt locations at haunches and quarter points. Mark the end of cracks and document their lengths so comparisons can be made to determine their change or growth.

FACTOR RATINGS FOR SEAM CONDITION

<table>
<thead>
<tr>
<th>Observed Condition</th>
<th>Factor Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seams are correctly assembled and tight; bolts are also tight.</td>
<td>7</td>
</tr>
<tr>
<td>Minor cracks exist at a few bolt holes; minor cracks may possibly allow some infiltration.</td>
<td>5-6</td>
</tr>
<tr>
<td>Major crack exists at a single location, bolts are loose, infiltration has caused slight deflection.</td>
<td>3-4</td>
</tr>
<tr>
<td>Significant cracking has occurred along much of the seam, soil infiltration has caused considerable deflection of the barrel.</td>
<td>2-3</td>
</tr>
<tr>
<td>Cracks up to 80 mm length exist beside a given bolt hold, significant number of bolts are missing, infiltration has caused severe local deflection.</td>
<td>2</td>
</tr>
<tr>
<td>Cracks are prominent, reaching from one bolt hole to another, significant infiltration exists throughout.</td>
<td>1-2</td>
</tr>
<tr>
<td>Cracks exist all along the seams, backfill has pushed into the structure.</td>
<td>1</td>
</tr>
</tbody>
</table>
Culvert-Style Bridges

HEADWALL CONDITION

What To Look For
Characteristics of the concrete in headwalls are similar to those of concrete in culverts. Refer to paragraphs on cracks and spalling.

FACTOR RATINGS FOR HEADWALL CONDITION

<table>
<thead>
<tr>
<th>Observed Condition</th>
<th>Factor Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition like new, no hollows, cracking, spalling, slabbing, delamination, chipping, nor settlement.</td>
<td>7</td>
</tr>
<tr>
<td>Minor headwall settlement and pulling away from the barrel are noted; minor hairline cracks are found.</td>
<td>5-6</td>
</tr>
<tr>
<td>Extensive undercutting and significant settlement of the headwall are noted; moderate cracking is found.</td>
<td>4-5</td>
</tr>
<tr>
<td>Major undercutting and extreme settlement is noted; considerable deterioration is found.</td>
<td>3-4</td>
</tr>
<tr>
<td>Undercutting is so severe that the headwall has started to rotate away from the barrel; major deterioration throughout the headwall is noted.</td>
<td>2-3</td>
</tr>
<tr>
<td>Significant rotation of the headwall from the barrel is obvious; spalling/cracking has occurred, along with associated deflection of the structure.</td>
<td>1-2</td>
</tr>
<tr>
<td>Severe movement of the headwall as a result of undercutting and settlement; severe deterioration and damage to the structure is noted.</td>
<td>1</td>
</tr>
</tbody>
</table>

BACKFILL
Consider this parameter only when there is evidence that barrel dimensions are undergoing significant dynamic changes.

THE SOIL COVER
The soil covering loads the culvert, but also has a beneficial load-distributing effect. Culverts with shallow cover are subjected to greater live-load stress than other culverts. The inspector should document the approximate soil cover at each culvert.
SUMMARY: RATING A METAL PRIMARY MEMBER

All factors discussed above contribute to adequate performance of the primary member, and thus need to be considered in its rating. The “primary member” rating may often be the lowest factor rating, but this may not always be the case. The performance of the culvert is a result of the interaction of all factors. These factors play roles of different importance depending on observed behavior, condition, geometry and site conditions. The relative importance of these factors is therefore, subject to the judgement of the Team Leader when rating “primary members” and the General Recommendation for the bridge.

CONCRETE CULVERTS

These are rigid structures and do not deflect appreciably before cracking or fracturing. Shape inspections, while important in flexible structures, have little value in inspecting concrete culverts. Also, soil stability and side support are less important for concrete culverts than flexible ones. However, surrounding soil must be stable to prevent settlement and carry loads. Inspections, thus should concentrate on possible defects in alignment, joints, and walls.

What To Look For

Visual Checks: All components of culvert barrels should be visually examined, including walls, floor, top, and joints. Tap the concrete with a hammer, particularly around cracks and other defects.

Misalignment: Check the barrel’s vertical and horizontal alignment by sighting along the crown and sides. Check for differential movement or settlement at joints between sections. Check vertical alignment for sags, beads, and faults. Check for sags during low flow. Look for spots with deep water or where sediment has been deposited. Misalignment may result from serious problems in the supporting soil; if due to improper installation or uneven settlement, further inspections may be needed to determine whether the condition is dynamic.

Seams (Joints): Defects are common and some may be serious. Typical joint defects include cracks, joint separation, and leakage (exfiltration and infiltration), but some culverts are designed with open joints to act as subdrains. Spalled or cracked joint edges may indicate expansion joints that are not functioning or full of incompressible materials. Identify any joints that are opened wide or are not uniform in width. Infiltration or exfiltration should also be noted. Separated joints may be caused by the same forces as misalignment, and are significant because they may accelerate leakage damage, causing erosion of backfill material.

Cracks: Location, size, and length or area of all cracks and spalls should be noted.

Spalling: Spalls often occur along cracks. Delaminations that are likely to become spalls may be detected by tapping with a hammer. These delaminations produce a hollow sound when tapped.

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Culvert-Style Bridges

Slabbing: Slabbing or slab shear refers to radial failure of concrete and occurs from distortion of reinforcement by excessive deflection. It is characterized by chunks of concrete shearing from the sides of the pipe. This is a serious problem that may occur under high fills.

What To Rate

For box culverts, rate the top slab as a primary member. Rate the walls as abutment stems, or piers. Rate the bottom as abutment or pier footings.

For circular pipes, pipe arches, ellipses or any other round shape, rate the entire barrel as primary members.

For arches, rate the arch as primary members. Rate the thrust blocks as abutment footings or pier footings.
This chapter includes the following rating items:

LIGHTING STANDARDS AND FIXTURES
SIGN STRUCTURE
UTILITIES AND UTILITIES SUPPORTS
Utilities

LIGHTING STANDARDS AND FIXTURES

What To Rate

Rate standards and fixtures on a per span basis, whether the item is above or below the deck. Rate lighting standards, lighting support, bulb housing, lens, and wiring including junction boxes. Rate all types of lighting, including roadway lighting, sign lights, traffic control, navigation and aerial obstruction. Lighting located on the approaches should be rated with the first or last span of the bridge if the lighting is close enough to the bridge to be considered bridge related lighting.

If several types of lighting are present on a given span, rate the condition of the worst system.

What To Look For

Check for collision damage, vandalism, and wind damage. Check structural integrity of standards and their anchorages. Check for spalls and cracking of concrete standards especially in the splash zone. For aluminum standards, look for wind-induced fatigue cracks, especially at bases and welded joints. Wood standards should be checked for rot and insect damage, especially at the bases.

Check for missing or inoperable units. Most inspections are done in daylight, so it may be difficult to determine if the lighting works. Look for obvious signs, such as a fixture hanging out of its housing, and exposed wiring. Aerial lights for aircraft are continuously lit. Navigation lights for ships are either continuously lit or have a photoelectric cell that turns the lights off during the day to conserve power. To test lights with a photoelectric cell, cover the cell for about one minute and check to see if the lights turn on. Navigation lights may be shut off during the non-navigation season.

Rating Examples

7 – New or near new condition. All fixtures appear to work.

5 – Minor collision damage, but not to the extent where structural integrity of the system is reduced. Some roadway lights may not be functioning. The standards may show minor deterioration.

3 – Collision damage that has reduced structural integrity of a standard or overhead frame. Any inoperable navigation, traffic control or aerial obstruction lights. Inclined poles. Any cracks in metal standard bases or welds.

1 – Any exposed wiring or other electrical shock potential. All traffic, navigation, or aerial obstruction lights inoperative. Any fixtures hanging out of its housing. Any cracks in welds or bases, loose anchorages, or deterioration that threatens the structural integrity of the system.

9.2
SIGN STRUCTURES

What To Rate

Rate effectiveness of bridge-related signs and structural condition of sign supports on a per-span basis. Bridge-related signs include load postings, "A" postings, navigation markers, height restrictions, and horizontal clearance markers. Signs on an approach should be rated with the span adjoining the approach. Signs on the under roadway are limited to bridge related signs such as clearance markers. Bridge Inspectors are responsible for all inspection aspects of signs attached to the fascia of a bridge (signage is for the under roadway). The Inspectors responsibility for overhead signage (signage is for the over roadway) is to inspect connection to the bridge including base plates of the posts. Additionally the remaining portions of the sign should be inspected as practical without the use of special inspection equipment. The remaining responsibility for the overhead sign rests with the Overhead Sign Structure Inspector.

What To Look For

Check for missing signs. Look for damaged supports or loss of legibility due to collisions, vandalism, deterioration, or other causes. Check for loose anchorages on the bridge and loss of foundation material around sign posts on the approaches. Check load posting signs for conformance with the department's Manual of Uniform Traffic Control Devices (MUTCD).

Rating Examples

7 - Signs are new or nearly new. No loss of legibility or damage of any kind.

5 - There may be minor loss of legibility due to dulled paint or loss of reflectorization. Graffiti, vandalism, or collision damage, but not affecting legibility. Minor deterioration or impact to supports.

3 - Signs are difficult to read for any reason. There may be considerable deterioration or impact damage to the supports. Any impact damage to an overhead sign. Sign is installed improperly or is otherwise nonfunctional (for example, a horizontal clearance marker with the direction of striping reversed).

1 - Sign illegible or missing, especially load-posting signs. Any overhead sign with collision damage or deterioration serious enough to threaten collapse. Any missing horizontal clearance markers.
UTILITIES AND UTILITIES SUPPORTS

What To Rate
Rate condition of the utilities on a per-span basis, including pipes, ducts, conduits, wires, junction boxes, expansion joints, couplings, valves, vents, pipe insulation, etc. Rate the supports and bracing. Include the condition of paint on utilities and their supports. If there are several utilities on the bridge, rate the worst utility.

If more than one utility is rated 4 or less, document the condition of each deficient utility.

EXCEPTIONS: Electric wiring or junction boxes for bridge lighting are rated with lighting standards and fixtures.

What To Look For
Inspect for breaks, cracks, expansion joint problems, and rust on pipes and ducts. Breaks and expansion problems are more likely when the substructure has settled. Check for leaks of any kind. Gas leaks are especially dangerous. Water or sewage leaks are especially serious if leakage is onto traffic or structural components. Look for loose coverings. Flaking asbestos is a serious problem. If the utility hangs below the beams, vertical clearance may be reduced. This is a deficiency that could be serious. Check vents and drains on encasement of pressure pipes. Do they appear functional?

For electric utilities that are not used for bridge lighting, check for loose wires or poor insulation. Missing covers or moisture problems are usually serious because of increased shock potential.

Inspect the supports for corrosion, loose connections, or lack of rigidity. Check for collision damage to the supports.

Rating Examples

7 – New or near new condition.

5 – Minor corrosion with no appreciable section loss, loss of wrapping, distortion or deterioration of one or two supports, but there is no sagging. No leaks.

3 – Heavy corrosion with noticeable section loss. Expansion joints may be nonfunctional. There may be several supports not intact causing sagging. Leaks in water or sewage lines.

1 – Flaking asbestos, major leaks or breaks. Any exposed live electric wires or other shock potential. Support failure resulting in serious distress to the utility. Major corrosion, impact damage, or severe sagging. Any gas leak.
CHAPTER 10

GENERAL RECOMMENDATION

This rating is the team leader’s assessment of the bridge condition overall. Give maximum weight to items of most importance, such as primary members, abutment stems, piers, scour, etc. Items of less importance have less influence in determining the general recommendation. The general recommendation should not be lower than the lowest of the individual rating items.

A general recommendation must be provided for every inspection except a type 4 (no inspection - under construction). For type 4 inspection reports, leave the general recommendation blank. Ratings of 8 (not applicable) and 9 (unknown) are never acceptable for the general recommendation.

The following relative weights are used in calculating the condition rating. Use these relative weights along with the scour ratings as a guide for the general recommendation:

<table>
<thead>
<tr>
<th>Item</th>
<th>Relative Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abutments</td>
<td></td>
</tr>
<tr>
<td>Joint with deck</td>
<td>4</td>
</tr>
<tr>
<td>Bearings, anchor bolts, pads</td>
<td>6</td>
</tr>
<tr>
<td>Bridge seat and pedestals</td>
<td>5</td>
</tr>
<tr>
<td>Backwall</td>
<td></td>
</tr>
<tr>
<td>Stem</td>
<td>8</td>
</tr>
<tr>
<td>Wingwalls</td>
<td></td>
</tr>
<tr>
<td>Walls</td>
<td>5</td>
</tr>
<tr>
<td>Deck Elements</td>
<td></td>
</tr>
<tr>
<td>Wearing surface</td>
<td>4</td>
</tr>
<tr>
<td>Curbs</td>
<td>1</td>
</tr>
<tr>
<td>Sidewalks and fascias</td>
<td>2</td>
</tr>
<tr>
<td>Superstructure</td>
<td></td>
</tr>
<tr>
<td>Deck structural</td>
<td>8</td>
</tr>
<tr>
<td>Primary member</td>
<td>10</td>
</tr>
<tr>
<td>Secondary member</td>
<td>5</td>
</tr>
<tr>
<td>Joints</td>
<td>4</td>
</tr>
<tr>
<td>Pier</td>
<td></td>
</tr>
<tr>
<td>Bearings, anchor bolts, pads</td>
<td>6</td>
</tr>
<tr>
<td>Pedestals</td>
<td>6</td>
</tr>
<tr>
<td>Stem solid pier</td>
<td>8</td>
</tr>
<tr>
<td>Cap beam</td>
<td>8</td>
</tr>
<tr>
<td>Pier Columns</td>
<td>8</td>
</tr>
<tr>
<td>Pier Footings</td>
<td>8</td>
</tr>
</tbody>
</table>
General Recommendation

Besides using relative weights as a guide, consult the following narrative descriptions:

7 – The bridge is in new condition, without deterioration except perhaps minor flaking of the top coat of paint. No work is needed other than routine maintenance.

6 – Only minor deterioration is present. Touch-up painting may be required or other minor repairs to secondary items. Minor bearing readjustments may be needed. There may be minor cracks or spalls in the substructure.

5 – Primary members and substructures are in good condition and do not need major repairs. Bridge load capacity is not reduced, but other parts of the bridge (such as deck elements) may need extensive repairs. The bridge may require repainting because of corrosion starting on steel members. Scour may have exposed, but not undermined footings.

4 – Moderate deterioration of primaries, secondaries, and substructures has occurred, but bridge load capacity is not substantially reduced. Considerable reconditioning of secondary members, substructures, and other components may be needed. Primary members do not yet need extensive reconditioning. There may be some minor substructure undermining.

3 – Considerable deterioration of some or all bridge components. The bridge may no longer be able to support original design loads. Load posting may be needed. There may be considerable section loss on primary and secondary members. Concrete components are spalled with rebar exposure over a large portion of the area. Extensive footing undermining may have occurred.

2 – Most bridge components are in poor condition. Primary and secondary members are extensively deteriorated. The bridge can no longer safely carry original design loads. The bridge may still be open to traffic, but at a reduced load posting. Temporary shoring or bracing may be necessary. Substructures may be so badly deteriorated to require immediate repairs. Scour and undermining may be extensive enough to threaten the stability of the bridge.

1 – Deterioration is so extensive that partial or total collapse is imminent. There is little or no load capacity, and the bridge may be closed. For the bridge to remain open to traffic, substantially reduced load posting and temporary shoring are necessary. Substructures may have settled, and be in danger of failing due to extensive undermining.

Addendum 2 - November 2001
CHAPTER 11

QUALITY CONTROL

This chapter includes the following sections:

QUALITY CONTROL CHECKLIST
CHANGING BRIDGE INSPECTION REPORTS
SUBMISSIONS TO MAIN OFFICE
FIELD REVIEWS
QUALITY ASSURANCE

Introduction

Quality control is a detailed process that includes field reviews and careful examination of all parts of the bridge inspection documentation. Quality control is accomplished mainly by checking all field reports for completeness, accuracy and conformance with this manual, and by reviewing the contents of the BIN folder. This effort is augmented by field visits where the actual inspection work is observed. The person responsible is the Quality Control Engineer (QCE), who must sign all inspection reports to certify that quality control has been done. An Inspection report is not official until it is signed by the QCE. The QCE is also required to complete and sign a field review checklist for each inspection team.

Checking for completeness involves thorough review of BIN folder contents to ensure that all required items are in the folder (see Chapter 2). Also, the QCE must make sure that all forms are present and completed properly. Using the following quality control checklist makes this easier.

Checking for accuracy and conformance with this manual requires the QCE to review the reports to make sure that all components of the bridge were properly rated and documented. The photos and remarks must be consistent with the ratings given and all elements requiring an increased level of intensity should be identified as so inspected. For example, if photos and descriptions indicate that a 2 rating is appropriate, but the item is rated 5, there is a problem needing resolution. Similarly, if a part of the bridge requires 100% hands-on inspection, but no statement to that effect was made in the inspection report, the QCE must determine if the required level of inspection intensity was done. The QCE should discuss any apparent problems regarding report accuracy with the team leader. Any required changes to the inspection report must be done as described later in this chapter.

11.1
Quality Control Checklist

The quality control checklist is a tool for reviewing bridge inspection reports. Its use is optional. After the QCE signs the inspection report, the checklist may be discarded. The following abbreviations are used in the checklist:

L (last) – Enter condition rating from the previous inspection report.

N (new) – Enter condition rating from the inspection report being reviewed.

C (comment) – check off if required comment has been provided.

P (photo) – check off if required photos have been taken and are appropriate.

SUMMARY OF RULES ON PHOTOS AND COMMENTS:

- Comments and photos are required with the biennial inspection for each item rated 4 or lower.
- Comments are required for items rated 5 or higher if the items were rated lower in previous inspection reports.
- Comments and photos are required for any item that is uprated because of repairs since the previous inspection.
- Comments are required for all items rated 9 except footings and piles.
- Unusual 8 ratings need to be explained with a remark.
- Comments need to be provided for any of the following kinds of rating changes:
  - from 8 to 1-7
  - from 1-7 to 8
  - from 9 to 8
  - from 9 to 1-7

- Comments are required if newly acquired record plans indicate a previous 8 or 9 rating was not appropriate.

GENERAL RECOMMENDATION

L & N – Enter the general recommendation for the bridge for the last and current inspection reports.

FLAGS

L & N – Check in the L (last) or N (new) column if any flags were issued. Check to see if flag documentation and actions are consistent with the previous and current flag status.
TP 349
[ ] Signature – Must be signed by the team leader for all reports.

[ ] Date –
- Should be the same as the last day in the field.
- For new bridges or major rehabs, is the inspection completed within 60 days from acceptance or opening to traffic?

[ ] Inspection Agency – Is this coded correctly?

[ ] Type of Inspection –
- Is this coded correctly?
- For new bridges or major rehabs, this should be 1 (biennial).

[ ] Posting Ok’d –
- Are vertical clearances on and/or under the bridge coded correctly?
- Is the load posting coded correctly?

[ ] 9s (unknown) – Is a comment provided for every item (except footings and piles) that is rated 9?

[ ] Gen. Rec. – Is the number appropriate for the ratings and comments in the inspection report?

[ ] Access – Is the actual access used to inspect the bridge noted on the form?

[ ] Flag Dese – Are all current or reissued flags briefly summarized?

TP 350
[ ] Date – Must match date of form TP 349.

[ ] SpanNos. – Are the correct number of spans inspected?

[ ] 9s (unknown) – Is a comment provided for every item (except footings and piles) that is rated 9?

[ ] Diving – Does scour documentation indicate water depths of 1.8 m or more at any substructure indicating the need for a diving inspection?

[ ] Special Emphasis –
- Does the special emphasis section in the report binder indicate non-redundant, fracture-critical, pins and hangers, fatigue-prone details, etc?
- Is there an identifying sticker on the binder cover?
Quality Control Requirements

[ ] 100% Hands-On –
  • Is this noted as being completed for fracture-critical members and/or special emphasis details?
  • Is the 100% hands-on inspection completed/waived for weld categories D, E, and/or E’ welds?

[ ] Field Notes –
  • Is the recorded date consistent with that recorded on forms TP.349 and TP.350?
  • Are the date, arrival, departure, temperature and weather blanks completed?

[ ] BIN Plate –
  • Where is it located?
  • Notify the Regional Bridge Maintenance Engineer of missing or defaced BIN plates for eventual replacement. (Consultant inspection teams are equipped to replace BIN plates)

[ ] Last Span Pier = 8 – Are all pier items rated 8 for single-span bridges and for the last span of multi-span bridges?

[ ] Last Span Joint = 8 – Is the superstructure joint for a single span bridge, or for the last span of a multi-span bridge rated 8?

DOCUMENTATION

[ ] Names – Do all documentation forms have TL and/or ATL names and other identifying information such as date and features?

[ ] Ref. by Report – Are inspection report comments cross-referenced with all relevant documentation?

[ ] Drolines –
  • Were droline readings taken along both fascias for bridges over water? This should be done for all biennial inspections and for those interim inspections where scour is a problem. If not, is there a valid reason why not?
  • Does this documentation include flow depth, estimated flood flow depth, and flow direction?

[ ] Scour –
  • Are channel profiles near substructures taken if water depth and/or turbidity prohibit a visual inspection?
  • Is the extent of scour documented by sketches?
  • Are substructure deficiency (underwater) sketches done, if necessary?
  • If there are any stream channel alignment problems, is there a stream alignment sketch?
  • Is water depth measured and documented to determine if diving is required?
PHOTOS
[ ] Standard Photos – Required for new bridges and after major rehabilitation.

[ ] North Arrow – Is the north arrow on the photo location sketch consistent with the direction of orientation?

[ ] Flow – Is the stream flow direction shown on the photo location sketch for bridges over water?

[ ] Photo No. & Loc. –
  • Are all photos located in the photo location sketch?
  • Are photo locations shown on the photo location sketch reasonably accurate?
  • Are above-deck photos identified as solid circles and below-deck photos as dashed circles?

[ ] References – Do all item numbers, descriptions and ratings given in the photo descriptions agree with the actual ratings and remarks (BD 188, 188a)?

INVENTORY
[ ] Signed – Was the inventory verification form signed by the preparer and reviewer?

[ ] Cont. Code – Should be entered for each line with changes. Lines with no changes should have check marks.

[ ] Clearances (R.R.) –
  • Were vertical clearances measured, if the bridge crosses a railroad?
  • Are the minimum clearance and its location noted?

[ ] Clearances (Hwy.) – Were vertical clearances measured if the bridge crosses a highway?

[ ] Debris Form – Was it completed if required?

[ ] Access Form – Was it completed when there was a change from the access shown on the preprinted TP 349?

[ ] Elect. Prox. – If required, was the Overhead Electric Survey form (BD 241) completed?

LOAD RATING
[ ] Signed – Was the most recent Level II load rating reviewed, initialed and dated by the Team Leader?

[ ] Match Plans –
  • Were structural changes to the primary members as shown on the plans or sketches-in-lieu of plans reflected in the Level II load rating?
  • Were any changes in the condition of the primary members reflected in the Level II load rating?
  • Were additional overlay thickness and railing changes (concrete parapet & steel railing) noted on the Level II load rating?
QUALITY CONTROL REQUIREMENTS

PLANS
[ ] Plans –
  • Were record plans or sketches-in-lieu of plans reviewed by the Team Leader?
  • Were the plans initialled and dated by the Team Leader?
  • Were the plans updated to reflect comments in the inspection report? (e.g., new wearing surface, railing replacement, bridge widening)

SPECIAL EMPHASIS SECT.
[ ] Welds Located – Were D, E, and E' category welds located on sketches in the Special Emphasis section of the binder?

[ ] Category – Were all D, E, and E' welds properly identified?

[ ] Fatigue Analysis – This must be done for all category E and E' welds to exempt the 100% hands-on requirement.

[ ] NR-FCM Drawn – Does the Special Emphasis section have sketches identifying all non-redundant and fracture-critical members/details?
# QUALITY CONTROL CHECK LIST

**BIN** ____________________________  **REGION** ____________________________  **COUNTY** ____________________________  **INSPECTION DATE** __/__/__  **TYPE OF INSPECTION** ____________________________

**T. LEADER** ____________________________  **Q.C. ENGINEER** ____________________________  **Q.C. DATE** __/__/__  **PREVIOUS INSPECTION DATE** __/__/__

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## SIGNATURE

**CHECK BOX IF COMPLETED**

| SIGNATURE | DATE | INSPECTION AGENCY | TYPE OF INSPECTION | POSTINGS OKD | GS | GEN. REC.
|-----------|------|------------------|--------------------|--------------|---|---------|

**ACCESS**

**FLAG DESC.**

**LEGEND:**

L = LAST INSPECTION RATING
N = NEW INSPECTION RATING
C = CHECK IF COMMENTS' WRITTEN
P = CHECK IF REQ'D PHOTO TAKEN, AND IS APPROPRIATE

11.7
## QUALITY CONTROL CHECK LIST

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</table>
Changing Bridge Inspection Reports

Occasionally, an original entry on an inspection report must be changed. A change may be necessary because of an error by the inspector at the bridge, quality control review, discovery of new information after the first part of the inspection, etc. In an effort to ensure the validity and integrity of the bridge inspection report, absolutely no erasures are allowed. Except for minor administrative changes, all inspection report changes must be made by the Team Leader or the Quality Control Engineer. The following steps need to be taken when making changes to the inspection report:

• **ADMINISTRATIVE CHANGES**

If an inspection report must be changed only for administrative reasons (such as a coding error in the control data), draw a single line through the incorrect entry and write the correct one above or below the lined-out entry. If the reason for the change is obvious, no further action is required. Otherwise, provide an explanatory note at the bottom of the page.

• **CHANGES IN THE FIELD**

When a change is required to reflect new information (e.g. discovery of a defect not previously observed), line-out any ratings and/or comments as necessary and add the new ratings and/or comments next to the lined-out items. Provide an initialed and dated explanatory note at the bottom of the page.

• **MINOR QUALITY CONTROL CHANGES**

When the Quality Control Engineer needs to make a minor change, such as a 9 rating to 8, or finds a discrepancy between a condition rating and the remarks or photos, (where the correction is obvious), the QCE should line out the rating, remark or photo description, and write the correction next to the lined-out item. The QCE should date and initial the change.

• **SIGNIFICANT QUALITY CONTROL CHANGES**

When the Quality Control Engineer disagrees with the conclusions of the Team Leader on one or more significant element of the bridge, the QCE and TL need to confer and agree on the changes (if any) that need to be made. If a change is necessary, it can be made by either the TL or the QCE by lining out any ratings, photo descriptions, sketch components, remarks, etc. that have to be changed. New ratings, remarks, etc. should be made next to the lined-out items if possible. It may be necessary to supplement the report with additional pages of comments. All changes need to be initialed and dated. Changes made by the QCE should be co-initialed by the TL to show concurrence with the changes. If the TL does not agree with the QCE’s changes, the Regional Structures Engineer should be consulted to resolve the problem.
Submissions to Main Office

Send inspection and inventory data to the Structures Division for quality assurance review. The submissions should be transmitted as follows:

SUBMISSION NUMBERING

Each submission has a submission number that must appear on all submission correspondence, including transmittal memos and submission summary sheets.

The submission is a five-digit code consisting of three sub-fields. The first two digits are as follows:

<table>
<thead>
<tr>
<th>Region</th>
<th>Insp. by Consultant</th>
<th>Insp. by State</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>11 New York Co.</td>
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<td></td>
</tr>
<tr>
<td>11 Queens Co.</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>11 Kings &amp; Richmond Co.</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

Niagara Falls Br. Comm. 2L
NYS Bridge Authority 2K
NYS Thruway Authority 2L
Ogdensburg Br. & Port Authority 2M
Port of NY Authority 2O (Alpha O)
Power Authority 2P
Seaway Authority 2Q
Thousand Island Br. Authority 2S
MTA Bridges & Tunnels (TBTA) 2U
Nassau Co. Br. Authority 23

The third digit is the last digit of the inspection year. The last two digits represent the sequential submission number, starting with 01. Re-submissions are identified by adding an “R” suffix to the original submission number.
Examples:
Submission number 56608 is the eighth (08) submission in 1996 (third digit), inspected by state inspectors in Region 6 (56).

Submission number 2L012 is the twelfth submission in the year 2000 (or 1990, or 2010), inspected by the NYS Thruway Authority (2L).

The Uniform Code of Bridge Inspection allows inspections to be submitted as late as January 15 following the year of inspection. The third digit of the submission number must reflect the year of inspection, not year of submission. The last two digits of the submission number (sequence number) should continue the numbering from the last submission in the inspection year. Do not reset the sequence to 01 when submitting in the early part of the new calendar year for inspections completed in the previous year.

REQUIRED ITEMS
Submissions will consist of the following:
- Letter of transmittal (3 copies)
- Submission summary sheet (3 copies)
- Photocopy of inspection report (without photos) for each bridge submitted
- Original inventory verification forms
- Debris forms
- Overhead electric survey forms
- Access Category forms
- Photo packets as required (explained later in this chapter)
- R.R. vertical clearance forms
- Sample BIN folders

ASSEMBLING AND MAILING
All required items listed above, should be boxed and sent to:
NYS DOT
Bridge Inventory and Inspection
State Office Campus
Bldg: 7, Room 216
Albany, NY 12232

Attn: , Main Office Liaison Engineer

Put no more than one submission in a single box. However, more than one box may be required for a submission.

Include three copies of the transmittal letter and submission summary sheet in the main submission box. If more than one box is required for a single submission, enclose a copy of the transmittal letter and submission summary sheet in each additional box.
Quality Control Requirements

All required items in the submission should be physically grouped together. For example, put all inventory forms together in a bundle, all inspection forms together in another, etc. New bridges and major rehabilitations are the exception. For these bridges, attach the inspection report to the appropriate inventory forms with a paper clip.

Include BIN folders for at least 10% of the bridges inspected by each team, with a minimum of one per team. These will be reviewed for quality assurance as described later in this chapter. Before sending a submission, contact the Main Office Liaison Engineer to find out if the Liaison Engineer has any special BIN folder needs.

INSPECTION REPORTS

The inspection reports sent to the Main Office consist of completed forms TP349 and TP359 followed by comment sheets, documentation forms, sketches and, where applicable, flag notification letters, and Flagged Bridge Report(s). These items should be stapled together (do not use paper clips).

PHOTO PACKETS

A photo packet consists of the Main Office copy of the inspection report (described above) plus a photo location sketch, and photos mounted and cross-referenced on form BD 187. Send a photo packet for the following cases:

- General recommendation is 3 or lower for the first time.
- Bridge is posted for load, and was not previously posted
- Bridge was structurally flagged during the most recent inspection (exception: if the structural flag was issued for missing, damaged or illegible load posting signs, and there are no other structural flags, no photo packet is required)

GENERAL

- All required items for each bridge must be in the same submission.
- Photocopies must be legible
- The number of bridges in a submission should generally be between 25 and 50 bridges (authority submissions are generally smaller).
- Send original inventory forms (not photocopies). All other documents should be photo copies.
- Load rating updates should be sent to the Regional Load Rating Engineer.
- For biennial inspections, inventory verification forms are required. Forms for debris, elec-
trial survey, access category and RR vertical clearance are only required when changes from the previous inspection are found.

- Interim inspections do not require forms for inventory verification, debris, electrical survey, access category, or RR vertical clearance.

- The Uniform Code of Bridge Inspection requires that an inspection report be submitted by two months after the completion of field work, and one month from quality control date.

**MAIN OFFICE REVIEW**

The Structures Division will do a quality assurance review. After this review, one of the following courses of action will occur:

- The data will be processed with or without comments, and the BIN folders are returned.

- Some data will be processed with or without comments, and the BIN folders are returned. The remaining data will be returned with comments for revision and resubmission.

- The entire submission is returned with comments for revision and resubmission.

**Field Reviews**

These are part of both quality control and quality assurance. The QCE should visit each new team in the field within six weeks of the new assignment. Subsequent visits by the QCE should be at approximately six month intervals. More frequent visits may be necessary if there are problems. Other field reviews may be done by Regional project managers, Regional Bridge Management Engineers, Regional Bridge Evaluation Engineers, main office bridge inspection liaison engineers, and the Federal Highway Administration.

Field reviews may be scheduled or unscheduled. The time needed to observe the team doing inspections depends on the experience of the team and the type of bridge inspected. Any observed problem with the work should be documented on the field review checklist. Even if the problem is not specifically covered in the checklist.

Field reviews should be done when the teams are inspecting bridges that are sufficiently large or complex, and have some problems, to adequately judge the ability and knowledge of the teams.

Safety is the most important element in New York's bridge inspection program. With this in mind, field reviews shall include a review of the team's compliance with all applicable state and federal safety regulations. This is also a good time to discuss current safety issues and overall safety awareness with the team.

The following Field Review and Safety Field Review Checklists should be used for all field reviews:
FIELD REVIEW CHECKLIST

Region ___________________________ County _______________ BIN _______________________

Team Leader ________________________ Asst Team Leader(s) ____________________________

QC Engineer ________________________

Date _______________

The following items were reviewed with the inspection team during this field visit:

☐ Proper determination & use of direction of orientation.
☐ Field check of previous postings.
☐ Awareness & use of the “rating the worst” list, with proper documentation of all elements.
☐ Review of previous inspection report before present inspection to determine problem areas.
☐ Review of special emphasis sec. & plans for members & details requiring special attention.
☐ Use of proper access equipment.
☐ Identification of D, E, and E* welds and proper documentation.
☐ 100% hands-on inspection of non-redundant members performed.
☐ Proper use of D-meter, and section loss documentation.
☐ Understanding and using flagging procedures.
☐ Proper use of rating scales.
☐ Proper input on report forms.
☐ Appropriate use of sketches and tables when preparing documentation.
☐ Verification/update of plans or preparation of sketches in lieu of plans.
☐ Taking and documenting drop line readings and/or substructure scour documents when required.
☐ Proper photo documentation & cross-referencing.
☐ Use of basic inspection equipment, forms, and manuals.
☐ Proper use of safety equipment & procedures.
☐ Primary completion of inspection report in the field.
☐ Maintenance of daily log.
☐ Deployment of resources and progress of inspections.

GENERAL REMARKS:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

QCE SIGNATURE ____________________________

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SAFETY FIELD REVIEW CHECKLIST

Page 1 of 2

REGION: ___  BIN: ___  DATE: ____  Q/A REVIEWER: ________

TEAM LEADER: ________  ASSISTANT TEAM LEADER: ________

Equipment

Is the appropriate Personal Protective Equipment (PPE) being used?  Y  N

Is the required PPE available in the van?  Y  N  Safety Manual?  Y  N  First Aid Kit?  Y  N
(See list on page 2)

Does the team have a list of emergency phone numbers and locations available in the van?  Y  N
(If they are not available, it is suggested that they get them)

Work Zone Protection

Are cones and signs being utilized on the approaches?  Y  N  If no cones and/or signs used, explain why.

Is Maintenance and Protection of Traffic being used?  Y  N  If no, should it be?  Y  N  If it should be, explain.

If yes, check who is performing set-up:  ☐ contractor  ☐ state forces

If yes, circle equipment and/or personnel used: Arrow board, Shadow Vehicle(van), Shadow Vehicle(truck), Impact Attenuator, Flaggers, Other ________

If yes, describe the conditions that require the M & PT set-up (i.e. 100% "hands-on" inspection, pier, deck, fascia, or primary member inspection). ________

Is the set-up in conformance with MUTCD Standards?  Y  N  If not, why? ________

Access & Fall Protection

Are the inspection crew members trained in fall protection and scaffolding safety?  Y  N  If yes, name of person and organization who provided training ________

If no, name people who haven't ________

If a state UBRI is being used, are the operators certified?  Y  N  N/A
SAFETY FIELD REVIEW CHECKLIST
Page 2 of 2

If a state bucket truck is being used, have the operators been trained in its operation? Y N N/A
If a rental aerial lift device is being used, have operators been trained in its operation? Y N N/A
If no, why? Circle type used: _____ UBIU, 30' Bucket Track, _____ Lift.

Is the bridge being rigged? Y N If yes, circle type of set-up: Cable and Catenary, Hook and Chain/Wire, Pick with Trolley Rail, Other(describe)

If yes, are all safety procedures being followed? Y N If no, why

If yes, are they riggers knowledgeable in all applicable OSHA regulations? Y N If no, why?

If required, what type of fall protection equipment is being used?

Questionnaire

Does the inspection team feel additional safety equipment is needed? Y N If yes, what?

Does the inspection team feel additional safety training is needed? Y N If yes, what?

Does the reviewer feel additional equipment and/or safety training is needed? Y N If yes, what?

General comments


Personal Protective Equipment List

Hard Hat  High Visibility Apparel
Boots  Protective Eyewear
Respirator  Harness
Lanyard  Gloves

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Quality Assurance

The purpose of quality assurance is to ensure that bridge inspections are reasonably uniform statewide and that they are consistent with the requirements of this manual. Uniformity from region to region is essential for an accurate assessment of the state's bridges. Bridge inspection quality assurance is the responsibility of the main office Structures Division Bridge Inspection Unit staff. All inspection reports, including those submitted by the authorities, are subject to the quality assurance review.

The initial submission review is a check of selected items of each inspection report as follows:

- Inclusion of all required forms.
- Explanations of all 9 ratings other than footings and piles.
- Team Leader and QCE signatures.
- Correct inspection date, field dates, and personnel identification.
- Control data.
- Flag documentation.

The bridge inspection liaison engineers do the technical QA review. This includes a detailed review of the sample BIN folders. All rated items, comments, photos, sketches, flag reports, etc. are carefully checked for technical accuracy and compliance with this manual. This review may be as detailed as the quality control review. Other inspection reports without BIN folders are sampled and given a less detailed review that focuses on the more important items rating items, and documentation. Every other inspection report not otherwise reviewed in more detail, is scanned briefly for obvious technical errors or omissions.

If there appears to be a serious problem with the use of the rating scale, if the report is incomplete, or there is some other significant technical problem, the liaison engineer may reject the report and require resubmission. For minor problems, the report may be accepted, but comments provided so that the QCE can take steps to correct the problem for future inspections. If the Team Leader and/or the Quality Control Engineer disagree with the comments, they should contact the liaison engineer to resolve any differences.

The liaison engineers will also do field reviews as part of quality assurance.
Quality Control Requirements
Appendix A
APPENDIX A
SAFETY

Safety is the most important element in New York's bridge inspection program. Inspectors must never place themselves or the public in unnecessary danger to expedite completion of an inspection. Inspectors must always follow all applicable federal and state safety regulations and guidelines, including but not limited to, the department's Bridge Inspector's Safety Manual, Safety Bulletins, the FHWA Bridge Inspector's Training Manual/90, and OSHA and ANSI standards.

In order for an inspector to operate a New York State Department of Transportation Underbridge Inspection Unit (UBIU) as either a ground or bucket operator, the inspector must show proof of certification that they have successfully completed the state's UBIU training program. Non-certified inspectors may ride in the bucket with a certified bucket operator. Re-certification is required for any operator who has not operated a UBIU for 90 days or more.

Inspectors must also follow all applicable OSHA standards when using or operating a rental UBIU.

Inspectors must also follow "common sense" rules, always being aware of the surroundings and of all dangers present. Appropriate safety equipment must always be used properly, and the following articles worn:

- Bright orange hard hat manufactured to current ANSI standards.
- Bright orange safety vest or other safety apparel.
- Proper footwear (heavy leather work shoes or boots, not sneakers).

The following articles should be worn as circumstances warrant:

- Proper fall protection, if working in a UBIU, bucket truck, scaffold, lift platform, or any other location where a fall of more than 1.8 m could occur.
- Life vest, if working over or near water where a drowning hazard exists.
- Face shields or eye protection manufactured to current ANSI standards, when using grinding tools or chipping hammers.
- Special equipment when working in enclosed spaces without normal air circulation, such as long culverts, box girders, or pier interiors (reference the most current "Confined Space Entry Policy and Procedures" Safety Bulletin).

The following Department Safety Bulletins must be followed when inspecting bridges. This list represents the most current versions. Since these bulletins are subject to change, it is the inspector's responsibility to update these Safety Bulletins as they are revised. Contact your Regional Employee Safety and Health Representative for the most current Safety Bulletins.

- Reporting Injuries and Accidents - SB-8-6
- Working Near Railroads - SB-91-2
• Confined Space Entry Policy and Procedures - SB-99-3
• Rabies Virus - SB-92-1
• Working Near Energized Electrical Lines and Equipment - SB-92-2
• Bloodborne Pathogen Exposure Control Plan - SB-93-3
• Hard Hats and High Visibility Apparel - SB-93-4
• Work Clothing Guidelines - SB-00-4
• Seat Belts - SB-00-1
• Histoplasmosis - SB-94-4
• Poison Ivy - SB-94-6
• Tailgate Safety Training - SB-94-8
• Safe Operating Condition of Vehicles and Equipment - SB-94-9
• Modification of Vehicles and Equipment - SB-94-10
• Vehicle Warning Lighting Standards - SB-94-12
• Cold Weather Hazards - SB-95-2
• Asbestos - SB-99-5
• Work Zone Enhancements for Shoulder Work - SB-95-8
• Vehicle and Equipment Backing - SB-97-3
• Fall Protection - SB-00-5
• Aerial Lift Devices - SB-00-7
• Working in Proximity to Water - SB-00-6
• Respiratory Protection - SB-98-11
• Chain Saw Safety SB-01-01
• Rental/Leased And Surplus Equipment - SB-00-8

Listed below are some highlights of the most commonly referred to Safety Bulletins. Refer to the respective Safety Bulletin for more details.

**SB-00-5 “Fall Protection”**

A. Employees working in areas unprotected by passive fall protection systems (OSHA specified railings or nets), where danger of falling exists for a fall of six (6) feet or greater, shall use a fall arrest system meeting OSHA standards. A full body harness is the only acceptable device for personal fall protection.

B. When working on suspended scaffolding at an elevation of 6 feet or more above ground or other surface, fall protection independent of the scaffold is required. For suspended scaffolds, railings do not eliminate the need for fall protection.

C. When working in the bucket of an aerial lift device, a personal fall arrest system is required. A full body harness is the preferred device for fall protection in aerial lift devices. Safety belts may be used as “positioning devices” in aerial lift equipment; and are an acceptable alternative to harnesses only in this application. Because aerial lifts have passive fall protection systems, the intent of the belt is to keep the occupant(s) in the device upon impact, not to attenuate a fall from it. Therefore, a 6-foot lanyard will probably not work with a safety belt. The lanyard has to be short enough to prevent you from falling out of the bucket.

*Addendum 2 - November 2001*
D. OSHA requires that scaffolding be designed by a Qualified person and erected by a Competent one. If the scaffolding has been properly designed by a qualified person, the rigger should be able to quantitatively support the system’s ability to meet OSHA Standards. The competent person on site should be able to answer the Team Leaders questions concerning limitations in weight, height, and number of people it can support. If the rigger does not know the system’s limitations, then it is possible that it has not been properly designed. If this is the case, then the Team Leader should call the Project Manager for direction. See OSHA 29 CFR 1926.450(b) for information on the responsibilities of these two titles.

E. The erector/contractor should instruct the inspection team on the proper use of the scaffolding system at the beginning of each work day.

F. Although the rigger is primarily responsible for making sure the scaffolding is assembled correctly, it is good practice for the inspection team to inspect the scaffold daily before use.

G. When climbing requires 100% fall protection, two lanyards are generally required. One lanyard needs to be anchored while the other is being reattached.

SB-00-7 “Aerial Lift Devices”

A. When working in the bucket of an aerial lift device, a personal fall arrest system is required. See SB-00-5 “Fall Protection” note C for the types of fall protection systems allowed.

B. Employees climbing in and out of an aerial lift device shall maintain 100% fall protection for heights six (6) feet or greater.

C. Employees shall keep both feet on the bucket floor while the bucket is moving. Employees shall not attach themselves to an adjacent structure while working from the bucket. Employees required to leave the bucket to gain access to a work location shall maintain 100% fall protection by connection to a safety line or structure. You can’t unclip your lanyard from the bucket and connect it to the adjacent structure unless a second lanyard maintains your fall protection during the transfer. Employees exiting buckets in locations requiring 100% fall protection shall wear a full body harness.

SB-00-6 “Working in Proximity to Water”

A. A personal floatation device (PFD) is required where a danger of drowning exists. However, this requirement can be superseded with the use of 100% fall protection. If an employee cannot fall into the water as the result of use of 100% fall protection, there is no danger of drowning and a PFD is not required. Your lanyard needs to be anchored high enough above the water to prevent you from hitting the water when the lanyard is fully deployed.
Appendix B
Appendix B
APPENDIX B
NON-DESTRUCTIVE TESTING PROCEDURES

Occasionally, when visually examining steel, inspectors will detect a crack or suspected crack that needs to be verified by nondestructive methods. Dye-penetrant and magnetic-particle inspection techniques are used. For either method, photograph the test area both before and after testing.

Dye-Penetrant Testing

Proper surface preparation is essential. Remove all paint, rust, dirt, scale, welding flux, grease or other impurities from all surfaces within 80 mm of the test area. Any hand tools, power tools, or chemicals that will remove contaminants without masking a discontinuity, are acceptable. In addition, weld profiles must have a smooth contour and transition with the base metal, such that surface irregularities will not interfere with test results. Sometimes, the weld must be ground to accomplish this. After surface preparation, clean the test area with solvent and allow it to air-dry thoroughly before applying the penetrant.

Apply a thin, even coating of the penetrant over the entire test area. Penetrant must be applied only when the surface temperature is between 2°C and 50°C. The preferred minimum temperature is 16°C. The penetrant must remain on the test area for a minimum time (dwell time) consistent with the manufacturer's recommendations, not to exceed 60 minutes.

After this dwell time, wipe the test area with a clean, dry, lint-free cloth until most penetrant is removed. Then, lightly moisten the cloth with solvent and wipe the test area until all excess penetrant is removed. Too much solvent will remove the penetrant from cracks thereby making the test inaccurate. Allow the area to air-dry thoroughly before applying developer.

Apply developer according to manufacturer's instructions. Minimum development time is 7 minutes. If no cracks are apparent after this period, and the test has been properly done, conclude that there are no surface discontinuities.

Photograph any revealed cracks. Investigate further by re-grinding the test area to a depth of 1 mm. Retest and photograph the result. If the second test does not reveal a crack, the defect was probably only a surface discontinuity that was ground out. Otherwise, the detected defect is a crack.

After testing, remove all developer and repaint the test area if it is a painted bridge.

Magnetic-Particle Testing

Generally, this test will be done only by people trained or otherwise approved by the Structures Division.

The test area surface must be prepared as thoroughly as for dye-penetrant testing. Also, the steel areas onto which the poles of the electromagnet are applied, must be cleaned to bare metal. The test area need not be cleaned with solvent afterwards.
The test area is magnetized with an electromagnet called a yoke that operates with a 110 V, 60 Hz power supply producing a DC magnetic field. The magnetic field must be strong enough to produce a minimum lifting force of 180 N at the pole spacing used.

Dry magnetic particles come in a variety of colors. Select one providing maximum contrast with the test area. Particles are applied with a powder blower that must provide a light, uniform, dust-like coating of the test area. Particles may not be reclaimed for reuse.

This inspection technique is most sensitive to discontinuities with the major axes normal to the line between the poles of the yoke. Since discontinuities can have any orientation, the test area must be magnetized in at least two directions 90° apart. The test area must be magnetized before applying particles.

Use the following test procedure:

1. Place the yoke on the test area and energize the magnetic field.
2. While maintaining the field, apply the dry magnetic particles in a light, uniform coating between the poles and on the test area.
3. Remove excess particles using a dry air current that is not too strong to disturb particles that may be attracted to a flux leakage field indicating a discontinuity. Subsurface discontinuities may appear as broad, fuzzy, lightly held powder patterns.
4. De-energize the field, remove the yoke, and inspect. Photograph the area if a discontinuity is apparent.
5. Turn the yoke 90° and repeat the procedure.

As with the dye-penetrant procedure, the test area should be ground down 1 mm and retested if any discontinuity is apparent.
Appendix C
APPENDIX C
UNDERWATER INSPECTION

1. PROGRAM DEVELOPMENT

A. FEDERAL REQUIREMENTS

The 1967 collapse of the Silver Bridge in Virginia caused the establishment of the National Bridge Inspection Standards (NBIS). The 1985 collapse of the Chickasawbogue Creek Bridge in Florida due to pile failure underwater prompted FHWA to issue a directive to each state to establish an underwater inspection program.

In 1988 NBIS was revised to establish procedures for underwater diving inspection. FHWA issued Technical Advisories T5140.20 (9/16/88), T5140.21 (9/16/88) and T5140.23 (10/28/91). These advisories established inspection frequency, levels of inspection, qualification and training of personnel, evaluation of scour vulnerability, and others.

B. N.Y.S. REQUIREMENTS

The Uniform Code of Bridge Inspection (Appendix F) and the 1995 NYS Diving Specification established the criteria for identifying a bridge for underwater diving inspection, maximum inspection interval, filing requirements, and qualifications and responsibilities of diving inspection teams.

2. N.Y.S. DIVING INSPECTION PROGRAM

CRITERIA FOR SELECTING BRIDGES

See Part 165.4(b) of the Uniform Code of Bridge Inspection in Appendix F. In addition to Part 165.4(b)(3) of the Code, the NYS Diving Specification states that a diving inspection should not be done for bridges meeting all of the following criteria:

- The SSU (substructure unit) has a maximum water depth of 0.9m (3’) or less.
- The current is 0.6 m/sec (2 ft./sec.) or less.
- A general bridge inspector using chest waders could adequately inspect the SSU.

Initially, the recommendation for a diving inspection should be made during the general inspection. A diving inspection should not be recommended where the high water is seasonal. If low water conditions allow a complete scour and foundation evaluation by the general bridge inspector, the general inspection should be scheduled during low water.

The Main Office Structures Division is responsible for managing the diving program: the final decision regarding the inclusion of a bridge in the diving program will be made by the Structures Division.
Appendix C

INSPECTION FREQUENCY

The frequency of a bridge diving inspection is based on the following criteria:

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>INSPECTION FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSU General Recommendation of 1 or 2, or an active structural flag due to an underwater condition</td>
<td>1 year</td>
</tr>
<tr>
<td>SSU General Recommendation of 3</td>
<td>2 years</td>
</tr>
<tr>
<td>SSU General Recommendation of 4 or greater</td>
<td>5 years</td>
</tr>
</tbody>
</table>

If it becomes necessary to deviate from these frequencies, a detailed explanation should be provided regarding the rationale for this departure.

GENERAL INSPECTION ACCESS CATEGORY COORDINATION

For bridges requiring diving inspection, be sure to so indicate on the Access Category Form (BD 192) and mark the diving inspection box on form TP350.

SCHEDULING INSPECTIONS

Diving inspections should be coordinated with the general inspections. If a diving and general inspection are scheduled for the same year, the diving inspection should preferably be done before the general inspection. This allows the Team Leader to have up-to-date foundation and stream channel information, which could help the Team Leader rate items that might otherwise be rated 9 (unknown).

If an inspection team encounters high water during a scheduled general inspection, they should either postpone this bridge for inspection during low water, or inspect as much of this bridge as possible and return during low water to complete the inspection. This avoids the extra cost of diving inspections.

INSPECTION INTENSITY

Diving inspections are detailed, visual and/or tactile inspections that may require partial cleaning. All surfaces of underwater components (e.g., footings, piles, stems, scour protection devices) are inspected and all anomalies such as section loss, voids, holes, etc. are measured. The inspection is done by a diver experienced in bridge inspection under the direction of a Professional Engineer (on-site P.E.). The diving inspection does not normally employ nondestructive testing procedures.
FATHOMETER SURVEYS

A fathometer survey is a representation of the channel bottom usually by a grid parallel to both facias and the substructure. The result of the survey is a channel bottom contour map including areas around the bridge foundations. The change in channel bottom contours can be detected by comparing contour maps from fathometer surveys done over time. This is useful in identifying progressive scour activity and related stream channel aggradation and degradation.

Generally, a baseline fathometer survey is done for every bridge in the diving program. The frequency of subsequent surveys depends on the following factors:

- Actual or potential scour problems
- History of scour and flooding problems
- Certain design features (such as spread footings and inadequate hydraulic openings) that may increase scour susceptibility in erodible streams
- Aggressive or unstable streams with active aggradation, degradation, steep slopes, high velocities, bank erosion, and tendencies of lateral migration
- Streams with adverse hydraulic or flow conditions, such as sharp bends and crossings near confluences
- Areas of tidal influence

Additionally, fathometer surveys should be done after a bridge rehabilitation that significantly changes the substructures and/or stream, and after installing scour countermeasures and retrofits. Finally, the survey frequency needs to reflect the scour ratings provided in the diving and general inspection reports as follows:

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>SURVEY FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scour ratings of 1 or 2, or active structural flag for a scour problem</td>
<td>1 year</td>
</tr>
<tr>
<td>Scour rating of 3</td>
<td>2 years</td>
</tr>
<tr>
<td>Scour rating of 4 or higher</td>
<td>5 years</td>
</tr>
</tbody>
</table>

If it becomes necessary to deviate from these frequencies, a detailed explanation should be provided regarding the rationale for this departure.

The recommendation to do a fathometer survey may be made by the Regional Hydraulics Engineer or the Regional Structures Engineer subject to the concurrence of Main Office Structures Division.
USE OF DIVING INSPECTION INFORMATION DURING GENERAL INSPECTION

During a general bridge inspection, the depth of water and/or the stream velocity may preclude direct inspection of the stream channel bottom, scour, and the underwater parts of the abutments, wingwalls, and piers. The general bridge inspector should review the most recent diving inspection report and the fathometer survey report. General observations of the bridge, such as superstructure and substructure settlement may be combined with the information from the diving/fathometer reports, to rate elements such as footings, stem, and piers.

Indicate on Form BD 188 of the inspection report when a diving inspection report and/or a fathometer survey report has been used as the basis for rating any bridge element, and provide the date of the referenced report. The Team Leader should provide the rationale for a 9 rating when pertinent information is available in the diving inspection report and/or the fathometer survey report.

ROLES AND RESPONSIBILITIES

The Main Office Structures Division is the project manager responsible for contract administration of the diving and fathometer survey program. Activities include:

- policy interpretation
- maintaining the diving specification
- reviewing estimates
- negotiating contracts
- reviewing progress reports
- communication with consultants regarding technical and procedural issues
- personnel approval
- changes to scope of work such as addition or deletion of SSUs.
- quality assurance review of the diving reports and fathometer surveys to ensure compliance with the specification and technical integrity of the reports
- maintaining a database with information used in producing monthly progress reports, federal compliance lists, and lists of bridges scheduled for the diving season
- preparing the list of scheduled bridges which is provided to the Regions for review and input, before being sent to the consultants
- assists Regions if technical questions and issues arise, and serves as liaison between the Regions and the consultants.
Appendix C

The diving consultant engineering firm is responsible for:

- performing diving inspections and fathometer surveys in accordance with the diving agreement
- performing quality control of all work
- applying the Flagging Procedure, Appendix I of this manual, to both diving inspections and fathometer surveys

Documentation of substructure elevation at channel bottom should include a textual analysis of the existing conditions:

- in comparison to the conditions at the time of construction and any later modifications
- in comparison to the conditions during the last inspection and/or survey
- relative to the remaining embedment of the substructure

The Regions provide essential information to the Main Office. Site-specific information from the Regions is essential in evaluating recommendations for underwater repairs, inspection frequency, and further investigations. Such recommendations need to be reviewed by the Regions to ensure appropriate action, including notifying the Main Office of any actions that might affect agreements, schedules, and/or records maintained in Albany.

It is the Region's responsibility

- to provide all pertinent information to the diving consultant engineering firm prior to any inspection or survey. If this information is not available, the consultant shall notify the Main Office and shall then recommend further investigation in the inspection report or fathometer survey report.
- to actively monitor general inspection reports that have recommendations for further investigation by diving. If these bridges are not in the diving program and are judged to be appropriate additions to the program, the Regional Diving Manager should coordinate with the Main Office to get the bridges scheduled for diving and/or fathometer survey.
Appendix D
Appendix D

APPENDIX D
MOVABLE BRIDGES

Generally, inspection of mechanical and electric components of movable bridges is beyond the scope of general bridge inspections, but structural components of movable spans must be inspected with the same intensity required for conventional bridges.
Appendix E
APPENDIX E

SUSPENSION BRIDGES

Most suspension bridges are large, unique structures that require specialized bridge-specific inspections according to specifications provided by the owner. If there are no specific instructions to the inspector, use the following information and the guidelines in the FHWA Bridge Inspector’s Training Manual/90 (section 21.2).

All suspension bridges have common features that the inspector needs to be aware of. The superstructure is supported by vertical suspenders, which in turn, are supported by a main suspension system. That system usually consists of two or more large cables, but eyebar chains may be found on older or smaller bridges. The suspension system is in tension and requires substantial end anchorage with at least one intermediate per support. The main suspension system is considered fracture-critical, and load-path non-redundant, thus requiring special inspection techniques.

Eyebar chains must be inspected with the same inspection intensity as any fracture-critical tension member (see Appendix G). The entire chain length must be inspected 100% hands-on. This type of detail is particularly vulnerable because steel used for eyebars often has poor notch toughness, therefore the chains are susceptible to cracks. The likelihood of corrosion especially at the connections, contributes to the vulnerability of this type of system.

Full hands-on inspection of main suspension cables may not be necessary because they are fabricated from many individual strands and thus have a high degree of internal redundancy. It is, however, necessary to give special consideration to these components and if the detected conditions so warrant, a full 100% hands-on inspection may be required. The inspector should walk along the entire length of the cable to assess the condition of the wrapping, cable bands, and the suspender to cable band connections. A mirror mounted on the end of a stick or pole is used to inspect the cable underside. Any corrosion on the cable underside may be very serious – water may be leaking through the cable.

At the sply casting, the main cable divides into smaller strands. All accessible wires and anchor bars in this area (anchorage zone) should be inspected 100% hands-on. Document carefully and thoroughly, any broken or corroded wires or anchor bars.
Appendix F
PART 165

UNIFORM CODE OF BRIDGE INSPECTION
(Statutory Authority: Highway Law §§230, 231, 233)

Section 165.1 Purpose and Authority
165.2 Applicability
165.3 Definitions
165.4 Inspection Type and Frequency
165.5 Qualifications and Responsibilities of Bridge Inspectors
165.6 Scope and Documentation of Inspections
165.7 Filing Requirements for Bridge Inspection Reports
165.8 Load Capacity Evaluation
165.9 Load Posting
165.10 Structural Integrity and Safety Rating System
165.11 Structural Integrity Evaluation
165.12 Department Authorizations to Close Bridge
165.13 Filing of Bridge Design and Maintenance Guidelines

165.1. Purpose and Authority. In order to serve, protect and preserve the health, safety and welfare of the public, Chapter 781 of the Laws of 1988 established a program of comprehensive bridge management and inspection within the Department of Transportation to facilitate comprehensive bridge management; inspection, maintenance; improved knowledge of the condition of bridges; structured comparisons of bridge conditions; prioritized and optimized rankings of bridges in need of major maintenance, rehabilitation and replacement; a mechanism for improving historical predictions; the development of a means to assess and project bridge performance and deterioration; development of data to quantify the effectiveness of preventive maintenance, and increased scheduling of bridge maintenance.

Pursuant to Chapter 781 of the Laws of 1988, the Commissioner of Transportation hereby establishes a Uniform Code of Bridge Inspection which prescribes the standards for bridge inspections and evaluations; requirements for the establishment of a rating system; procedures for underwater inspections; requirements for the performance of bridge structural and foundation system evaluations in conjunction with an inspection and criteria for their need and frequency; and the qualifications of bridge design, construction, and inspection experience for licensed professional engineers who may perform or supervise bridge inspections and evaluations in accordance with the provisions of this Part.

165.2. Applicability. The Uniform Code of Bridge Inspection shall apply to all bridges which are publicly-owned, operated or maintained as defined in Section 230 of the Highway Law, which carry public highway traffic and shall not apply to bridges that exclusively carry railroad or subway tracks. This Code shall also apply to bridges which are owned, operated or maintained by railroads and carry public highway traffic over the railroad.

F.3
155.3. Definitions. As used in this Part, unless the context otherwise requires, the following words and terms shall have the following meaning:

"AASHTO" shall mean the American Association of State Highway and Transportation Officials.

"AASHTO Manual" shall mean the current edition of the "Manual for Maintenance Inspection of Bridges", and all interim updates published by the American Association of State Highway and Transportation Officials.

"Bridge" shall mean a structure including supports erected over a depression or an obstruction such as water, highway, or railway, having a track or passageway for carrying public highway traffic and having an opening measured along the center of the roadway of more than twenty feet between undercrossings of abutments or spring lines or arches, or extreme ends of openings for multiple boxes and may include multiple pipes where the clear distance between openings is less than half of the smaller contiguous opening. The term bridge, as defined in this Part, shall also include the approach spans.

"Bridge Inspection Manual" shall mean the Bridge Inspection Manual published by the Department.

"Bridge Inventory and Inspection System" shall mean the inventory and inspection system for bridges maintained by the Department.

"Code" shall mean the Uniform Code of Bridge Inspection, as set forth in this Part.

"Commissioner" shall mean the Commissioner of Bridge Inspection of the State of New York.

"Department" shall mean the Department of Transportation of the State of New York.

"Inspection Flagging Procedure for Bridges" shall mean the engineering instruction of the same name published by the Department.

"OSHA" shall mean the Federal Occupational Safety and Health Administration.

"Public Entity" shall mean any department, board, bureau, commission or agency of the state or its political subdivisions, public benefit corporation or any public authority, including the Port Authority of New York and New Jersey.

"Publicly-Owned, operated or maintained" shall mean a bridge that is owned, operated or maintained by any public entity.

"Quality Control Engineer" shall mean the professional engineer responsible for reviewing and signing inspection reports. In signing the inspection reports, the Quality Control Engineer is attesting to the accuracy and correctness of the report in accordance with the established
Appendix F

standards. The Quality Control Engineer shall not be the same individual responsible for performing the inspection or initially preparing the report.

"Redundancy" refers to the bridge's ability to retain structural capacity, stability and serviceability if one or more primary load carrying components or primary structural members were to structurally fail.

"Substantial Structural Alteration" shall mean any work that modifies the live load capacity, load distribution or load paths or structural behavior of the bridge.

165.4 Inspection Type and Frequency. Bridge inspections shall fall into one or more of the following categories:

a. General Inspection
b. Diving Inspection
c. In Depth Inspection
d. Special Inspection

(4) General Inspection. A general inspection is the regularly scheduled inspection which each bridge receives throughout its life and which focuses on bridge condition, ability to function, safety and maintenance issues, and produces the basic statistical data necessary to understand, study, monitor and manage all bridges subject to this Code. Where applicable, a general inspection shall be scheduled during periods of low water in order to minimize the need for a diving inspection.

There are two (2) types of general inspections, "biennial inspections" and "interim inspections," as follows:

(1) Biennial Inspections. All bridges subject to the provisions of the Code shall receive a biennial inspection which is to be performed at least once every two years. In addition:

(1) All bridges open to highway traffic while undergoing repair, reconstruction or rehabilitation shall continue to receive biennial inspections during such construction when due.

(2) All new bridges, reconstructed bridges, and rehabilitated bridges shall receive a biennial inspection within 60 days of formal project acceptance or fully opening the bridge to highway traffic, whichever occurs first.

(2) Interim Inspections. All bridges subject to the provisions of the Code which meet one or more of the following criteria shall receive an interim inspection:

(1) All bridges which are proposed for load capacity below the State unrestricted legal load limit.
(vi) All bridges which received a condition rating, that is computed by the Department's Bridge Inventory and Inspection system, of three (3.00) or less from their most recent General Inspection.

(vii) All bridges for which the entity with inspection responsibility determines that it is appropriate.

Interim inspections shall be performed at or near one year after each biennial inspection. Bridges open to highway traffic while undergoing repair, reconstruction or rehabilitation shall receive an interim inspection when due.

For very large or unusual structures, a program of scheduled special inspections may be substituted for interim inspections. In such cases, the inspection scope, schedule and findings must be documented and clearly demonstrate that the basis that is the cause for an interim inspection is being addressed. In no case shall such special inspections occur at an interval exceeding that required by an interim inspection.

(b) Diving Inspection. A bridge subject to the provisions of the Code shall be designated as a bridge requiring diving inspection if it meets one or more of the following diving criteria:

(1) A bridge with any portion of a substructure exposed to water deeper than six (6.0) feet, during periods of normal low water, shall be designated for diving inspection.

(2) A bridge with any portion of a substructure exposed to water deeper than three (3.0) feet, but no deeper than six (6.0) feet, during periods of normal low water, may or may not be designated as a bridge requiring inspection by divers depending on the judgment of the responsible professional engineer in charge of diving inspection activity. In making this determination, the responsible professional engineer shall take into consideration, among other factors, structure type, materials of construction, foundation type, footing location relative to channel bottom, known or suspected problems, waterway characteristics, superstructure and substructure redundancy, etc. In making this evaluation and resulting determination, existing bridge records, including existing inspection information shall be reviewed.

(3) A bridge with no portion of any substructure unit exposed to three (3.0) feet or more of water, during periods of normal low water, will normally not be designated for diving inspection.
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Diving inspections may be performed as part of a general inspection, in-depth inspection, special inspection or as an independent inspection effort. When making determinations on the need for diving inspection, it must be recognized that bridges are constructed of differing structural configurations and situated in widely varying environments. This results in varying degrees of inspection difficulty, complexity, structural redundancy and structural sensitivity. Portions of the diving inspection criteria intentionally leave discretion to provide for proper bridge-by-bridge evaluation of the above and other factors in determining the need for a diving inspection.

Diving inspections shall be performed at maximum inspection intervals of sixty (60) months. However, it shall be determined, on a bridge-by-bridge basis, if a "complete" or "partial" diving inspection is needed on a more frequent basis. If it is determined that more frequent diving inspections are needed, they shall be scheduled.

(c) In-Depth Inspection. An in-depth inspection is a comprehensive detailed inspection of an entire bridge which frequently incorporates destructive, as well as non-destructive inspection techniques. It is more complete and more intensive than a general inspection and the results of such an inspection can be used to satisfy the Code requirements for a general inspection. In-depth inspections are performed on an "as needed" basis to assist in making bridge rehabilitation versus replacement decisions, and to assist in the development of bridge rehabilitation designs.

(d) Special Inspection. A special inspection is a unique inspection effort targeted at special situations or conditions and may be performed to study a unique or unusual bridge feature in greater detail than would have normally occurred during a general inspection. A special inspection may also be performed to monitor the condition of a specific bridge detail or situation on a repetitive basis and shall be performed whenever the structural integrity of a bridge is or has been threatened by a storm, flood, natural phenomena, accident or man made occurrence.

Due to the wide variability of situations and conditions requiring a special inspection, there can be no predetermined schedule or frequency interval for the performance of special inspections. Frequency intervals are determined based on the particular parameters of the different situations and conditions under consideration.

165.5. Qualifications and Responsibilities of Bridge Inspectors.

(a) Field Personnel:

(1) General and In-Depth Inspection. All field work shall be performed by an inspection team consisting of at least a team leader and an assistant team leader.

The team leader shall be present at the bridge inspection site throughout the bridge inspection, shall personally inspect the bridge, supervise other inspection team member(s) to ensure that each bridge is properly inspected and shall ensure that the inspection results are
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properly documented. The team leader shall ensure that additional team members are appropriately qualified and trained for their required duties, such as traffic control, debris removal, measurement or the preparation of sketches. A team leader must meet both of the following minimum qualifications:

1. Be currently registered with the New York State Education Department as a Professional Engineer (P.E.). An out-of-state P.E. registration may be substituted for a New York State P.E. provided that the individual received the P.E. based upon satisfactory completion of a 16 hour written examination, has applied for P.E. registration in New York State, and the New York State Education Department has acknowledged receipt of the individual's intent to practice in New York under subsection (b) of Section 7208 of the Education Law, and

2. Have at least three (3) years of bridge experience in design, construction, inspection or other bridge engineering related work.

Civil Engineering experience on Department projects or programs may be substituted for all or a portion of the experience requirement in Subsection (ii) herein, if the Department determines, on the basis of the Department work, that the engineer possesses the necessary experience and skill.

An Assistant Team Leader must:

1. Possess a Bachelor of Science Degree in Civil Engineering from an Accreditation Board for Engineering and Technology (ABET) accredited program or an equivalent degree acceptable to the Department, or

2. Possess an Associate Degree in Civil Engineering Technology or an equivalent Associate Degree determined to be acceptable by the Department, and 12 years of bridge experience in design, construction, inspection or other bridge related work, or

3. Have at least three (3) years of bridge experience in design, construction, inspection, or other bridge related work.

Civil Engineering experience on Department programs or projects may be substituted for all or a portion of the experience requirements in subsections (i) and (ii) herein if the Department determines, on the basis of the Department work, that the person possesses the necessary experience and skill.

2. Diving Inspection. All field diving inspection work shall be performed by an inspection team. The size and the makeup of diving inspection teams will vary depending on field conditions and project methodology. However, a diving inspection team shall always include a team leader meeting the qualifications of a general inspection team leader, a diver, a dive tender, if necessary, and additional personnel that are necessary to complete the inspection effort in
accordance with OSHA and other regulatory requirements. The team leader and the diver may be the same person, provided that person meets the qualifications of both positions.

Divers shall have at least three (3) years experience in construction diving and/or inspection diving activities in performing the same type of diving to be used for the inspection, either "scuba" or "wet Air supplied air".

A dive tender shall meet all current applicable medical and OSHA requirements. In addition, a dive tender shall have at least two (2) years responsible experience in construction diving and/or inspection diving activities.

(3) Special Inspection. Field work for a special inspection shall be performed by an individual or an inspection team as the situation dictates. Minimum personnel qualifications cannot be standardized because of the widely varying situations requiring special inspections. The professional engineer in charge of such an inspection shall ensure that individuals assigned to a special inspection effort are appropriately qualified and trained. This determination shall consider such factors as inspection difficulty and inspection criticality.

(b) Office Personnel:

(1) Quality Control Engineer. The Quality Control Engineer shall review and sign as "Reviewed By" all field inspection reports and shall meet the same qualifications specified for a general inspection team leader. An individual cannot function as a Quality Control Engineer over work for which the individual was, or is, responsible.

(2) Load Rating Engineer. The Load Rating Engineer directs, supervises and signs all structural capacity load rating calculations. The Load Rating Engineer shall meet the same qualifications specified for a general inspection team leader.

(3) Load Posting Engineer. The Load Posting Engineer shall make and sign all load posting determinations and shall meet the same qualifications specified for a general inspection team leader.

(4) Structural Integrity Evaluation Engineer. The Structural Integrity Evaluation Engineer shall supervise the preparation of and signs all structural integrity evaluation reports and shall meet the same qualifications specified for a general inspection team leader.

162.6 Scope and Documentation of Inspections. All general, in-depth and diving bridge inspections shall include a review of the most recent inspection report, the most recent structural integrity evaluation, and, to the extent available and reasonably retrievable and consistent with engineering practice and public safety to understand the structural performance and work history of the bridge, an examination of the design, as built plans, contract documents, history of construction.
including any history of structural alterations, repairs, rehabilitation or maintenance.

(a) General Inspection.

(1) Biennial Inspection. A biennial bridge inspection shall be performed and documented in accordance with Department's "Bridge Inspection Manual" including current updates, revisions and technical advisories and the AASHTO Manual.

(2) Interim Inspection. An interim bridge inspection shall be performed and documented in accordance with the Department's "Bridge Inspection Manual" including current updates, revisions and technical advisories and the AASHTO Manual, subject to the following exceptions:

(i) Conditions that have not substantially changed since the previous biennial inspection do not have to be fully documented with sketches, notes and photographs. When changes have not occurred, notes indicating that no changes have occurred since the previous biennial inspection will satisfy sketch, note and photographic documentation requirements.

(ii) Conditions that have substantially changed since the previous biennial inspection either by increased deterioration, or by repair or improvement, shall be documented with sketches, notes and photographs as required for a biennial inspection.

(b) Diving Inspection. A diving inspection shall be performed and documented in accordance with the requirements of the Department's "Bridge Diving Inspection Specifications" and "Bridge Diving Inspection Rating Criteria" including current updates, revisions and technical advisories and the AASHTO Manual.

(c) In-depth Inspection. An in-depth inspection shall be done in accordance with the requirements of the Department's "Specification For In-depth Bridge Inspection" including current updates, revisions and technical advisories and the AASHTO Manual. However, applicability of this specification to a specific bridge or project shall be reviewed by the professional engineer responsible for the project to determine if modifications to the standard specification are necessary. When appropriate, this professional engineer shall develop any necessary modifications in the form of an addendum to the standard specification or shall develop a substitute specification, which shall be used for the in-depth inspection.

(d) Special Inspections. The inspection scope and documentation required to satisfactorily inspect and document the situation under consideration shall be determined by the individual in charge of such inspection activities.

This flexibility is necessary due to the unique and variable situations being addressed by special inspections.
165.7. Filing Requirements For Bridge Inspection Reports. Two copies of all bridge inspection reports shall be filed with the Department's Regional Director located in the Department's Regional Office in which the bridge is located. Reports shall be filed within the time allowed in the following table. All General and Driving inspections scheduled for a calendar year inspection cycle shall be filed no later than January 15th of the year following the inspection calendar year.

<table>
<thead>
<tr>
<th>Inspection Type</th>
<th>Number of Days After Completion of Field Work</th>
<th>Quality Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Inspection</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Driving Inspection</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Special Inspection</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>In-Depth Inspection</td>
<td>120</td>
<td>30</td>
</tr>
</tbody>
</table>

All reports filed shall be neat, easy to read, include original photographs or good quality photographic reproductions, and shall be signed and dated by the individual responsible for the field inspection as well as by a Quality Control Engineer.

165.8. Load Capacity Evaluation. Each bridge which is subject to the inspection provisions of this Code, shall be rated for safe load carrying capacity. Load ratings shall be determined in accordance with the provisions of the AASHTO Manual. If it is determined by this load rating process that the maximum legal total load under state law exceeds the load equivalent to the Operating Rating Capacity level as defined by the AASHTO manual, the bridge must be load posted subject to sections 233 and 224 of the Highway Law, and Sections 1621, 1640, 1650 and 1660 of the Vehicle and Traffic Law.

(a) Level 1 and Level 2 Load Ratings. Level 1 and Level 2 load ratings are defined to differentiate between rating analyses of differing degree of sophistication and/or comprehensiveness, and to differentiate whether or not the rating is certified by a Licensed Professional Engineer.

(1) Level 1 Load Rating: A level 1 rating refers to any fully documented analysis or capacity evaluation that is signed and certified by a Licensed Professional Engineer as being complete and correct in its computation of bridge load capacity. Generally, a level 1 analysis shall be in conformity with the analysis assumptions and provisions of the AASHTO Manual. However, evaluation methods and/or analysis assumptions that differ from the AASHTO provisions are permitted provided that they conform to accepted structural engineering practice, and they are fully documented and certified as being correct and appropriate by the certifying Licensed Professional Engineer.

(2) Level 2 Load Rating: A level 2 load rating refers to a specific type of computerized load rating analysis produced by the Department as part of its general bridge inspection program. However, any uncertified rating analyses that substantially conforms to the provisions and assumptions of the AASHTO Manual may be referred to as a Level 2 load rating. Level 2 load ratings may be used to identify
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bridges that are likely to be load capacity deficient and must receive further evaluation. Level 2 ratings may be used to assign interim load restrictions to a deficient bridge until a Level 1 load rating can be undertaken.

The Department's Level 2 load ratings are computed using a Department owned and maintained system of computer programs whose logic substantially conforms to analysis methods and assumptions contained in the AASHTO Manual. For each type of bridge capable of being analyzed, the Level 2 programs contain some general assumptions relating to the location of critical components or cross sections to be analyzed. Although they are normally appropriate and generally accurate for typical situations they may not be correct in every case. Although quality control reviews are made, the Department does not certify its Level 2 ratings as being complete and fully correct in its computation of load capacity. The Department maintains computer records of its Level 2 data and analysis results, and updates this information on a periodic basis as part of its general inspection process.

(h) Criteria for performing Level 1 Load Rating.

(1) A Level 1 load rating shall be performed on part of the structural design process for all new and replacement bridges and for all rehabilitation and repair designs involving a substantial structural alteration to the bridge. The Level 1 load rating results for the new or reconstructed structure shall be summarized in a table placed on the contract drawings which are prepared for the project.

(2) A Level 1 load rating shall be included as part of all Structural Integrity Evaluations as defined and required by Section 165.11 of this Code.

(3) A Level 1 load rating shall be performed whenever the posted load on a bridge, or full legal load if the bridge is not posted, exceeds the operating rating capacity determined by a Level 2 load rating.

(c) Documentation of Level 1 Load Ratings:

(1) Load Rating Vehicles: All Level 1 load ratings shall be based on both the AASHTO "H" and "W" analysis vehicle configurations. Both the AASHTO "H5" and "W" truck loads and equivalent lane loads shall be used to determine the rating values. If the inventory rating as defined by the AASHTO manual based on the "H5" vehicle loading equals or exceeds HS-70 (38 tons), it is not necessary to compute ratings based on the "W" loading. Load ratings based on the AASHTO "Typical Legal Load Types" (Type 3, Type 352, Type 3-3) or any other rating vehicle configuration are not required by this Code, but may be desirable to use for individual posting evaluations.

(2) Rating Summary Sheet: All Level 1 rating documentation shall contain a Rating Summary Sheet, which provides the inventory and operating ratings, as such terms are defined in the AASHTO manual, for the bridge. The rating summary sheet shall also tabulate the
ratings for each individual span or continuous span structural unit. For bridges which have structural floor systems, the ratings of the controlling floor system components as well as the main members shall be tabulated. Individual load rating values shall be expressed in terms of the equivalent rating vehicle and tonnage as shown:

Examples: HS-22 (38.6 tons)  
K-24 (74 tons)

The level 1 rating summary sheet shall be signed by the load rating engineer.

(a) Filing Requirements for Level 1 Load Ratings. All Level 1 load ratings shall be filed with the Department. The Level 1 load ratings shall be filed by submitting two signed copies of the rating calculations and summary sheets to the Department's Region Office in which the rated bridge is located.

165.9 Load Posting. A bridge must be posted for a restricted load limit when a load rating analysis and/or posting evaluation, as required by the AASHTO Manual and this Code, indicates that a bridge does not have sufficient live load capacity to safely carry full legal traffic loads.

A safe load level for a bridge is calculated by ascertaining the limits defined by the Inventory and Operating load rating levels and using the Operating load rating as the upper limit. However, in no case shall loads be allowed on a bridge which exceed the bridge's operating rating capacity.

(a) Load Posting Requirements. No bridge shall be posted for a load less than three (3) tons. In the event that a bridge's operating rating is less than three (3) tons, the bridge must be closed to all vehicular traffic.

(b) Load Posting Signage Requirements. Load posting signage shall be in conformance with the New York State Manual for Uniform Traffic Control Devices.

165.10. Structural Integrity and Safety Rating System. Structural Integrity and Safety Rating refers to a systematic method for evaluating and ranking the relative structural integrity and safety of a bridge or group of bridges against structural failure and/or collapse.

A Structural Integrity and Safety Rating system shall, at a minimum, consider the following fundamental bridge vulnerability factors, where applicable:

(1) Condition: Refers to the extent of deterioration and/or loss of ability to structurally function as was intended by its original or rehabilitated design or loss of structural safety.

(2) Load Capacity: Refers to the ability to safely carry live loads that may be imposed upon the bridge.
(3) Redundancy: Refers to the bridge's ability to retain structural capacity, stability and serviceability if one or more primary load carrying components or primary structural members were to structurally fail.

(4) Fracture Susceptibility: A measure of the presence of details and/or behavioral characteristics that are prone to fracture.

(5) Hydraulic vulnerability: Refers to the bridge's potential for failure due to its exposure to hydraulic forces, or due to erosion or scour of the foundation material.

The rating system has the capability to rank the relative structural integrity of bridges, as well as identify bridges that have any significant vulnerability with regard to any one or a number of the above-noted vulnerability factors.

Structural integrity and safety ratings shall be made for all bridges. The rating system to be used shall be either the system developed by the New York State Department of Transportation for use on its bridges or the public entity may develop a rating system unique for bridges under its jurisdiction. Any public entity that establishes a rating system for use in complying with this Code shall file with the New York State Department of Transportation a description of the rationale and/or logic of the rating method, as well as a list of integrity ratings for all bridges under their jurisdiction. Filling of rating systems and bridge structural integrity and safety ratings shall be with the New York State Department of Transportation Main Office Structures Division. Structural integrity and safety ratings shall be updated on a biennial basis to reflect any changes recorded by general inspections.

The New York State Department of Transportation shall maintain a structural integrity and safety rating system which it will apply to all bridges which it inspects. This system is to be made available to all public entities for their own use. The description and criteria of the New York State Department of Transportation structural integrity and safety ratings are issued as a reference document to this Code, and is titled "New York State Department of Transportation Structural Integrity and Safety Rating Guide." This document also contains criteria, based on a structural integrity and safety rating system, for requiring a Structural Integrity Evaluation as described in Section 165.11 of this Code.

165.11. Structural Integrity Evaluation. A Structural Integrity Evaluation is a detailed structural and foundation evaluation and analysis. Used in conjunction with transportation, it assesses a bridge's structural condition and integrity as well as present and future needs to preserve or upgrade the safety and serviceability of the bridge.

The scope of a Structural Integrity Evaluation shall include, where applicable to the determination of integrity and safety, the following:

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F.14
Appendix F

(a) A review, where available and reasonably retrievable and consistent with engineering practice to perform such an evaluation, of the design, design as-built plans, contract documents, an assessment of construction, structural alterations, rehabilitation, and maintenance repairs.

(b) A review of design code changes since the time of original design with emphasis on the impact the original design assumptions have on the bridge's structural integrity and safety in comparison with current standards and practices.

(c) A Level 1 Load Rating as defined by Section 165.8 of this Code.

(d) For bridges over water, an evaluation of the effect of relevant or anticipated stream changes, as well as an evaluation of the effects of hydraulic flows, including design flood conditions. The Federal Technical Advisory (Code T 5140.20) titled “Scour at Bridges” published by the Federal Highway Administration may serve as a guide for evaluating bridges for scour vulnerability.

(e) An evaluation of the effects of deterioration and modification to the original structure on structural integrity, in conjunction with a general inspection conforming to the requirements of this Code.

(f) A life cycle projection of the scope and estimated cost of maintenance, repair, and/or rehabilitation needed to preserve or upgrade the structural integrity and safety of the bridge, in order to provide criteria for comprehensive bridge management and safety.

Structural Integrity Evaluations shall be documented in a detailed report format and shall be signed by a qualified Structural Integrity Evaluation Engineer as defined by Section 165.5 (b)(4) of this Code. Two copies of the Structural Integrity Evaluation report shall be filled with the New York State Department of Transportation Regional office in which the bridge is located. One copy of the report shall be made available to the bridge inspector as a reference for all subsequent general bridge inspections.

Whenever a Structural Integrity and Safety Rating indicates a high vulnerability to structural failure a structural integrity evaluation shall be performed. Specific criteria for requiring a Structural Integrity Evaluation to be performed based on the New York State Department of Transportation structural integrity and safety rating system are described in the New York State Department of Transportation “Structural Integrity and Safety Rating Guide.”

In cases where a bridge meets the criteria for requiring a Structural Integrity Evaluation, but already has such an evaluation on file, a repeat evaluation is not required unless it is determined that the evaluation on file is no longer appropriate for the bridge in question. A recommendation of appropriateness shall be made and documented by the Bridge Inspection Team Leader based on a review of the
report as part of performing a general bridge inspection. In cases where only portions of the report are no longer appropriate, amendments to the original Structural Integrity Evaluation report may be produced.

165.12. Department Authorization to Close Bridge. Each Department Regional Director is authorized to close any bridge subject to this code when, in his opinion, based upon inspection or otherwise, if not closed, may constitute a threat to the public health, safety or welfare.

When such a closure is required, the Regional Director shall document the reasons for the closure and transmit such documentation to the bridge owner. The bridge cannot be reopened to traffic without a certification of a professional engineer licensed in New York, that the bridge is safe for public use and travel with legal weights, or if posted, with such posted weights. The party having jurisdiction over the bridge is responsible for providing this certification to the Department.


(a) Every owner of a publicly owned, operated or maintained bridge, as defined in Section 165.2 of this Title, shall submit to the New York State Department of Transportation certified designs and "as built" plans for all bridges constructed or on which substantial structural alterations are made on or after June 1, 1989.

(b) All designs and plans shall be certified by a licensed Professional Engineer and must bear the signature and seal or stamp of such Engineer.

(c) All designs and plans shall be submitted to the Department of Transportation Regional Director within whose region such bridge is located.

(d) Maintenance Guidelines. All certified designs and plans subject to this section shall contain desirable maintenance guidelines applicable to the bridge. Such guidelines shall be consistent with standards established by AASHTO, and this requirement may be satisfied by the designer by reference to these standards. Designs and plans for very large or unique bridges and movable bridges shall include special maintenance guidelines as is appropriate.
Appendix G
Appendix G
APPENDIX G

SPECIAL EMPHASIS INSPECTION REQUIREMENTS

In addition to conventional visual inspections required for all bridges, certain details and components of metal structures require additional inspection intensity. This additional requirement, known as "100% hands-on" inspection, means that the inspector must get within 0.5 m of the component to be inspected. Adequate lighting is also essential. A hand-held spotlight is ideal, but a flashlight is satisfactory if electric power is unavailable. A magnifying glass and mirror should also be used for suspect areas.

With respect to bridge structures, redundancy means that should a member or element fail, the load previously carried by the failed member will be redistributed to other members or elements. These other members have the capacity to temporarily carry additional load, and collapse of the structure may be avoided. On non-redundant structures, the redistribution of load causes additional members to also fail, resulting in a partial or total collapse of the structure.

The New York State Department of Transportation requires that for a bridge to be load path redundant, it must have four or more main load carrying members or load paths. For the purposes of this section, only those structural systems which are load path redundant are considered to be redundant.

A fracture critical member is a member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse.

Unless a written exemption is granted by the Deputy Chief Engineer (Structures), exposed surfaces of the following elements and components must receive a 100% hands-on visual inspection during each general biennial or interim bridge inspection.

1. All non-redundant or fracture-critical metal superstructure and substructure elements subjected to any type of stress condition. These situations include (but are not limited to):
   - Truss chords and diagonals.
   - Main girders of two and three girder bridges.
   - Floorbeams spaced more than 3.6 m o.c. on trusses or two and three girder bridges.
   - Floorbeam/truss and floorbeam/girder connections if floorbeam spacing is greater than 3.6 m o.c.
   - Metal pier caps and pier columns.
   - Anchorage zones of main cables of suspension bridges and the full length of the cables.

2. All stringers within 1 m of a stringer/floorbeam connection, regardless of degree of redundancy, if the stringer webs are vulnerable to cracking from fatigue or out-of-plane distortions. The stringer webs are inspected hands-on if all the following conditions exist:
   - The stringer bottom flange bears on the floorbeam top flange.
   - The stringer web is unstiffened.
   - Any end diaphragms present do not extend the full depth of the stringer.
Access for these details may require the use of a UBU with an articulated boom or rigging. The usual failure mode for this type of detail is longitudinal cracking near the bottom of the stringer. Failure is more likely under expansion joints where leakage of water, debris, and deicing chemicals accelerate deterioration. See Inspection T.A. 94-004 for a sketch of this detail and more information.

3. All pin-and-hanger details, regardless of element redundancy, and all primary members within 1.5 m of the pin-and-hanger details.

4. In tension and stress-reversal areas, all details not in the original design that are vulnerable to fatigue cracks. From the standpoint of crack propagation, any detail welded onto a primary member is considered part of the primary member, including (but not limited to):
   - Tack welds.
   - Welded erection aids.
   - Remaining backup bars at groove welded connections, if the bars are discontinuous.
   - Plug welded holes.

5. All areas of primary members having field-welded repairs of cracks caused by impact damage and fatigue.

6. Bearing stools, in certain cases, have details which require “100% hands-on” inspection. The bearing stool detail of concern utilizes a wide-flange beam section placed vertically (strong axis perpendicular to the beam/girder) beneath a beam/girder end, with an outboard stiffener bracing the stool back up to the bottom flange of the beam/girder. A potential problem exists where the stool bears against its supporting sole plate and bearing assembly. This special emphasis requirement occurs when only a near-side/far-side fillet weld (along web of the vertical beam section) positively attaches the stool to the sole plate, and the bearing stool’s flanges only bear on the sole plate without positive attachment. A failure scenario can start with corrosion to the stool’s web above and around its fillet weld attachment to the sole plate. Concurrently, corrosion to participating bearings increases frictional resistance, which results in increasing horizontal loads applied to the stools. Under these additional loads, the corroded reduced web section of the stool can distort and tear at its fillet weld attachment to the sole plate. This can result in the stool’s web yielding and flanges riding off the sole plate’s edges. See Inspection T.A. 88-002 for a sketch of this detail and more information.

7. Multi-span in line thru-girders, in certain cases, have shear splice connections which warrant particular concern. The connection in question is usually located adjacent to a pier bearing with only one end of the two girders being connected directly supported by the bearing. There is no web continuity between girders. The girder end not directly supported by the bearing is primarily dependent on the shear capability of the connection. This shear splice utilizes angles riveted and/or bolted to both faces (near and far sides) of the web at the ends of both girders. The outstanding legs of these angles are riveted and/or bolted back-to-back, connecting the ends of the two girders. Failure of this connection would most likely cause superstructure collapse. See Inspection T.A. 86-002 for a sketch of this detail and more information.
When performing the required "100% hands-on inspection," particular attention should be given to the following: all girdler components for a minimum 6 m length from both sides of the connection centerline, cracks that could emanate from bolts and/or rivet holes, member alignment, crevice corrosion, and fasteners for signs of distress like looseness, corrosion, or bending.

Since all bridges are considered unique, more steps may be required in some cases, therefore, these items are to be considered as a minimum.

8. Details vulnerable to cracking from out-of-plane distortions. These include (but are not limited to) girdler webs at girdler-floorbeam connections (especially on skewed bridges), and coped or blocked floorbeam details.

9. Certain concrete deck haunches require 100% "hands-on" inspection. In this detail, the concrete haunch extends past the edges of the top flange (haunch is wider than top flange), with the bottom face of the concrete haunch flush with the bottom face of the top flange. This generally results in a 90° edge of unreinforced concrete that is prone to spalling.

This detail was used in removable bridge deck forming systems and has caused failures resulting in falling concrete. In some cases, the unreinforced parts of the haunch have cracked and fallen, thus creating a hazard to traffic beneath the bridge. Apparently, the failures occur due to forces resulting from corrosion products on the edge of the flange. The crack initiates at the top edge of the flange and propagates upward at approximately 45° before intersecting the vertical haunch face, thus resulting in loose concrete. The inspector should be very careful to look for hairline longitudinal cracks along the vertical face of the haunch.

When performing the inspection of a bridge with this particular haunch detail, 100% "hands-on" inspection is required on every haunch over its entire length. The findings should be documented in the inspection report.

For sections of structures over highway or pedestrian traffic this 100% "hands-on" inspection should include sound the entire length of the haunch with a hammer. Cracks or loose concrete on the haunches should be safety flagged.

For further information, see Inspection T.A. 96-001.

10. All AASHTO Category I, II, and III weighted details, unless calculations are performed and checked to estimate remaining safe fatigue life. Safe life is defined as the time interval in which there is a 2.3 percent probability of detail failure.

The analysis methods to be used are in the AASHTO Guide Specification "Fatigue Evaluation Procedures for Steel Bridges," which is also available in NCHRP Report 239. Traffic counts more than 10 years old may not be used, unless there is evidence that traffic on the bridge has not increased.

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Appendix G

Automatic exemptions from the 100% hands-on requirement will apply to redundant members only when these calculations result in a safe life of at least 10 years. For safe lives less than 10 years, the Structures Division will grant exemptions only on a case-by-case basis.

For bridges with a calculated detail safe life of 10 to 50 years, automatic exemption from 100% hands-on inspection is valid until 6 years after date of analysis. The details then will be reanalyzed using current traffic count data.

If the calculated detail safe life is greater than 50 years, the automatic exemption is valid indefinitely and re-analysis is not necessary unless traffic increases by more than 6 percent annually. If traffic growth is greater, re-analyze every 6 years.

All areas requiring 100% hands-on inspection must be clearly identified in a specially prepared section at the end of the report binder. This section must identify location and type of component to be inspected hands-on. Sketches, copies of plan sheets, and/or photos should be used for documentation. For reference during future inspections, the location of any cracks found should be noted in the special emphasis section. Also, the binder cover should have a sticker stating “Special emphasis required during each general inspection. See the last section of this binder for details.” Fatigue-prone details exempt from 100% hands-on inspection must still be identified in this section.

If an exemption to the requirements of this Appendix is granted, then a copy of the Main Office letter must be included in the special emphasis section. If exemption is automatic because of fatigue-life calculations, then a copy of the calculations must be placed in the special emphasis section. The person performing the calculations, and checking them, must be identified. There must also be a comment on Form TP 350 noting that 100% hands-on requirements have been waived.

When a 100% hands-on inspection occurs under provisions of this Appendix, then the Team Leader must note this on Form BD 188.
Appendix H
APPENDIX H
REQUIRED TOOLS AND EQUIPMENT

Each team performing general bridge inspections must have proper tools available at the site. Additional equipment may be required and should be available on an as-needed basis. All tools must satisfy OSHA requirements.

Each team should be equipped with the following:

- Work-zone protection and traffic control equipment, including signs, traffic cones and flags.
- Personal safety equipment including hard hats, vests, goggles, face shields, harnesses (or belts), and lanyards.
- Basic access equipment such as a step ladder, extension ladder and rope.
- Tools for cleaning, including a whisk broom, wire brush, scraper, shovel and broom, and disk and die grinder.
- Tools for inspection, including chipping hammers, pocket knives, screwdrivers, or awls, magnifying glass, flashlights, lead or drop light (including 110 VAC power source), mirrors, etc.
- Tools for measuring, such as a plumb bob, protractor, levels, folding rules, tapes, calipers, pocket rulers, thickness gages, D-meter, scarp probing rods, vertical clearance rod, weighted sounding lines, etc.
- Tools for documentation, such as 35 mm camera with electronic flash, instant camera, triangles, straight edges, steel scribes, center punches, engineer/architect scales, magnetic compass, etc.
- Cellular phone.
- Consumable supplies, including lumber crayons, spray paint, zinc-rich primer, dye-penetrant test materials (penetrant, cleaner, developer, rags), camera batteries, film, disposable dust/muscle respirators, etc.

Each team should have access to the following equipment as-needed:

- Equipment for working over water, such as life jackets, waders, one or more ring buoys with at least 35 m of attached line, and a jon boat (or other small, lightweight, flat-bottom boat) equipped with a pike pole, oar or other reach-extension device, a ring buoy and life jackets for all occupants.
- Drills or ram-set guns for mounting BIN plates.
- Personal protective equipment such as rain suits, gauntlet gloves, rubber boots, etc.
Appendix I

has been Superseded by EI 10-016

Click here to view EI 10-016,
INSPECTION FLAGGING PROCEDURE FOR BRIDGES

Link to NYSDOT Engineering Instructions Main Page
Appendix  J
APPENDIX J

LEAD PAINT CONTAINMENT

Environmental lead contamination is of increasing concern. Lead-based paint used on bridges can contribute to this contamination. While the impact of general bridge inspections on lead contamination levels is minimal due to the nature and volume of waste produced, NYS DOT will make every effort to avoid contributing to potential public health concerns as a result of its bridge inspection activities.

Paint debris released as a consequence of general bridge inspection must be collected, labeled, and disposed of properly. The debris should be collected in buckets or other suitable containers as it is produced by using brooms or other devices to prevent it from dropping below the bridge. If debris drops below the bridge, all reasonable and prudent steps must be taken to collect it. The collected debris should be disposed of under contract or removed from the site for disposal as directed by the Region, in conformance with State and Federal regulations.
Appendix K
**NYS DEPT. OF TRANSPORTATION**  
**BRIDGE INSPECTION REPORT**

**TEAM LEADER**

**P.E. NUMBER**

**STATE**

**RAMP BRIDGE ATTACHED TO SPAN**

**INSPECTION AGENCY**

**TYPE OF INSPECTION**

**STATE HWY. NO.**

**MILEPOINT**

**FEATURE(S) CARRIED:**

**TOTAL SPANS:**

**BRIDGE DIRECTION:**

**YEAR BUILT:**

**SUPERSTRUCTURE TYPE(S):**

**ABUTMENTS:**

**WINGWALLS:**

**APPROACHES:**

**ACCESS CATEGORY:**

**FLAG ISSUED:**

**REVIEWED BY**

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**Joint with deck**

**Bearing, anchor bolts, pads**

**Bridge seat and pedestals**

**Backwall**

**STEM (breastwall)**

**Erosion or scour**

**Footings**

**Piles**

**Recommendation**

**STREAM CHANNEL:**

**Pavement**

**Stream alignment**

**Guidance railing**

**Erosion and scour**

**Waterway opening**

**GENERAL RECOMMEND**

**Review by**

**P.E. NUMBER**

**DATE**

Form TP 349
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DIVING INSPECTION REQUIRED: [ ] YES [ ] NO

SPECIAL EMPHASIS INSPECTION REQUIRED: [ ] YES [ ] NO

NON-REDUNDANT/FRACTURE CRITICAL:

PIN AND HANGERS:

FATIGUE-PRONE WELDS/ASHTO D, E OR E'1:

NON-CATEGORIZED FATIGUE-PRONE DETAILS:

OTHERS (SPECIFY):

RECOMMEND FURTHER:

INVESTIGATION:

1 = NO

2 = YES

REMARKS:

DATE

TIME OF ARRIVAL

TIME OF DEPARTURE

TEMP (°C)

WEATHER CONDITIONS

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Forms

NYS DEPT. OF TRANSPORTATION
BRIDGE INSPECTION REPORT

BIN _______________________

TEAM LEADER: ______________________
ASST. TEAM LEADER: ______________________
DATE: / / 

Feature Carried: ______________________
Feature Crossed: ______________________

REMARKS:


Form RD 288

K.8
BD 242 (5/95)

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
FLAGGED BRIDGE REPORT

INITIAL:

INSPECTOR

RED FLAG*

YELLOW FLAG*

SAFETY FLAG*

DATE OF INSPECTION

SUPERSEDES FLAG NUMBER

PROMPT INTERIM ACTION RECOMMENDED

YES

NO

BRIDGE DESCRIPTION:

DIM

REGION

COUNTY

TOWN

FEATURES: CARRIED

GROSSED

NUMBER OF SPANS BY TYPE

APPROXIMATE YEAR BUILT

POSTED FOR LOAD

NO

YES

TONS

IS BRIDGE WHOLLY OR PARTIALLY STATE OWNED?

YES

NO

DESCRIPTION OF FLAGGED CONDITION (Be specific as to exact nature and location of problem):

_________________________________________________________________________

_________________________________________________________________________

_________________________________________________________________________

INITIALLY DEVELOPED PHOTOS ATTACHED?

YES

NO IF YES, NUMBER ATTACHED

Flagged Bridge Report Complated By

GENERAL NOTIFICATION: (For Red Flags and Safety Flags with FIA only)

To

of Regional Office on

at

o’clock

To

(Responsible Party) on

at

o’clock

By

Signature of State Team Leader

Date

* The appropriate caption in the upper left of this form shall be initialed
BD 243 (5/95)

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
SUMMARY BEG FLAG INFORMATION

FLAG #  

DIN:  

ROUTE:  

BRIDGE TYPE:  _____ TRUSS  _____ GIRDER/BEAM  _____ ARCH  _____ FRAME  _____ OTHER

MATERIAL TYPE:  _____ CONCRETE  _____ STEEL  _____ TIMBER  _____ OTHER

ACTION(S) TAKEN:


DATE OF LAST PREVIOUS INSPECTION:  / /  BY:  

PREVIOUS FINDINGS AT THIS LOCATION:


ACTION(S) TAKEN AFTER PREVIOUS INSPECTION, IF ANY:


IF NO ACTION TAKEN, WHY?


THIS REPORT PREPARED BY:  / /  (date)

Attached is the Flagged Bridge Report.
NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
FLAG REMOVAL/INACTIVATION REPORT

FLAG NUMBER __________________________

RED FLAG __________________________

YELLOW FLAG __________________________

SAFETY FLAG __________________________

FLAG IS TO BE:

REMOVED __________________________

INACTIVATED __________________________

CERTIFICATION BY __________________________

ACTION TAKEN:

____________________________________

____________________________________

____________________________________

REPORT PREPARED BY __________________________

DATE __________________________
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<th>Land Use Code</th>
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**Debris and Stored Material Category Codes**

- D1 - Containers, Market
- D2 - Containers, Unmarked
- D3 - Non-Construction
- D4 - Wood, Dwellings
- D5 - Wood, Heavy
- D6 - Wood, Light
- D7 - Metal, Light
- D8 - Rubber, Plastic, Synthetics
- D9 - Automotive, Supposition
- D10 - General, Tough

**Land Use Category Codes**

- 01 - Buildings, Incl. Commercial
- 02 - Buildings, Non-Fuel Storage
- 03 - Buildings, Offices
- 04 - Buildings, Parking Facilities
- 05 - Buildings, Franchised Facilities
- 06 - Attachments/Support
- 07 - Fuel Storage

**Priority Codes**

- H1 - High Priority (Photos Required)
- M - Medium Priority
- L - Low Priority
- N - No Debris/Land Use

**TX Codes**

- 2 - Updating an Existing Record
- 3 - Creating a New Record

**INSTRUCTIONS**

1. For each line enter only the span or spans affected by debris, stored material and/or land use. Region, County, and BM only have to be entered once for a bridge with multiple span entries, with each span recorded below the previous span entered.

2. All unused category columns are to be left blank.

3. Code the most critical priority rating for each span affected.

4. More than one BM can be entered on a sheet.

5. When removing a previous condition for debris, code the Priority Code as 'N.'
DEBRIS AND STORED MATERIAL

01 - CONTAINERS, MARKED - Marked flammable or with other chemical symbols, etc.
02 - CONTAINERS, UNMARKED - Unmarked or other than previous category markings.
03 - NON-CONTAINERSIZED - Salt, chemicals, or other similar items stored in piles or loose.
04 - WOOD, DWELLINGS - Shacks and other makeshift dwellings.
05 - WOOD, HEAVY - Stored lumber, crates, trees, vegetation, old furniture, etc.
06 - WOOD, LIGHT - Paper products, wood chips, leaves, etc.
07 - METAL - Abandoned vehicles, appliances, corr., etc.
08 - RUBBER, PLASTICS, SYNTHETICS - Tires, mattresses, automobile seats, etc.
09 - ASBESTOS SUICIDATION - Material that by appearance may be asbestos.
10 - GENERAL TRASH - Fixed up discarded material that does not fit into the previous categories.

LAND USE CATEGORIES

20 - BUILDINGS, IND./COM. FUEL STORAGE - Large fuel storage facilities, vehicle service stations, fuel distributors, etc.
21 - BUILDINGS, IND./COM. NON-FUEL STORAGE - Industrial or commercial buildings like warehouse, refrigerated storage, vehicle service stations without fuel storage, etc.
22 - BUILDINGS, OTHER - Buildings that do not fit into the previous two categories like shops, stores, permanent residences, etc.
23 - BUILDINGS, PARKING FACILITIES - Multi-level parking garages, parking lots, etc.
24 - BUILDINGS, ELECTRICAL FACILITIES - Electrical or telephone substation, transformers, etc. [do not include utilities being carried by the bridge].
25 - ATTACHMENTS/QUIP/APPRT - Attachments in or supported by the bridge structure for which it was not intended and that is compromising the structure's integrity.

PRIORITY CODES - This is used to code the relative priority or urgency for removal of underbridge debris or alteration of the land use in order to reduce the bridge's susceptibility to fire or damage. The following codes shall be used:

H - HIGH PRIORITY: Use to identify large quantities of debris that appear to be flammable and where a debris fire would likely cause structural damage to the bridge. Photographs are only required for this category to present the situation.
M - MEDIUM PRIORITY: Use to identify where significant debris is present, but its burning would be less likely to cause severe damage to the bridge.
L - LOW PRIORITY: Use to identify cases where, 1) there is debris, but burning would not cause damage to the bridge; 2) debris under the bridge that is not flammable (e.g. scrap metal), or 3) land use is an occupied building or a parking facility.
N - No Data/Land Use - Use only when removing a previous report of debris or land use.

Only one code shall be used per span, and it shall reflect the span's highest priority.
B.I.N.  
Region  County  
Feature Carried  
Feature Crossed  
General Recommendation  

199  INSPECTION  

REVIEWED BY  
TITLE  

Form BD 218a

K.20
INSPECTION
PHOTOGRAPHS
LOAD RATING

REVIEWED BY

TITLE

Form BD 221
SKETCHES IN LIEU OF PLANS
DETAILS OR SITUATIONS REQUIRING SPECIAL EMPHASIS DURING INSPECTION
Appendix L
APPENDIX L

TECHNICAL ADVISORY STATUS

Technical Advisories (T.A.s) are a form of communication used by the Structures Division to provide technical information to those involved with bridge inspection activities. Some T.A.s issued have been superseded by this manual while others have not.

Listed below are the Technical Advisories through T.A. 00-001 that remain in effect as of the date of this Addendum:

INSPECTION

85-001 Introduction to Technical Advisory
85-002 Inspection of Non-Bearing-Centered Connection of Select In Line Thru-Girders
86-004 Air Quality Testing of Confined Spaces
86-005 Culvert Inspection Manual Report No. FHWA-IP-86-2
87-004 Investigation of Transition Failures Involving Movable Bridges
87-005 “Inspection of Fracture Critical Bridge Members—Supplement to Bridge Inspector’s Training Manual” - FHWA-IP-86-26
87-006 Bridge Inspection Checklist
87-007 Bridge Inspector’s Manual for Movable Bridges - FHWA-IP-77-10
87-013 Providing Bridge Owners with Bridge Inspection Reports
88-001 Shadow Vehicle Policy
88-002 Inspection of Bridge Bearing Stools
90-001 Inspection and Evaluation of Truss-Floorbeam Hanger Connections
94-004 Steel Special Emphasis Stringer Connections
96-001 Policy For the 100% “Hands-On” Inspection of Haunch Details
96-002 Prestressed Concrete Beam Cracking
96-003 Additional Procedures for Inspection Fall Protection
98-001 Review and Identification of Information in BIN Folder of Bridges Affected by Tidal Scour in Regions 10 and 11
00-001 Special Case Fracture Critical Details

INVENTORY

86-001 Vertical Clearance Measurements for Bridges Spanning Railroads
86-002 Modification of Inventory Requirements for 1986 (Regions 1, 4, 5, & 8 only)

LOAD RATING

The following T.A.s are superseded by this manual:

**INSPECTION**

- 85-003 Scheduling Biennial & Interim Inspections, New “Type of Inspection” Codes and Interim Inspection Documentation
- 87-001 Revised Pages to New York Bridge Inspection Manual-82
- 87-002 Submission Guidelines for Bridge Inspection, Inventory, and Load Rating Data to the Structures Division
- 87-003 Changes to Bridge Inspection Reports
- 87-008 Observation of Posted Load Limits Being Exceeded During Bridge Inspections
- 87-009 Scheduling Bridge Inspections for Periods of Low Water
- 87-010 Policy on Use of Condition Code of (9) “Unknown” on N.Y.S.D.O.T. Bridge Inspection Reports
- 87-011 Use of Bridge Plans as Part of Bridge Inspections
- 87-012 Criteria for Selection of Bridges to Receive Inspection by Divers
- 87-015 Bridge Inspection Report Remarks
- 87-016 Liquid Penetrant Inspection Procedure
- 87-017 Dry Magnetic Particle Inspection Procedure
- 87-018 Technical Advisory Index 1985 through 1987
- 88-003 Regional Quality Control Engineer Field Review of State Employee and Contract Engineer Bridge Inspection Team Activities
- 92-001 Date of Inspection
- 92-002 Bridge Inspection Intensity Requirements
- 94-002 Use of Diving Inspection Information in the General Inspection Process
- 94-003 Standard Bridge Inspection Tools, Equipment, and Supplies
Appendix M
APPENDIX M
USING THE FEDERAL SCALE

Introduction

In order to accurately supply the Federal Highway Administration with required bridge condition information, it is necessary to collect the data directly in the field using the Federal Rating Scale. Inspectors will need to follow the instructions in the "Bridge Inspector’s Training Manual 90" (FHWA PD-91-015) and the "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges" (Report No. FHWA-PD-96-001) when filling out the Federal Rating Form for all bridges. On the form, the inspector enters the BIN for the bridge and the five rating elements: deck, superstructure, substructure, channel and culvert. This form is part of the Inspection Report and must be quality-controlled accordingly. When completing these forms, the inspector needs to consider the condition of the entire bridge and not rate the element using the "worst of multiple elements" concept as described in Chapter 1 of this (NYSDOT) manual. Refer to the FHWA "Bridge Inspector’s Training Manual 90" for further directions on element rating. This appendix contains the complete FHWA rating information (reprinted below verbatim) as described in the FHWA "Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation’s Bridges" and is annotated in italics to clarify areas of possible confusion arising from differences between the FHWA and NY State inspection procedures.

Federal Rating System

Item No. 58 through Item No. 62 - Indicate the Condition Ratings

In order to promote uniformity between bridge inspectors, these guidelines will be used to rate and code Items 58, 59, 60, 61, and 62.

Condition ratings are used to describe the existing, in-place bridge as compared to the as-built condition. Evaluation is for the materials related, physical condition of the deck, superstructure, and substructure components of a bridge. The condition evaluation of channels and channel protection and culverts is also included. Condition codes are properly used when they provide an overall characterization of the general condition of the entire component being rated. Conversely, they are improperly used if they attempt to describe localized or nominally occurring instances of deterioration or disrepair. Correct assignment of a condition code must, therefore, consider both the severity of the deterioration or disrepair and the extent to which it is widespread throughout the component being rated.

The load-carrying capacity will not be used in evaluating condition items. The fact that a bridge was designed for less than current legal loads and may be posted shall have no influence upon condition ratings.
Portions of bridges that are being supported or strengthened by temporary members will be rated based on their actual condition; that is, the temporary members are not considered in the rating of the item.

Completed bridges not yet opened to traffic, if rated, shall be coded as if open to traffic.

The following general condition ratings shall be used as a guide in evaluating Items 58, 59, and 60:

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>NOT APPLICABLE</td>
</tr>
<tr>
<td>9</td>
<td>EXCELLENT CONDITION</td>
</tr>
<tr>
<td>8</td>
<td>VERY GOOD CONDITION - no problems noted.</td>
</tr>
<tr>
<td>7</td>
<td>GOOD CONDITION - some minor problems.</td>
</tr>
<tr>
<td>6</td>
<td>SATISFACTORY CONDITION - structural elements show some minor deterioration.</td>
</tr>
<tr>
<td>5</td>
<td>FAIR CONDITION - all primary structural elements are sound, but may have minor section loss, cracking, spalling or scour.</td>
</tr>
<tr>
<td>4</td>
<td>POOR CONDITION - advanced section loss, deterioration, spalling or scour.</td>
</tr>
<tr>
<td>3</td>
<td>SERIOUS CONDITION - loss of section, deterioration, spalling, or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.</td>
</tr>
<tr>
<td>2</td>
<td>CRITICAL CONDITION - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.</td>
</tr>
<tr>
<td>1</td>
<td>&quot;IMMINENT&quot; FAILURE CONDITION - major deterioration or section loss present in critical structural components, or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic, but corrective action may put the bridge back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>FAILED CONDITION - out of service beyond corrective action.</td>
</tr>
</tbody>
</table>

**Item 58 - Deck**

This item describes the overall condition rating of the deck. Rate and code the condition in accordance with the above general condition ratings. Code N for culverts and other structures without decks e.g., filled arch bridge.

Concrete decks should be inspected for cracking, scaling, spalling, leaching, chloride contamination, potholing, delamination, and full or partial depth failures. Steel grid decks should be inspected for broken welds, broken grids, section loss, and growth of filled grids from corrosion. Timber decks should be inspected for splitting, crushing, fastener failure, and deterioration from rot.

The condition of the wearing surface/protective system, joints, expansion devices, curbs, sidewalks, parapets, fascias, bridge rail, and scuppers shall not be considered in the overall deck evaluation. However, their condition should be noted on the inspection form.
Appendix M

Decks integral with the superstructure will be rated as a deck only and not how they may influence the superstructure rating (for example, rigid frame, slab, deck girder or T-beam, voided slab, box girder, etc.). Similarly, the superstructure of an integral deck-type bridge will not influence the deck rating.

Note: The New York State rating system requires the deck be rated “8” (not applicable) for structures such as frames, slabs, and those with side-by-side prestressed concrete box-beams. The Federal Rating System, on the other hand, requires a deck rating for all structures except culverts and structures with fill between the rating surface and the superstructure which should be coded “N” (not applicable) on the Federal Rating Form. When coding an “N” on the Federal rating Form, the type of structure should be noted (i.e.) concrete rigid frame with fill. All structures which are not culverts or do not have fill between the rating surface and the superstructure should receive a rating number on this form.

The TP 349 and TP 350 should still be coded as specified in the NYS Bridge Inspection Manual.

Item 59 - Superstructure

This item describes the physical condition of all structural members. Rate and code the condition in accordance with the previously described general condition ratings. Code N for all culverts.

The structural members should be inspected for signs of distress which may include cracking, deterioration, section loss, and malfunction and misalignment of bearings.

The condition of bearings, joints, paint system, etc. shall not be included in this rating, except in extreme situations, but should be noted on the inspection form.

On bridges where the deck is integral with the superstructure, the superstructure condition rating may be affected by the deck condition. The resultant superstructure condition rating may be lower than the deck condition rating where the girders have deteriorated or been damaged.

Fracture critical components should receive careful attention because failure could lead to collapse of a span or the bridge.

Note: Since the New York State rating system includes miscellaneous superstructure items such as bearings, joints, paint system, etc., the coding of these individual items is part of the (NYS) Bridge Inspection Report (BIN folder). Therefore, it is not necessary to repeat notes specific to these elements on the Federal Rating Form.
Appendix M

Item 60 - Substructure

This item describes the physical condition of piers, abutments, piles, fenders, footings, or other components. Rate and code the condition in accordance with the previously described general condition ratings. Code N for all culverts.

All substructure elements should be inspected for visible signs of distress including evidence of cracking, section loss, settlement, misalignment, scour, collision damage, and corrosion. The rating given by Item 113 - Scour Critical Bridges, may have a significant effect on Item 60 if scour has substantially affected the overall condition of the substructure.

The substructure condition rating shall be made independent of the deck and superstructure.

Integral-abutment wingwalls to the first construction or expansion joint shall be included in the evaluation. For non-integral superstructure and substructure units, the substructure shall be considered as 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.

Note: Collision protection devices are considered in the determination of this item for the Federal Rating Form.

Item 113 is a Federal Item. While scour is a critical situation and should be considered in the rating of a bridge substructure, the computation of Federal Item 113 is done by the Department's Structures Division Bridge Safety Assurance Unit. However, if the Hydraulic Vulnerability Assessment report is available for the bridge, a rating of 2 or less should be reflected in your coding of this item (no. 60).

Item No. 61 - Channel and Channel Protection

This item describes the physical conditions associated with the flow of water through the bridge such as stream stability and the condition of the channel, riprap, slope protection, or stream control devices including spur dikes. 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 may result in immediate or potential problems. Accumulation of drift and debris on the superstructure and substructure should be noted on the inspection form, but not included in the condition rating.

Rate and code the condition in accordance with the previously described general condition ratings and the following descriptive codes:
Appendix M

<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>NOT APPLICABLE - use when bridge is not over a waterway (channel).</td>
</tr>
<tr>
<td>9</td>
<td>There are no noticeable or noteworthy deficiencies which affect the condition of the channel.</td>
</tr>
<tr>
<td>8</td>
<td>Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.</td>
</tr>
<tr>
<td>7</td>
<td>Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and or channel have minor amounts of drift.</td>
</tr>
<tr>
<td>6</td>
<td>Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor stream bed movement evident. Debris is restricting the waterway slightly.</td>
</tr>
<tr>
<td>5</td>
<td>Bank protection is being eroded. River control devices and or embankment have major damage. Trees and brush restrict the channel.</td>
</tr>
<tr>
<td>4</td>
<td>Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.</td>
</tr>
<tr>
<td>3</td>
<td>Bank protection has failed. River control devices have been destroyed. Stream bed aggradation, degradation or lateral movement has changed the channel to now threaten the bridge and or approach roadway.</td>
</tr>
<tr>
<td>2</td>
<td>The channel has changed to the extent the bridge is near a state of collapse.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed because of channel failure. Corrective action may put bridge back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed because of channel failure. Replacement necessary.</td>
</tr>
</tbody>
</table>

Item No. 62 - Culverts

This item evaluates the alignment, settlement, joints, structural condition, scour, and other items 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. For a detailed discussion regarding the inspection and rating of culverts, consult Report No. FHWA-IP-86-2, Culvert Inspection Manual, July 1986.

Item 58 - Deck, Item 59 - Superstructure, and Item 60 - Substructure shall be coded N for all culverts.

Rate and code the condition in accordance with the previously described general condition ratings and the following descriptive codes:

M.7 Addendum 1 - April, 1999
<table>
<thead>
<tr>
<th>CODE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>NOT APPLICABLE - Use if structure is not a culvert</td>
</tr>
<tr>
<td>9</td>
<td>No deficiencies.</td>
</tr>
<tr>
<td>8</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the culvert. Insignificant scrape marks caused by drift.</td>
</tr>
<tr>
<td>7</td>
<td>Shrinkage cracks, light scaling, and insignificant spalling which 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. Metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting.</td>
</tr>
<tr>
<td>6</td>
<td>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. Metal culverts have a smooth curvature, non-symmetrical shape, significant corrosion or moderate pitting.</td>
</tr>
<tr>
<td>5</td>
<td>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 at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection in one section, significant corrosion or deep pitting.</td>
</tr>
<tr>
<td>4</td>
<td>Large spalls, heaving scaling, wide cracks, considerable efflorescence, or opened construction joint permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting.</td>
</tr>
<tr>
<td>3</td>
<td>Any condition described in Code 4, but which 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 at curtain walls, wingwalls, or pipes. Metal culverts have extreme distortion and deflection in one section, extensive corrosion, or deep pitting with scattered perforations.</td>
</tr>
<tr>
<td>2</td>
<td>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.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed. Corrective action may put bridge back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Replacement necessary.</td>
</tr>
</tbody>
</table>

**Note:** This item should be rated only if the General Type Main Span is coded “culvert” (19) in the Bridge Inventory. If the General Type Main Span is not “culvert”, place an “N” in this column on the Federal Rating Form. If the General Type Main Span is “culvert”, give a rating in this column and place an “N” in the columns for Deck, Superstructure, and Substructure on the Federal Rating Form.
**FEDERAL RATING FORM**

NYS DEPT. of TRANSPORTATION

BRIDGE INSPECTION REPORT

TEAM LEADER

ASST. TEAM LEADER

DATE

FEATURE CARRIED:

FEATURE CROSSED:

<table>
<thead>
<tr>
<th>Description</th>
<th>Deck</th>
<th>Superstructure</th>
<th>Substructure</th>
<th>Channel</th>
<th>Culvert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fed. Item #</td>
<td>58</td>
<td>59</td>
<td>60</td>
<td>61</td>
<td>62</td>
</tr>
<tr>
<td>Rating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:

Notes:
1) See attached explanations for Federal Item Nos. a) 58 - Deck, 59 - Superstructure, 60 - Substructure; b) 61 - Channel and Channel Protection; c) 62 - Culverts

2) Item Nos. 58, 59, and 60 shall be coded **N** for all culverts.

3) A rating or an **N** must be entered for all Federal Items. Blanks are not acceptable.

Revised 6/99
The attached documents are to be incorporated into the 1997 New York State Department of Transportation Bridge Inspection Manual. These include:

1) Pages C.5, C.6, and C.7 to replace the existing pages C.5 and C.6 in Appendix C. These pages better describe the roles and responsibilities of the Main Office, the Regional Offices, and the Consultant Engineering firm with regards to the Underwater Inspection Program.

2) Appendix M - "Using the Federal Scale."

3) Revised Appendix A, giving highlights of the most commonly referred to Safety Bulletins.

4) Updated Table of Contents.

Questions regarding this manual should be directed to the Bridge Inspection Unit of the Structures Design and Construction Division of the Department at (518) 457-5498.
ADMINISTRATIVE INFORMATION: This Engineering Bulletin (EB) is effective January 1, 2002. It does not supersede any previous issuances. The attached materials are to be incorporated into the 1997 New York State Department of Transportation Bridge Inspection Manual.

PURPOSE: To distribute various revised sections to the cited Manual.

TECHNICAL INFORMATION: Following is a list of the changes made to the Bridge Inspection Manual:

1) Chapter 4A, Stream Alignment and Waterway Opening. Revised rating instructions for these items.

2) Chapter 6, Deck Elements. Monolithic Deck Surface definition and rating instructions have been updated along with the rating photos.

3) Chapter 7, Superstructure Paint. Revisions to this item include instructions for rating Non-Weathering Steel and for rating Weathering Steel.

4) Chapter 11, Quality Control Requirements. Field review requirements updated to include Safety Field Review Checklist.


7) Miscellaneous changes and corrections to the following chapters: Chapter 1, Chapter 4D, Chapter 8, Chapter 9, Chapter 10, Chapter 11.

TRANSMITTED MATERIALS: The materials cited immediately above are herewith transmitted.

CONTACT: Direct questions regarding this manual to the Inspection Unit of the Structures Design and Construction Division of the Department at (518) 457-5498.
Represented here is a new form for communication from the Structures Division. Entitled TECHNICAL ADVISORY, abbreviated as T.A., it will provide technical information to those involved with bridge Inventory, Inspection, and Level Two Load Rating activities.

Attached are copies of blank Inventory, Inspection, and Level Two Load Rating T.A. forms, differentiated by the shaded unit title boxes located along the right hand side of each page. The smaller box, below the unit title box, will contain the last two digits of the year issued plus a three digit T.A. issue number. Should a particular T.A. need revision, then a new T.A. will be issued with the year and T.A. number that it supersedes in the "Superseded" box in the heading. At the end of each year, an index for that year's issuances will be printed for reference.

Issuance of all T.A.'s will be from the appropriate unit or sub-unit within the Structures Division. During training sessions, each attendee will receive a copy of all current T.A.'s. A normal issuance to the Region will consist of copies to the Regional Director, Regional Structures Engineer, Regional Bridge Inventory Coordinator and State Employee Bridge Inspection Team Leader, Assistant Team Leader and Senior Engineering Technicians. Current issuances will be given to all new Contract Engineers by the Structures Division at project start up meetings.

However, after the start up meeting, it will be the Regional Structure Engineer's responsibility to distribute any new T.A. issuances to onboard Contract Engineers.

Suggestions from Regions for possible issuance of a T.A. are encouraged. Suggestions should be sent to the appropriate unit in the Structures Division for consideration.

Questions concerning this T.A. should be addressed to the Inventory and Inspection Unit in the Structures Division.
Shown in Figure 1 is a detail that was occasionally used to connect in line thru-girders on 1930's era highway bridges over railroads. As can be seen, the connection does not occur at the center of the bearing and the end of one span's support is primarily dependent on the shear capability of fasteners, either through bolts or rivets. This detail is being highlighted in this T.A. because of its unusual nature and also its criticalness. Failure of this detail would most likely cause superstructure collapse. Last inspection of bridges with this detail has revealed individual fasteners that have failed.

NOTE: No continuity of web. Support of the right span dependent primarily on the shear capacity of these fasteners shown.

Figure 1
When inspecting thru-girder bridges with this detail, the following should routinely be done:

1. Thoroughly inspect each fastener for any signs of distress such as looseness, corrosion, bending, etc. and note any distress.

2. Thoroughly inspect 2 feet from both sides of the centerline of the connection for cracks or tears in the structural elements that make up the thru-girders. Attention should be given to cracks that could emanate from bolt and/or rivet holes.

3. Inspect the zone as described in 2. for crevice corrosion. Refer to the text at the bottom of page 11.23 of the Inspection Manual for the description of crevice corrosion.

4. Inspect for any other signs of distress such as displacement of the connection, deformation of structural members, alignment and profile of members, etc.

5. Document the connection and its condition with sketches (if plans are not available), measurements, and photographs using clear, concise descriptions.

This list represents a set of general steps that are to be followed as a guide when a bridge with this detail is encountered. Since all bridges should be treated as unique, more steps may be required in some cases, therefore, these steps are to be considered as a minimum.

This detail should be considered as a "detail requiring special emphasis" during each inspection. The corresponding sticker and special inspection emphasis section shall be produced for each appropriate inspection binder.

Significant deficiencies to this detail should be considered as a serious matter and should receive a "Structural Flag".
This Technical Advisory is to inform bridge inspection personnel that,

1. Air quality sampling should be done before entering into any confined space, and
2. Portable air testing equipment will be made available through the Regional Safety Representative to test air quality before entering confined spaces.

This equipment tests for the following:

1. Presence of combustible gases.
2. Level of carbon monoxide present.
3. Oxygen deficiency.

An example of a location where such equipment might be used would be entering the inside of a sealed box arch pier.

When an inspector believes that a test of air quality should be made to facilitate an inspection, the inspector should make appropriate advance arrangements with one of the Department's II Regional Safety Representatives. The Main Office Employee Safety and Health Section has informed us that the Regional Safety Representative will arrange to conduct air quality tests for the bridge inspection crew providing sufficient advance notice is given.
## TECHNICAL ADVISORY

**ISSUED BY:** STRUCTURES DIV.
**BRIDGE INSPECTION UNIT**

**SUBJECT:**
CULVERT INSPECTION MANUAL

**REPORT NO.:** PEWA-IP-86-2

**DATE:**
12/26/86

**SUPERSSEDES:**
NONE

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The purpose of this Technical Advisory is to distribute a limited number of manuals titled "Culvert Inspection Manual" dated July 1986, to Regional Structures Engineers for re-distribution to selected State employee bridge inspection personnel. The "Culvert Inspection Manual" contains practical information involving procedures for inspection of various types of culvert bridges. Bridge inspection personnel should be familiar with this manual and use the information in the manual to strengthen their inspection of culvert type structures.

Each Regional Structures Engineer, each State employee bridge inspection Team Leader, and each State employee bridge inspection Quality Control Engineer shall have their own personal copy of this manual. Sufficient copies of this manual are attached to the Regional Structures Engineer's copy of this T.A. to accommodate this distribution.

A copy of this manual should be made available to other State employee bridge inspection personnel for their review.

Each Contract Engineer performing general bridge inspection work for the Department shall obtain a copy of this manual for each of their inspection Team Leaders and Quality Control Engineers. Contract Engineers can obtain copies of this manual from:

- Superintendent of Documents
  - US Government Printing Office
  - Washington, D.C. 20402

  or

- National Technical Information Service
  - Springfield, Virginia 22161
The purpose of this Technical advisory (T.A.) is to transmit a copy of an Illinois Department of Transportation report entitled "Investigation of Trunnion Failures Involving Movable Vertical Lift Bridges" and a related March 24, 1987 memorandum from the Federal Highway Administration.

As stated in the attached report and the FHWA memorandum, several fatigue cracks have been found in movable bridge trunnions in the State of Illinois. The report author identifies certain design and operational characteristics which he believes were significant contributing factors in the development of these fatigue cracks. According to the report, significant factors were that the trunnions had an abrupt change in cross section and that the trunnions were subject to more than 90 degrees of rotation under normal operating conditions.

It is very important that maintainers, owners, and inspectors of bridges incorporating trunnions have the attached material and understand that a trunnion failure could lead to catastrophic collapse. Towards this end, each Regional Structures Engineer shall identify all movable bridges in his Region and he shall identify the parties responsible for their maintenance, ownership, and inspection. (Attached to this T.A. is a draft list of movable bridges from the Department's current Bridge Inventory Data Base File to help with bridge identification). Once the maintainers, owners, and inspectors of these bridges are identified, a copy of this T.A., with all attached material, shall be forwarded to each of the identified parties. The transmittal shall:

1. Specifically emphasize the importance of proper maintenance and inspection of trunnions.
<table>
<thead>
<tr>
<th>SUBJECT:</th>
<th>INVESTIGATION OF TRUSSION FAILURES INVOLVING MOBILE BRIDGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Emphasize the probable significance of abrupt change in trunnion cross section and the degree of rotation experienced during normal operation.</td>
</tr>
<tr>
<td>3.</td>
<td>Emphasize that trunnion failure could lead to catastrophic collapse.</td>
</tr>
</tbody>
</table>

MOBILE BRIDGES SPANNING THE STATE'S CANAL SYSTEM

As trunnions are considered to be part of the "mechanical" portion of mobile bridges, inspection of trunnions on mobile bridges spanning the State's Canal System is performed by the Department's Waterways Division. (See attached copy of a memorandum entitled "Inspection of Electrical and Mechanical Aspects of Mobile Bridges Spanning the State Canal System" dated 3/11/86). In accordance with this memorandum, each Regional Structures Engineer is to regularly receive a copy of each inspection report of the electrical and mechanical aspects of mobile bridges performed by the Waterways Division. Regional Structures Engineers should review their files to determine if they have received a recent report. If not, the Regional Structures Engineer should request a copy of the report from the appropriate Regional Waterways representative.

MOBILE BRIDGES INSPECTED BY CONTRACT ENGINEERS

A copy of this Technical Advisory with all attachments, shall be by each Regional Structures Engineer to each Contract Engineer performing inspections of mobile bridges under his direction. When the prime Contract Engineer's Agreement provides for the mechanical inspections to be performed by a Sub-Consultant with special mechanical expertise, the Regional Structures Engineer shall direct the prime Contract Engineer to forward a copy of this T.A. and all attachments to the appropriate Sub-Consultant.

MOBILE BRIDGES INSPECTED BY STATE EMPLOYEE BRIDGE INSPECTION TEAMS

Even though very few State employee bridge inspection teams will be responsible for inspecting the mechanical aspects of any mobile bridges, each State employee inspection person shall be provided with a copy of this Technical Advisory and all attached materials.
If a particular State employee bridge inspection team is responsible for the inspection of a movable bridge, the Regional Structures Engineer shall review this material with that inspection team and emphasize the importance of close trunnion inspection.

**FLAGGING CRACKS IN TRUNNIONS**

Any indication of cracking in a trunnion shall be treated as a "Structural Flag" situation in accordance with the Department's current Bridge Flagging Procedure.
In cooperation with the Federal Highway Administration and the National Highway Institute, a "Fracture Critical" training course was recently given to State employee bridge inspection Team Leaders, Assistant Team Leaders, and other pertinent Regional bridge inspection personnel. The book titled "Inspection of Fracture Critical Bridge Members-Supplement to Bridge Inspector's Training Manual" was distributed to all course participants. This book contains important information concerning appropriate identification and inspection of Fracture Critical bridge members. Effective immediately, it is Department policy that each State employee and Consultant bridge inspection Team Leader, Assistant Team Leader, and Quality Control Engineer shall have a personal copy of this book. Each NYSDOT Regional Structures Engineer shall also have a personal copy. Copies of this book will be provided to State employees by the Structures Division. Consulting engineering firms performing general bridge inspections in New York State shall obtain their own copies of this book for distribution to their employees. Copies of this book can be obtained through the National Technical Information Service, Springfield, Virginia 22161. The book is dated September, 1986 and is referenced as "Report No. FHWA-IP-86-26".

As a point of clarification, the book describes three types of redundancy,

(1) Internal Redundancy
(2) Load Path Redundancy
(3) Structural Redundancy

For the purposes of bridge inspection in New York State, only Load Path Redundancy shall be considered. For example, if a structure is either internally redundant or structurally redundant, but not load path redundant, the non-redundant load path members shall receive the required 100% "hands-on" inspection.
The purpose of this Technical Advisory is to distribute copies of FHWA bridge inspection work booklet titled "Bridge Inspector Training Course - Inspection Checklist". A personal copy of this booklet shall be given to each bridge inspection Team Leader, Assistant Team Leader, and Quality Control Engineer working on bridge inspection work in New York State.

Sufficient copies of this booklet are attached to each Regional Structures Engineer's copy of this T.A. to accommodate the distribution stated above for all State employee bridge inspectors in his Region. Sufficient copies of this booklet are also attached to each Regional Structures Engineer's T.A. to accommodate forwarding one copy of the booklet to each Contract Engineer currently performing general bridge inspection work under the Regional Structures Engineer's direction. Regional Structures Engineers shall forward one copy of this T.A. and the booklet to each Contract Engineer performing general bridge inspection work under his direction. Each effected Contract Engineer shall reproduce sufficient copies of this booklet to accommodate the required distribution to each of their bridge inspection Team Leaders, Assistant Team Leaders, and Quality Control Engineers.

The attached "Inspector's Checklist" booklet contains valuable information and pointers in terms of appropriate preparation for an inspection, equipment and tools to be used, specific inspection procedures, inspection documentation pointers, etc. All inspection personnel shall review this booklet and become familiar with its format and contents. In the future, this booklet shall be considered as supplementary information for New York State bridge inspectors. Knowing and using the information in these booklets should enhance each bridge inspector's knowledge and capabilities, generally improving the comprehensiveness of bridge inspections performed in New York State.
The purpose of this Technical Advisory is to distribute a limited number of manuals titled "Bridge Inspector's Manual For Movable Bridges FHWA IP 77-10" to Regional Structures Engineers for re-distribution to selected State employee bridge inspection personnel. The "Bridge Inspector's Manual For Movable Bridges FHWA IP 77-10" contains detailed information involving various types of movable bridges. Bridge inspection personnel should be familiar with this manual and use the information in the manual to strengthen their knowledge of movable structures.

Each Regional Structures Engineer, each State employee bridge inspection Team Leader, and each State employee bridge inspection Quality Control Engineer shall have their own personal copy of this manual. Sufficient copies of this manual are attached to the Regional Structures Engineer's copy of this T.A. to accommodate this distribution.

A copy of this manual should be made available to other State employee bridge inspection personnel for their review.

Each Contract Engineer performing general bridge inspection work for the Department shall obtain a copy of this manual for each of their inspection Team Leaders and Quality Control Engineers. Contract Engineers can obtain copies of this manual from:

Superintendent of Documents
US Government Printing Office
Washington, D.C. 20402
<table>
<thead>
<tr>
<th>Issued By:</th>
<th>Subject:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structures Division</td>
<td>Providing Bridge Owners with Bridge Inspection Reports</td>
<td>November 1, 1987</td>
</tr>
<tr>
<td>Approved By:</td>
<td></td>
<td>Supersedes:</td>
</tr>
<tr>
<td>Dymszynski</td>
<td></td>
<td>None</td>
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</table>

The purpose of this Technical Advisory is to implement a policy change in the timing of the forwarding of routine general bridge inspection and diving inspection reports to bridge owners and maintainers.

Effective immediately, copies of all **Quality Controlled** bridge inspection reports shall be quickly forwarded to appropriate bridge owners and maintainers once received in the Regional Structures Engineer's office. Regional Structures Engineers shall not wait for Structures Division submission acceptance or data entry into the computer file prior to forwarding reports to bridge owners and maintainers.

Regions and the Structures Division shall continue to perform a general review of bridge inspection submissions after the individual reports have passed the standard Quality Control Engineer's review. When based on such reviews, corrections, clarifications, reinspections, etc., are necessary to reports after distribution to bridge owners and maintainers, the initial report shall be amended in accordance with T.A. 87-003. When this occurs, a copy of all amended pages shall be sent by memorandum or letter to all parties who received copies of the initial report. The transmittal correspondence shall clearly state the Region, County, BIN, and the amended page numbers being transmitted. The transmittal shall instruct each recipient to attach the amended sheet(s) to all copies of the initial report. The original of the amended sheet(s) shall be affixed to the original report retained in the Regional Office.

Implementation of this Technical advisory should result in bridge owners/maintainers receiving bridge inspection information in a more timely manner.
This Technical Advisory establishes a mandatory shadow vehicle policy as an element of the maintenance and protection of traffic procedure for bridge inspection teams. A shadow vehicle shall be used when a bridge inspection team is occupying all or any portion of the highway pavement in accordance with the following:

**Interstate/Expressway Highway:**
When a bridge inspection team occupies any portion of a travel lane, a large dump truck shall be used as a shadow vehicle. A truck mounted impact attenuator shall be used if available.

**State and Local Roads:**
When a bridge inspection team occupies any portion of a travel lane, a shadow vehicle shall be used. Generally, a large dump truck, with impact attenuator, if available, is preferred, but in some situations a smaller vehicle may be used such as a stake truck or inspection van. The smaller vehicle option would most likely be used on local, rural roads.

The determination of the "type" of shadow vehicle, where discretionary, shall be made by the bridge inspection team leader or his/her supervisor. Factors such as highway classification, traffic volume, speed limits, sight distance, pavement condition, etc., are to be considered when making this determination. The Regional Safety Representative shall be consulted if there are any questions or doubts as to the appropriate vehicle to be used.
<table>
<thead>
<tr>
<th>SUBJECT:</th>
<th>SEAWAY VEHICLE POLICY</th>
</tr>
</thead>
</table>

All traffic control, regardless of the classification of highway, shall be performed in strict conformance with the NYS DOT Manual of Uniform Traffic Control Devices and the Department Bridge Inspection Safety Manual.

Provisions of this Technical Advisory shall be strictly followed, adhered to, and enforced.
INTRODUCTION:

The purpose of this Technical Advisory is to highlight a particular bearing stool detail that saw limited use in the 1960’s and has proven itself to be potentially hazardous when allowed to deteriorate extensively.

Bridge bearing stools are attached below the ends of beams/girders to compensate for beam/girder depth differences between two abutting superstructures terminating at a common pier. The bearing stools transmit beam/girder end reactions to supporting sole plates and bearing assemblies.

DESCRIPTION OF DETAIL:

The bearing stool detail of concern uses a wide-flange beam section placed vertically (strong axis perpendicular to the beam/girder) beneath a beam/girder end, with an outboard stiffener bracing the stool back up to the bottom flange of the beam/girder (see appended sketch). The stool, with "mill to bear" ends, and outboard stiffener are attached to the bottom flange of the beam/girder with all around welds. A potential problem exists where the stool bears against its supporting sole plate and bearing assembly. This occurs when only a near-side/far-side fillet weld (along the web of the vertical beam section) positively attaches the stool to the sole plate, and the bearing stool’s flanges only bear on the sole plate without positive attachment. (See location of missing welds on appended sketch.)

POTENTIAL PROBLEM:

A failure scenario for this bearing stool detail can start with a leaking joint above the stool and the build up of debris around it. In this environment, the stool’s web can rust heavily above and around its fillet weld attachment to the sole plate. Concurrently the same moisture and debris causes the frictional resistance of participating expansion bearings to increase; increasing the horizontal loads applied to the stools. Under the additional horizontal loads, the rusted reduced web section of the stool can distort and tear at its fillet weld attachment to the sole plate. This can result in the stool’s lower web yielding; and the stool’s flanges riding off the sole plate’s edges, dropping several inches as the stool crushes around the sole plate and bearing assembly.
Welds attaching the stool's flanges to the sole plate (along with the near-side/far-side fillet welds at the web) would greatly enhance the integrity of this bearing stool detail and extend its lifecycle. During an inspection, the absence or existence of such flange welds should be verified by the inspector. When no welds are found attaching the stool's flanges to the sole plate, the inspector should: a) document (in the inspection report) the absence of the welds, and the present loss of section and distortion of each stool inspected; b) identify the stools without flange to sole plate welds as requiring a "special emphasis" (100% hands-on close visual) inspection during all future inspections; and c) write a special letter of notification to the Region's Regional Structures Engineer, identifying the bridge and the location(s) of the missing welds. Any stool missing the flange to sole plate welds and showing significant deterioration should be structurally flagged in accordance with the department's current "flagging procedure for bridges".
INTRODUCTION:

This Technical Advisory addresses procedures for inspecting and assessing the safe load capacity of load path non-redundant floorbeam hanger assemblies found on some truss bridges. These details can be highly susceptible to failures caused by overloads, especially when the hanger exhibits corrosion induced section loss of even moderate amounts. Failure of these hanger assemblies will result in a collapse of at least part of the bridge deck with the likelihood of vehicles falling through the bridge floorsystem.

DESCRIPTION:

A typical example of a floorbeam hanger assembly is shown in the detail below. These types of details tend to be more common in older trusses (built prior to 1930) and were often used on pin-connected trusses since the assemblies could be conveniently hung from the truss joint pins. These hanger details are also found frequently on "lightweight" trusses, i.e. those having timber or open grating decks and relatively low dead load to span ratios.

The floorbeam hangers generally consist of rods or bars, angle shapes, or plate elements. These hangers are normally internally non-redundant, consisting of only one or two internal elements.
## CONTINUATION SHEET

| DATE:       | December 18, 1990 | PAGE: | 2 |

**SUBJECT:**

**INSPECTION AND EVALUATION OF TRUSS-FLOORBEAM HANGER CONNECTIONS**

### STRUCTURAL CONSIDERATIONS:

1. Fracture Critical: Since the floorbeam is entirely supported by the hanger below the plane of the truss lower chords, there is no alternate secondary load path. If the hanger assembly fractures the floorbeam will collapse. Lack of secondary load paths also means that the predicted design tension stress in the hanger will not be conservative.

2. Small Member Sections: The total design dead plus live load in the hanger is small compared to most other truss primary member loads. To carry these design loads, members having small cross sectional areas such as rods, small plates or angles were often used. The capacities of such small members can be significantly reduced by even modest section loss. Hanger sections on older bridges that were originally proportioned for light design loads compared to modern standards are highly sensitive to overloads.

3. Corrosion Susceptible: The hanger assemblies are generally situated below the bridge deck, usually outside the deck fascia, thus they are subjected to dirt and road salt which will accelerate corrosion if not routinely cleaned and maintained.

4. Low Dead Load Ratios: Floorbeam hangers will often have relatively low dead load to (design) live load ratios, thus the live load component of the total intended design capacity predominates. In such cases, any increases in live load above the design or posted load will cause a disproportionate increase in the total stress in the hanger. Lowest dead load ratios occur with bridges having timber decks and other lightweight decks and components.

**INSPECTION:**

Floorbeam hangers are fracture critical members, thus they shall receive "hands-on" inspections during all general bridge inspections (biennial and interim). These details shall be documented in the "Special Emphasis" section in the inspection report binder.

Section loss in the hanger members shall be measured as accurately as possible to determine the critical cross sectional area of the hanger. Section thicknesses shall be measured with calipers or a D-meter as is appropriate. Critical sections could be anywhere in the hanger, but is most often adjacent to the truss joint or the upper part of the floorbeam and/or through a fastener hole. For pin connected trusses, the critical section may be in line with the hanger pin hole. Maximum loss of section will usually occur in areas of dirt and debris accumulation, typically adjacent to the top of the floorbeam or at the truss connection (gusset plate or pin). Dirt, debris, and corrosion scale shall be wire brushed off prior to inspecting and measuring the hanger cross section.
In cases where the floorbeam hanger is sandwiched between members of a truss pin or gusset plate assembly, the inspector shall determine as best possible, whether significant deterioration is present in any such inaccessible areas of the hanger. Evidence of deterioration is ascertained from inspecting the edges of the hanger, probing between the connection components with a knife, feeler gage or similar probe, and from observing general deterioration or patch rust in the connection assembly.

Floorbeam hangers with any significant measurable section loss (10-20% or greater) or with compelling evidence of active member corrosion shall be considered as a structural flag condition, either red or yellow depending on the extent of deterioration and considering the posted load capacity of the bridge. The only exceptions are cases where there is documented evidence that the bridge can safely carry legal loads or its currently posted load and the documentation accounts for the present condition of the floorbeam hangers. Such documentation will normally be Level 1 load rating information contained within the BNS folder. Note that the NCHRP level 2 load rating program does not rate the floorbeam hangers. A red structural flag shall be issued if there is reasonable evidence that the allowable legal or posted loads on the bridge may be causing axial stresses in the deteriorated hanger section that exceed the operating rating stress level.

If judged as faulty in truss floorbeam hangers, a red structural flag shall be issued.

DOCUMENTATION:

Any observed hanger section loss or evidence of hanger deterioration shall be documented by notes and photographs in accordance with the provisions of the Bridge Inspection Manual. The documentation shall note deterioration findings and quantity section loss where measured for individually identified hangers as is appropriate. A Table summarizing hanger locations and measurements is recommended.

LOAD CAPACITY EVALUATION:

The loss of function of a floorbeam hanger with section loss can be more accurately evaluated if its live load capacity is computed and compared to the loads being applied to the bridge.

The capacity of the critical floorbeam hanger section can be estimated from available Level 2 load rating analysis data supplemented by simple calculations. Although the Level 2 program does not load rate floorbeam hangers, it does provide data useful for determining both the dead load and rating vehicle live loads applied to the floorbeam hanger.

An example showing how to load rate a floorbeam hanger using Level 2 load rating analysis data is presented in this Technical Advisory. Whether Level 2 rating data is available or not, the rating procedure consists of the following basic steps:
1. Compute the hanger dead load force:
   - The hanger dead load force equals the floorbeam dead load reaction.
   - The hanger dead load equals the truss panel point load minus that portion of the panel point load attributed to the truss steel. The Level 2 program lists these truss panel point loads (see Example).
   - Note that intermediate hanger dead loads on a truss line should be equal for trusses with constant panel lengths (floorbeam spacings).

2. Compute the hanger live load force due to a rating vehicle load:
   - The hanger live load equals the maximum live load reaction on a single floorbeam, or the maximum live load on a single truss panel point.
   - If the truss contains tension verticals at any panel point (i.e. no truss diagonals connect to the lower chord panel point joint), then the hanger live load equals the tension vertical L load.
   - If the truss does not have tension verticals, the live load hanger force is computed as the maximum floorbeam reaction.
   - It is suggested that the AASHTO B-20 load be used for live load, especially where low capacities are suspected.

3. Compute the axial tension capacity of the hanger:
   - The axial capacity of the hanger is computed from its critical section area times the allowable inventory and operating tension stress levels per the AASHTO Manual for Maintenance Inspection of Highway Bridges.
   - Estimation of hanger section loss is of critical importance. Include allowances for increased section loss in inaccessible areas where corrosion is observed or suspected.
   - Capacity and rating calculations based on varying amounts of section loss are suggested. This helps evaluate the effect of deterioration on the hanger load capacity, and helps account for uncertainties in estimating the actual hanger cross-sectional area.

4. Compute the hanger inventory and operating load ratings:
   For simplicity, use the working stress analysis method where:
   \[ R.F. = \left( \frac{\text{Cap.}}{\text{D.L.}} \right) / \text{L.L.} \]
   where:
   - R.F. = Rating Factor (inventory or operating rating)
   - Cap. = Hanger capacity (at inv. or oper. stress level)
   - D.L. = Dead load force in hanger
   - L.L. = Live load force due to rating vehicle

5. Determine the Safe Load:
   Although the operating rating is the upper load limit allowed, it is recommended that a load limit at or near the inventory rating be used to determine the safe load level. Using the inventory level is particularly appropriate to account for the lack of internal redundancy or the effects of uncertain or combined deterioration.
   \[ \text{Safe Load} = (\text{R.F.}) \times (\text{Rating Vehicle gross weight}) \]
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SUBJECT: INSPECTION AND EVALUATION OF TRUSS-FLORSEAM HANGER CONNECTIONS

EXAMPLE Floorbeam Hanger Load Rating from NYS DOT Level 2 LR: Output Data.

1. FLOORBEAM HANGER D.L. = Panel Point D.L. = (Truss Steel D.L.)

From Level 2 Rating Output:

TOTAL OF LOADS PER FOOT DUE TO SLAB, STRINGERS AND SDL ON ALL MAIN MEMBERS = 0.60
LOADS DUE TO FLOORSEAMS ON LEFT 0.00 MIDDLE 0.00 RIGHT 0.00 MAIN MEMBERS LOADS PER FOOT DUE TO SIDEWALK STRINGERS LEFT = 0.000 RIGHT = 0.000

TOTAL TRUSS PANEL POINT LOADS 0.670 1.520 1.929 1.907 1.553 0.670 TRUSS Steel Dead Loads per Panel, POUNDS

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<tr>
<th>PANEL POINT DEAD LOADS</th>
<th>Total Panel H.D.L.</th>
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<td>POINT</td>
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</tbody>
</table>

LEFT REACTION = 21.14 RIGHT REACTION = 21.14

FLOORBEAM HANGER D.L. = 7.17 - 1.907 = 5.26

Note: All intermediate floorbeam hanger D.L.'s are equal.

2. FLOORBEAM HANGER LIVE LOAD (Incl. Impact)

- Floorbeam Hanger L.L. = Truss Hanger L.L.
- Truss Hbras. E01-L01 and D05-L05 are cross hanger verticals.
- All intermediate Flibas. Hangers have equal live loads.
CONTINUATION SHEET

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SUBJECT: INVESTIGATION AND EVALUATION OF TRUSS-FLOORBEAM HANGER CONNECTIONS

Floorbeam Hanger Live Load (cont'd)

From Level 2 Rating Output:

THE DISTRIBUTION FACTOR FOR THIS MEMBER = 1.04

<table>
<thead>
<tr>
<th>MEMBERS</th>
<th>DEAD</th>
<th>LIVE LOAD</th>
<th>IMPACT</th>
<th>ALLOWABLE FORCES</th>
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<tr>
<td>LEFT</td>
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**LIVE LOAD = 910**

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<td>45.0 OPERATING RATING</td>
<td>0.78 EQUAL</td>
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</table>

Use Hanger \[ L = \frac{I}{E} \]

3. FLOORBEAM HANGER CAPACITY (based on Allowable Stresses)

**HANGERS:** 2 - 1½ dia. Rods; Area = 2.45 sq. in.

* Assume 70% Section Loss in Hangers based on inspection findings.
* Bridge built in 1910; Steel Yield Stress, FY = 30 ksi

Hanger Capacities:

- Inventory = 0.55FY \times 2.45 \text{ sq. in.} \times 70\% = 28.3 kip
- Operating = 0.75FY \times 2.45 \text{ sq. in.} \times 70\% = 38.1 kip

4. FLOORBEAM HANGER RATING (N-20 vehicle; gross wgt. = 20 tons)

\[ \text{Inv. R.F.} = \left( \frac{28.3 - 5.26}{49} \right) / 49 = 0.47 \] (9.1 tons)
\[ \text{Oper. R.F.} = \left( \frac{38.1 - 5.15}{49} \right) / 49 = 0.68 \] (13.6 tons)

5. SAFE LOAD LEVEL: Recommend at or near Inventory Rating

**Use Safe Load = 10 Tons**
In recognition of the red flag conditions that recently led to the partial closure of a portion of the Cross Bronx Expressway, this Technical Advisory is being issued to identify details prone to the type of failure that resulted in this closure. These failures typically involve stringer webs that experience corrosion thinning in conjunction with primary or secondary loadings (including sidesway, torsional displacement and end rotation) which induce cracking at some critical loss of section.

The detail in question (as shown in the attached sketch) is typically a stringer to floor beam connection. The stringer bottom flange bears on, and may be bolted directly to, the top flange of the floor beam. The stringer web is unstiffened, and diaphragms do not extend the full depth of the stringer, making the web vulnerable to out-of-plane bending. This detail is often seen at expansion joints, where repetitive loadings in conjunction with water, debris, and deicing agent accumulations provide the fatigue cycles and corrosion thinning and notching conducive to this type of failure.

This detail often fails by developing a longitudinal crack at, or about, the bottom fillet of each stringer which is undetectable from beneath the stringer. Additionally, if the structure is a deck girder or a deck truss, inspection of these details from a platform snooper requires erecting scaffolding (on the platform under the truss or girder) to get high enough to see the bottom fillet. Accordingly, access either by means of an underbridge unit with an articulated (fourth) boom or by rigging if necessary.

Effective immediately, stringer connections of this type shall be treated as special emphasis details regardless of redundancy. They shall be identified in the Special Emphasis Section in the back of the inspection binder, and arrangements shall be made to provide access as necessary to perform 100% hands-on inspection in accordance with special emphasis requirements.
The purpose of this Technical Advisory (T.A.) is to formalize the policy originally set forth in Arun Shiroi's memorandum to all Regional Directors dated May 31, 1990 pertaining to the 100% "hands-on" inspection of the haunch detail shown in Figure 1.

This detail was used for placement of removable bridge deck forming systems and has caused failures which have resulted in falling concrete. In some cases the unreinforced portions of the haunch have cracked and fallen creating a hazard to traffic beneath the bridge. The failures appear to occur due to forces resulting from corrosion products developed on the edge of the flange. The crack initiates at the top edge of the flange and propagates upward at approximately 45° before intersecting the vertical haunch face, thus resulting in loose concrete. The inspector should be very careful to observe if hairline longitudinal cracks are developing along the vertical face of the haunch as shown in Figure 2.

When performing the inspection of a bridge with this particular haunch detail, it is required that 100% "hands-on" inspection be done on every haunch over its entire length. The findings should be documented in the inspection report.

For portions of structures over highway or pedestrian traffic this 100% "hands-on" inspection should include sounding the entire length of the haunch with a hammer. Upon observing cracks or loose concrete on the haunches, the inspector shall issue a safety flag for the bridge as appropriate.

In some cases other affected agencies have not permitted the time and/or lane closures necessary to permit this close inspection. Inspectors should immediately report this interference to the appropriate Regional Structures Engineer.

Exceptions to the policy stated in this T.A. can only be granted by the Deputy Chief Engineer (Structures).
Haunch extending past the bottom of flange, generally resulting in a 90° sharp edge.

Fig. 1 Haunch Detail

Face of haunch-Likely location of longitudinal crack. Crack propagating towards flange.

Fig. 2 Likely Location of Crack Formation
This Technical Advisory is being issued as a result of discoveries of cracks in beams on an adjacent prestressed concrete box beam bridge. The cracks that were recently observed are diagonal cracks extending away from the bearing support near the area where the end block and voided section meet. The cracks may or may not extend across the bottom flange of the beam.

The prestressing force places compression in the beam which is sufficient to assure that no cracking occurs in the beam due to applied loads. Therefore, most cracks in prestressed beams are potentially serious since tensile forces exist that were not accounted for in the design. A structural failure is possible and appropriate action needs to be taken to ensure the safety of the traveling public.

Generally, there are three main types of structural cracks (see Fig. 1). First, there is web shear, also known as diagonal tension, which causes a crack at or near the support. These cracks typically extend up and away from the support at an approximately 45° angle. Secondly, there are flexural shear cracks which are found between the support and maximum moment area. This type of failure produces a crack pattern that consists of both vertical and diagonal cracks occurring together. Thirdly, there are flexural cracks which usually are found in the vicinity of the maximum moment. This failure mode causes cracking that is normal to the longitudinal axis and extends vertically through the tendon locations. (In addition, cracks occur in the ends of prestressed members due to detensioning forces. These cracks generally can be seen across the beam end and/or along the sides and bottom at the end.)

The following is a list of activities, at a minimum, that shall be performed at each prestressed concrete superstructure location.

When inspecting these types of structures, the following should be visually checked:

- each beam for sag condition
- support area for diagonal cracking (shear)
- mid-span area (maximum moment) for flexural cracks
- between mid-span and bearing for flexural shear cracks
- longitudinal cracking at tendon levels
- spalled areas for exposed tendons
- shear keys for grout displacement and evidence of leakage
In addition to the visual check, the following activities are also required:

- sound the beams at the support area and mid-span location and any other areas showing deterioration
- map out deteriorated areas, if found, for RSE use and evaluation
- evaluate and measure any loss to exposed tendons
- investigate previously repaired areas
- check drain holes for clogging
- document findings with notes, photographs and sketches including full crack documentation.

If the inspector has any question whether or not a structural flag should be issued, the Quality Control Engineer shall be contacted for assistance and, if necessary, the Regional Structures Engineer and the Main Office Bridge Inspection Unit.

Note: Many times these cracks are the full width of the beam and can be seen across the bottom of the beam.

Fig. 1
This Technical Advisory supplements the recently issued Bridge Inspection Safety Manual (1996) concerning the use of picks (catenary scaffolds).

1. The rigger shall supply certification to the team leader that the scaffolding system proposed to be used meets all applicable AASHTO regulations before deployment and that the system is safe for the intended use.

2. The team leader shall examine the rigging equipment at each deployment to ensure that the equipment is in good operational condition. If the equipment is not acceptable the team leader will notify the Regional Structures Engineer or his designee for resolution.

3. The Regional Structures Engineer with assistance from the Regional Safety Officer will perform random field reviews to ensure all policies and procedures are adhered to.

4. You are reminded that 100% fall protection will be maintained for heights six (6) feet or greater in accordance with the Bridge Inspection Safety Manual.

5. The Regional Structures Engineer will coordinate, and with the assistance of the Regional Safety Office, conduct training on Fall Protection Procedures and other safety matters.

We are also altering page 32 of the Bridge Inspection Safety Manual in the following manner:

a. Pick set-ups shall be erected as designed by the rigger and accepted by the team leader.
b). Supports shall not be relocated while personnel are on scaffolds unless the team leader determines it is the safest way for the relocation to occur. If the team leader determines that movement of the scaffolding while personnel are on it is the safest way a step by step procedure shall be developed and voice and/or visual communication shall be maintained between the rigger and the inspector during the relocation operation.

While we realize that policy is no substitute for good personal judgement, it is our intention that these steps will help ensure safety for all.

If any uncertainty exists as to departmental policy or standards or the adequacy of scaffolding, questions may be directed to the Structures Division, the Regional Safety Office, or Main Office Employee Safety and Health.
BACKGROUND

Two piles of a 10 pile pier bent on the Wantagh Parkway Bridge over Goose Creek in Nassau County settled, dropping approximately 2 feet. This caused a loss of bearing for the superstructure beams directly over the piles. The bridge was closed and an investigation determined there was an overall loss of bearing capacity of the piles, necessitating replacement of the bridge. A temporary bridge was erected and a permanent replacement is under design.

Tidal scour/erosion was determined to be the cause of the pile settlement. Tidal scour/erosion is an emerging science and only now are analytical methods being developed for predicting tidal effects and effective mitigation measures.

Besides a general loss of material from the creek bottom there was also local scouring and redepositing of sand such that the remaining material was poor and not well compacted. There is also a general movement of the channel taking place.

ACTIONS

Because of this problem, we will be implementing a number of changes in our procedures including:

- Installing scour monitors on bridges of this type
- Revising our inspection efforts to review data more rigorously, going back to the original plans, when available.
- Where original construction data is unavailable, testing for pile tip information.
- Taking periodic borings to test soil consolidation.
- Increasing diving inspection frequency for potentially vulnerable bridges.

We are also recommending adding a Hydraulic Engineer in Regions 10 and 11.
While this problem is being studied and revised procedures developed, please assure the following actions are taken for state and local bridges exposed to tidal scour.

- Review the attached Bridge Inventory and Inspection System (BIIS) generated list of Regional bridges (GROUP 1&2) exposed to tidal activity. Make corrections as necessary and indicate which substructure units are subject to tidal scour.

- For the corrected list indicate: the approximate water depth, whether as-built and/or contract plans are available, pile tip elevation if available, and how many fathometer and diving inspections there have been.

- Please send the requested information to the Structures Division as soon as possible.

- Review all fathometer, diving reports and plans along with all other records available. Look especially for erosion of channel bottom.

- If any concern is exposed follow the instructions indicated in the flagging procedure for bridge inspections.

The Main Office with Regional input will develop revisions to the Bridge Inspection Manual, Diving Inspection Specification and Hydraulic Vulnerability Manual along with other possible changes mentioned earlier.
The attached listings group bridges into two broad general categories as a rough initial cut that will help in prioritization of bridges for tidal scour investigation. The following is provided relative to these lists. While attempting to prioritize work is important, we recommend all spans of all bridges subject to tidal action be carefully reviewed for tidal scour.

GROUP 1

Attached Group 1 List is based on available computer data and other select information. The criteria used for Group 1 was any bridge meeting any one of the A, B or C criteria identified below:

Criteria

A. Number of spans greater than 1
   And
   A pier footing type (Inv. Item) = on “earth fill” (code 4,5,6,7) or
   “individual pile” (code 8) or “other” (code 0)

B. Any erosion or scour General Inspection rating of 3 or less (regardless of number of spans)

C. Bridges identified by individuals as being of similar construction to the Goose Creek bridge.

NOTE: It is suggested that any bridge meeting any one of the following bulleted criteria also be added to the Group 1 List, if not already on it. This may require adding bridges by hand.

- Bridges recommended for related further investigation from general inspection, diving inspection, fathometer, etc., activities.

- Bridges recommended for related work needs from general inspection, diving inspection, fathometer, maintenance programs, etc.

- Bridges that have received any related flags.

- Other bridges of specific concern to Regional bridge managers, maintainers, owners, etc.
GROUP 2

The attached Group 2 Listing is all bridges identified as subject to tidal scour that have not met any of the preceding A, B or C criteria. Bridges should be moved from the Group 2 List to the Group 1 List (by hand) based on the four bullet criteria previously stated, as appropriate.

MISCELLANEOUS

1. The attached list shows all spans of a bridge. However, all substructure units shown may NOT be subject to tidal action, in fact on some bridges only a very small percentage of the substructure units shown may be subject to tidal scour. The current inventory system cannot identify individual substructure units subject to water action (tidal or otherwise). If a substructure unit for a bridge is not subject to tidal scour please change the Tidal Scour (TS) column from true to false. Information for non-tidal substructure units is not required. If substructure information for non-tidal substructure units is not provided please indicate an “N” under the P.T.S. column to indicate not done.

2. Individuals should refer to the NYS DOT Inventory and Inspection Manuals for specific coding definitions provided. For example, Pier Footing Inventory Coding “K” means “Individual Pile”, “S” means “Continuous Pile” and “0” means “Other”. Inspection “Erosion and Scour” inspection condition rating of “3” means “serious condition”, etc. Care must be taken in reviewing this information to avoid misinterpretations and misunderstandings.
P.T. (PLAN TYPE) AND P.T.S. (PILE TIP SOURCE) CODING

P.T. - PLAN TYPE

CODE = “A” IF “ORIGINAL CONSTRUCTION AS BUILT” PLANS ARE AVAILABLE
CODE = “B” IF ORIGINAL CONSTRUCTION “DESIGN” PLANS ARE AVAILABLE BUT “ORIGINAL CONSTRUCTION AS BUILT” PLANS ARE NOT AVAILABLE
CODE = “C” IF REHAB PLANS BUT NO “ORIGINAL PLANS” ARE AVAILABLE
CODE = “D” IF ONLY “OTHER” TYPE OF PLANS AVAILABLE

P.T.S. - PILE TIP SOURCE FOR ELEVATION PROVIDED

CODE = “A” IF “ACTUAL” (NOT DESIGN ESTIMATE) ELEVATION IS PROVIDED FROM “AS BUILT” PLANS.
CODE = “D” IF ESTIMATED VALUE SHOWN ON “DESIGN” PLANS IS PROVIDED
CODE = “P” IF ACTUAL VALUE AVAILABLE FROM ACTUAL PILE DRIVING LOGS IS PROVIDED
CODE = “T” IF ACTUAL ELEVATION DETERMINED FROM “PHYSICAL TESTING” IS PROVIDED
CODE = “O” IF PILE TIP ELEVATION FROM OTHER SOURCES IS PROVIDED

NOTE

A SPECIAL LOG OF NOTABLE COMMENTS ON REVIEW FINDINGS SHOULD BE MAINTAINED. IT SHOULD INCLUDE ANY NOTABLE COMMENTS REGARDING PAST AND PRESENT WORK RECOMMENDATIONS, FURTHER INVESTIGATION RECOMMENDATIONS, FLAGS, MAINTENANCE NEEDS, ETC.
ITEM: PIER FOOTING

PROCEDURE: Record the type of pier footing.

If codes 1 - 7 are used, then "Pier Piles", Rec. Code 15, Column 35 should be coded "1".

If there is no pier, leave the item blank.

CODING:
1 - None, Stem Doweled to Rock
2 - Individual Spread-on Rock
3 - Continuous Spread on Rock
4 - Individual Spread-on Earth Fill
5 - Continuous Spread-on Earth Fill
6 - Individual Spread-on Earth Cut
7 - Continuous Spread-on Earth Cut
8 - Individual Pile
9 - Continuous Pile
0 - Other

ITEM: PIER PILES

PROCEDURE: Record the type of piles supporting the pier.

If there is no pier, leave the item blank.

CODING:
1 - No Piles
2 - Steel, "H" or "I" Section
3 - Steel Pipe
4 - Concrete, Cast-in-Place
5 - Concrete, Cast-in-Place, Tapered
6 - Concrete, Precast
7 - Concrete, Prestressed, Precast
8 - Timber
0 - Other

(Pages 188 and 189 of the Bridge Inventory Manual)
During the 2000 biennial bridge inspection of the Kosciuszko Twin Bridges in the Albany area, the Team Leader discovered a very serious condition that was red flagged. These bridges carry I-87 (Northway) over the Mohawk River and have high traffic volume. Both bridges have seven spans with the main span being a steel through arch. The end floorbeam at the southern end of each arch is suspended by two pin and hangers, one at each end of the floorbeam, near the finger joint in the deck. This end of the arch accommodates expansion and contraction of the steel framing that supports the concrete deck. The floorbeam hanger plates and the pin and hangers supporting them are fracture critical members requiring 100% hands-on inspection.

While inspecting the northbound bridge, the visible edge of the lower floorbeam hanger plates appeared to be nearly full thickness. The Team Leader, however, recognized that these critical members are vulnerable to advanced corrosion from leakage from the open joint above them. While the edges of the bottom hanger plate appeared to be nearly full thickness, serious section loss was found in the middle 3/4 of the hanger plate. This loss was difficult to detect because there is only 1" of bottom hanger plate above the top flange of the floorbeam that is not covered by the upper hanger plate. Layers of laminated rust were visible in this area. The inspectors removed as much of the delaminated rust as possible with a pointed hammer, and through caliper measurements, discovered that section loss in the hanger plate was creating a cross-section shape similar to an hour-glass. Although all the pack rust could not be removed, the Team Leader estimated hanger plate section loss at 50% at the right end of the floorbeam and 35% at the left end.

Similar conditions were found on the southbound bridge and also red flagged. Closer examination of the hanger plates after a bridge maintenance crew sandblasted the problem areas, confirmed the estimated section loss, but revealed more extensive loss than estimated at the other hangers. Sandblasting also revealed a crack in one of the floorbeam hanger plates that was impossible to detect due to pack rust. Overload traffic was prohibited from the bridges. Both bridges were partially closed to traffic while the floorbeam hangers were retrofitted with plates and threaded bolts. After repairs, unrestricted traffic was restored.

The 1998 and 1996 inspections reported minor pack rust to moderate corrosion at these floorbeam hanger plate locations, and the photos of the conditions were consistent with these descriptions. No flags were issued for any of the floorbeam hanger plates as a result of either of these two previous inspections.
Conclusion:

A comparison of the photos of the floorbeam hanger details taken in 1996, 1998, and 2000 points to the possibility that section loss may be occurring more rapidly than might be expected. Nonetheless, corrosion at these hanger plates has likely been progressing over the past several years. Pack rust was observed in the earlier inspections, but it may have obscured evidence of serious section loss. The fact that the edges of these plates were nearly full thickness, and not knife-edge as is normally seen, may be a contributing factor in previous inspections not detecting serious losses.

Recommendation:

Steel details that are both fracture critical and subject to advanced rates of section loss that may be obscured by pack rust should be viewed as a special genre that need to be inspected with more care than what is required for 100% hands-on inspection (ref. Appendix G, Bridge Inspection Manual). For the sake of identifying this class of detail apart from the larger group requiring special emphasis inspection, these details will be referred to as "Special Case Fracture Critical Details."

Bridge inspectors need to be especially diligent when inspecting such details, keeping in mind that severe section loss can be very localized and may not be evident without very close scrutiny. Such conditions are not necessarily limited to specialized bridges such as steel arches or to just pin and hanger assemblies. They may also exist in steel trusses and thru-girders, particularly at locations under finger joints and/or in areas that are difficult to inspect. Also, unusual steel details or high skews may result in corners or pockets that may be very difficult to see and where deck leakage with high concentrations of de-icing salt can collect.

Actions to be Taken:

1. The Regional Structures Engineer (RSE) will review all bridges with special emphasis inspection requirements to ensure that all Special Case Fracture Critical Details are identified and all inspection requirements are clearly established.

2. The RSE will review the remaining bridges to identify others with similar details that are not presently identified.

3. While inspecting bridges, inspectors will review the special emphasis inspection section in the BIN folder, if any, to ensure that all Special Case Fracture Critical Details are identified and all inspection requirements are clearly established.
4. When inspecting such details, inspectors must examine and measure, accurately, the critical components in their current condition. If this cannot be done, inspectors must call for further investigation. In many cases, this will require that maintenance or contract forces sandblast or otherwise clean the components that need to be measured. Bridges where critical components cannot be adequately inspected without follow-up actions, must be promptly reported to the bridge inspection Quality Control Engineer. The inspection report cannot be considered complete until the results of the further investigation are made a part of the report.

5. The QC Engineer will make sure that bridges marked for special emphasis inspection are inspected and documented in sufficient detail in the inspection report.

6. The QC Engineer will arrange for follow-up actions to adequately inspect the critical components that the inspector is unable to properly assess.

7. The Structures Division Bridge Inspection Unit will collect and maintain an inventory of all bridges having Special Case Fracture Critical Details.

8. The Structures Division Bridge Inspection Quality Assurance Engineers will audit select bridges in this inventory to ensure that the proper level of inspection is being done and that reports properly document conditions.

9. The Structures Division Bridge Inspection Unit will review the type and timeliness of follow-up actions taken, on an annual basis, and identify the need for additional program directions.
The purpose of this Technical Advisory is to inform inspection personnel of a fatigue prone detail that was used on many steel bridges in the past and to add this detail to the list of those that require a 100% hands-on inspection. Plate girders with thin webs (<0.4") and staggered diaphragms have shown a tendency to form web cracks adjacent to the connection plate snipe due to out of plane bending. The cracks tend to run both horizontally along the flange to web fillet weld and vertically along the connection plate to web fillet welds.

In general, these cracks can be detected by a hands-on visual inspection. Any areas of the web that exhibit oxide staining of the paint or paint creases should be thoroughly inspected.

On the reverse side of this page is a framing plan that shows the staggered diaphragm layout and typical crack locations for your use.
SUBJECT: BRIDGES WITH STAGGERED DIAPHRAGMS

PLAN OF GIRDERS AND STAGGERED DIAPHRAGMS

SECTION A-A

SECTION B-B
### TECHNICAL ADVISORY

**ISSUED BY:**
STRUCTURES DIVISION; BRIDGE INVENTORY UNIT

**SUBJECT:**
VERTICAL CLEARANCE MEASUREMENTS FOR BRIDGES SPANNING RAILROADS

**DATE:**
FEBRUARY 20, 1986

**APPROVED BY:**

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#### *INTRODUCTION*

This Inventory Technical Advisory (T.A.) explains the procedure to be followed during routine performance of "Biennial" bridge inspections for collecting, documenting, and submitting the measured "minimum vertical clearance" dimension for highway bridges that pass over railroad tracks. Measured "minimum vertical clearance" dimensions between underpassing railroad tracks and overhead non-highway bridges also fall under the provisions of this Inventory T.A. when these bridges are being inspected as part of the Department's bridge inspection program. This Inventory T.A. applies to all "Biennial" inspections performed after December 31, 1985 by both State employee bridge inspection teams and contract engineer bridge inspection teams.

#### *DESCRIPTION OF FIELD WORK*

Direct field measurements shall be made to determine the smallest vertical dimension between the top of each rail of each track to the bottom of the overpassing bridge superstructure. Direct reading telescoping vertical measuring devices already in the possession of the bridge inspection teams will provide suitable accuracy for this measurement. Measurements shall be recorded in feet and whole inches. Measured fractions of an inch shall be rounded down to the next lowest whole inch.

#### *DOCUMENTATION OF FIELD WORK*

A simple line sketch with accompanying table shall be prepared to record the minimum vertical clearances. The sketch shall show a plan view of the bridge and/or spans and locate all railroad tracks in relation to the bridge.
VERTICAL CLEARANCE MEASUREMENTS FOR BRIDGES SPANNING RAILROADS

The sketch shall also show the approximate location (point) of each minimum vertical clearance measurement being recorded. These points shall be numbered in ascending order and recorded in the table with the corresponding minimum vertical measurement. The following descriptive information shall also be provided on each sketch.

- BIN
- Feature Carried
- Features Crossed
- North Arrow
- Labeling of bridge elements based on inspection orientation
- Prepared By:
- Date:

A sample sketch and table is provided at the end of this T.A.

The following note shall be recorded in the "REMARKS" section of Bridge Inspection Form TP 349 for bridges on which vertical clearance measurements are made: "Railroad Underclearances Were Measured - See Inventory Section of this Report for Documentation".

* PLACEMENTS IN THE B.I.N. BINDER *

The original documents recording minimum vertical measurements shall be placed in the Inventory Section of the State copy of the inspection binder. Copies shall be prepared for local and other existing inspection binders as appropriate. Copies shall be prepared by the same party making copies of the inspection reports and inventory data.

* SUBMISSION TO THE MAIN OFFICE *

One additional copy of the minimum vertical clearance measurement documentation shall be separately bundled together and included as part of the normal Inventory and Inspection submission to the Structures Division.
The submission transmittal memo or letter to the Structures Division shall state the number of bridges in the submission for which minimum vertical clearance measurements are being provided.

* DISTRIBUTION AND QUESTIONS *

Distribution of this Inventory T.A. shall be in accordance with Technical Advisory - Inspection 85-001.

Questions from State employee inspection personnel concerning this Inventory T.A. shall be directed to the Inventory Unit in the Structures Division. Contract Engineer's questions shall be directed to the appropriate Regional Office Project Manager who may answer the question directly or re-direct them to the Inventory Unit in the Structures Division.
TECHNICAL ADVISORY

Introduction

The purpose of this Technical Advisory is to inform inspection personnel of the new requirements regarding the inspections of high rocker bearings during bridge inspections in NYS.

Background

There was an incident in Albany at the end of July 2005, in which a set of high rocker bearings tipped over and almost dropped the superstructure off of a pier. Although the full cause of this incident has not yet been determined as of this writing, it is clear that this type of bearing is susceptible to catastrophic failure. As a result of this incident, additional information is required during bridge inspections to better monitor high rocker bearings used in NYS.

Applicability

For the purposes of this advisory, a high rocker bearing is defined as an expansion bearing that uses a curved bearing surface (like a rocking chair) to allow expansion and contraction of a superstructure. A high rocker bearing is generally taller than it is wide and, for these requirements to apply, at least 200 mm (8 inches) high. The term “abnormal behavior” of bearings refers to bearings that are in the contracted position in warm weather and bearings that are in the expanded position in cold weather.

The following documentation is required for each location where high rocker bearings rated 4 or lower due to excessive tilt or abnormal behavior are found on a bridge. This information shall be collected from the most distressed bearing from each line of bearings and be documented using the guidelines below at each inspection. In the case of a single pier with two lines of expansion (rocker type) bearings for two different spans, two bearings will be recorded. For example, the “worst of” bearing on one span (e.g. span 1) may be rated “3”, while the “worst of” bearing on the other span (e.g. span 2) would be rated “4”. The inspector shall document both of these bearings in the table to represent the “worst of” bearings in each line of bearings. The rating reported in the Inspection Report for the bearing item will remain the “worst of” all of the bearings on the pier.

Action to be taken

During any inspection of bearings, inspectors should consider what is the normal behavior for this type of bearings. In New York State, bearings are generally designed to be set at 68° F. The design temperature range for bearings with steel superstructures in Regions 1 thru 9 is -30° to 120° F, and in Regions 10 and 11 the range is 0° to 120° F. Generally, this means rocker bearings should be vertical (no tilt) at 68° by design, but vertical at any temperature from 68° down to the midrange temperature (45° for upstate and 60° for Regions 10 & 11) would be acceptable. Normal behavior for this type of
bearing is to tilt away from the center of the span when the temperature rises and the deck expands. The bearings should tilt toward the center of the span as the temperature falls and the deck contracts. Note that when a bridge has two lines of rocker bearings on a pier and a joint in the deck over the pier, when the temperature is high, the bearings should tilt toward each other and, when the ambient temperature is colder than the midrange temperature, the bearings should tilt away from each other.

Abnormal movement of the bearings may indicate movement of the substructure on which the rocker bearing is founded or movement of the substructure with the fixed bearings. An effort should be made to determine if either of these cases caused the problem.

These measurements, calculations and documentation shall be included in every inspection of bridges that have high rocker bearings that are rated 4 or less due to excessive tilt or abnormal bearing behavior.

**Documentation of condition of rocker bearings:**

The inspection report shall include all the following that apply:

A. **Notes:** Bearing notes shall include (as appropriate and necessary) statements describing:

1. Ambient temperature during inspection.
2. Documentation of extension or contraction (tilt). The angle of rotation, \( \theta \), should be measured with a tilt meter or calculated from the measurements taken during the inspection. See the attached sketch for the minimum measurements needed.
3. Documentation of behavior/movement. Record observations regarding direction of movement of the bearing, if the bearing shows signs of movement (for example cracks in the paint or lighter color rust stains) and if the bearing has sufficient capacity to move further in the direction of travel under temperature extremes.
4. Presence of corrosion (including pack rust) or any debris that could inhibit proper function and documentation of section loss to any portion of the bearing assembly including anchor bolts.
5. Any sheared off or bent anchor bolts and location of such bolts.
6. While the rating of the inspection element "Bearings" is a "worst of" type rating, documentation of the condition of other bearings is required. For example, the bearing for girder G1 rates a "3" due to ...(give explanation), the rest of the bearings would rate "5."

B. **Rocker Bearing Field Documentation Summary**

The Rocker Bearing Field Documentation Summary shall be included in the Inspection Report. The summary shall include sketches and a table with the following data for the "worst of" bearing in each line of rocker bearings on a pier (including piers with two sets of expansion bearings as described above) or on an abutment:

- Ambient temperature, angle of rotation (with an indication if this angle is calculated or measured),
- dimensions A, B, C, D, E and X as shown in the documentation sketch shown on the following page.
Rocker Bearing Field Documentation Summary

1. Reference Sketch:
   - A = Height of rocker
   - B = High corner of rocker plate
   - C = Low corner of rocker plate
   - D = Width of rocker plate
   - \( \theta \) = Angle of rotation (tilt)
   - E = Eccentricity (translation)
   - X = Minimum clear distance between girders or from girder to abutment

2. Bearing Data Table:

<table>
<thead>
<tr>
<th>Date</th>
<th>Bearing Location</th>
<th>Ambient Temp</th>
<th>Dim &quot;A&quot;</th>
<th>Dim &quot;B&quot;</th>
<th>Dim &quot;C&quot;</th>
<th>Dim &quot;D&quot;</th>
<th>Dim &quot;X&quot;</th>
<th>Angle &quot;( \theta )&quot;</th>
<th>Dim &quot;E&quot;</th>
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</tr>
</tbody>
</table>

   C. Flags:

   In addition to the conditions for flagging bearings described in the NYS Bridge Inspection Manual, bearings that are contracted in warm weather and bearings that are expanded in cold weather could be yellow flagged. In extreme situations a special inspection should be scheduled to check the bearings at a higher ambient temperature, if the bearings are over extended, or at a lower temperature if the bearings are over contracted. Furthermore, high rocker bearings that appear to be at or near to their full extension or full contraction (tilt) when ambient temperatures are not near extreme levels should be red flagged and investigated further. The amount of allowable tilt varies with each type and configuration of rocker bearing. To compare the actual tilt to the allowable tilt the inspector should determine the allowable tilt from the record plans. If no plans of the bearings are available, the inspector should determine an acceptable tilt from the actual measurements assuming that the rocker should not bear on the outer quarter of the "D" dimension of the rocker as shown in the Section view above. The QC engineer should check the calculations and the measurements that determined the allowable tilt. Note that the tangent, or bearing, point between the rocker and masonry plate should always be located in the middle half of "D". Due to the wide variety of rocker bearings, engineering judgement is required when comparing the allowable tilt to the actual tilt and if a flag is required.
INTRODUCTION

Quality Control is an essential part of the Load Rating process. The Quality Control review for a Level II Load Rating consists of (1) verifying the accuracy and completeness of the Level II bridge model, and (2) verifying that the analysis engine and settings selected for use in the analysis of the bridge model conform to current NYSDOT Load Rating policies.

REQUIREMENTS

Each Level II Load Rating must undergo a Quality Control review prior to its submission to the Main Office. Deadline for submission of a Level II Load Rating to the Main Office is ninety (90) days after the last day of the bridge's field inspection work. The Load Rating Engineer (LRE) is responsible for the Quality Control review. Two individuals, one of whom shall be the LRE, shall perform the tasks of the Quality Control, each checking the work done by the other. The LRE shall meet the requirements stipulated in Section 165.5(b)(2) of the Uniform Code of Bridge Inspection. The following Level II Load Rating information shall be collected in a folder and placed in the bridge's BIN folder.

- The Level II Load Rating Cover Sheet showing the names of the two individuals that performed the tasks and the completion dates.
- Summary of modifications made to the bridge model and its analysis. Modifications shall be dated and shown in chronological order.
- The Rating Results Summary Table from the analysis, indicating the location and force effect of the controlling member. Example: “G4, Span 2, 27' from Begin CL of Bearings, Flexural”.

PROCESS

There are two levels of Quality Control: (1) the thorough check performed on a newly created model, and (2) the check of a bridge model updated from a previously created model. Listed below are the requirements for the two levels of Quality Control.
For newly created bridge models, the following information shall be checked:

- Verify that the model is coded correctly as compared to the bridge’s As-Built drawings.
- For new designs, compare the results of the Level I and Level II Load Ratings. A significant difference in bridge capacity shall be investigated to identify the cause of the difference. If the difference is the result of an error in the Level II Load Rating model, the model shall be corrected. However, if the difference is due to an error in the Level I Load Rating, the Level I Load Rating shall be returned to the designer for correction.
- If there are any hand calculations created to supplement the Level II Load Rating, these shall be checked and documented.

For updates, the following information shall be checked:

- If there are no changes in the bridge’s condition, (as reported in the latest inspection report) this should be stated in the description field, and no further check is required. However, the model shall be analyzed and the results shall be compared to the previous results. A significant difference in capacity shall be investigated and the reasons noted in the description field.
- If there are changes in the bridge condition, then the model shall be updated as follows:
  
  - Verify that all section loss documentation, changes in dead load or bridge configuration, and repair details, as reported in the latest inspection report have been incorporated into the model. If there are hand calculations created to supplement the Level II Load Rating, these shall be checked and documented.
  
  - Compare the updated Level II Load Rating capacity to the Level II capacity currently displayed in the Bridge Data Management System (BDMS). A significant difference in bridge capacity should have a valid reason. Examples include change in dead load, change in section loss and correction to the bridge model.
  
  - If there is a Level I Load Rating present in the system, compare the updated Level II Load Rating to the Level I Load Rating. A significant difference in bridge capacity shall be investigated to identify the cause of the difference and the reason noted in the description field. An outdated/incorrect Level I Load Rating shall be removed from BDMS and updated/replaced as described in Load Rating Engineering Instruction (El 05-034).
**PURPOSE**

Special Emphasis Inspection Requirements as outlined in Appendix G, Item 10 of the 1997 NYSDOT Bridge Inspection Manual require 100% hands-on review of all AASHTO Category D, E, and E’ welded details. Automatic exemption to this requirement is provided for redundant members only where calculation indicates a safe life of at least 10 years.

Analysis methods providing exemption to the Appendix G, Item 10, 100% hands-on requirement use the *Guide Specifications for Fatigue Evaluation of Existing Steel Bridges* (AASHTO 1990), whose development and use of fatigue evaluation procedures are explained in NCHRP Report 299. NYSDOT, in keeping compliant with FHWA policy, is issuing this Technical Advisory (TA) to transition from the old AASHTO Guide Specification to the new AASHTO LRFD based *Manual for Bridge Evaluation* for calculating fatigue life.

Fatigue Evaluation of Steel Bridges analysis methods as provided by Chapter 7 of *The Manual for Bridge Evaluation* shall be used in calculating remaining fatigue life for use in determination of exemption from 100% hands-on inspection. The below guidelines supersede Appendix G, Item 10 of the 1997 NYSDOT Bridge Inspection Manual.

**GUIDELINES**

Unless a written exemption is granted by the Deputy Chief Engineer Structures (DCES) or calculations are performed and checked to estimate sufficient remaining Minimum Expected Fatigue Life, exposed surfaces of all AASHTO Category D, E, and E’ welded details must receive a 100% hands-on visual inspection during each general biennial or interim bridge inspection. **Regardless of exemption herewith, these welded details must receive a 100% hands-on visual inspection during every 3rd biennial inspection (approximately a maximum frequency of 6 years).**

The analysis methods to be used are in the AASHTO *Manual for Bridge Evaluation*, Chapter 7 where the Minimum Expected Fatigue Life is defined as the time interval in which there is a 2% probability of detail failure. Traffic counts more than 10 years old may not be used, unless there is evidence that traffic on the bridge has not increased.
Automatic exemptions from the 100% hands-on requirement will apply to redundant members only when:

- The calculated Minimum Expected Fatigue Life is 10 to 50 years. Reanalysis shall be performed using current traffic count data every 6 years.
- The calculated Minimum Expected Fatigue Life is greater than 50 years. Reanalysis is not necessary unless traffic increases by more than 6 percent annually. If the traffic growth is greater, then reanalyze every 6 years.

For Minimum Expected Fatigue Life less than 10 years, the DCES will grant exemption from the 100% hands-on requirement only on a case-by-case basis if appropriate.

All areas requiring 100% hands-on inspection must be clearly identified in a specially prepared section at the end of the bridge report binder. This section must identify location and type of component to be inspected hands-on. Sketches, copies of plan sheets, and/or photos should be used for documentation. For reference during future inspections, the location of any cracks found should be noted in the special emphasis section. Also, the binder cover should have a sticker stating "Special emphasis required during each general inspection. See the last section of this binder for details." Fatigue-prone details exempt from 100% hands-on inspection must be identified in this section.

If the DCES ‘case-by-case’ exemption is granted, then a copy of the Main Office letter must be included in the special emphasis section. If exemption is automatic because of fatigue-life calculations, then a copy of the calculations must be placed in the special emphasis section. If calculations indicate no exemption, then a note must be placed in the special emphasis section stating this and the reason (e.g. traffic count greater than 10 years old, calculated minimum expected fatigue life less than 10 years, etc.). The persons performing and checking the calculations must be identified. There must also be a comment on Form TP 350 noting that 100% hands-on requirements have been waived.

**EXCEPTIONS**

Exemption from 100% hands-on inspection granted prior to issuance of this TA will remain in effect and not require reanalysis until the minimum of:

- Calculations are exhausted based on original issuance guidelines
- 6 years after original issuance date
- 6 year maximum frequency of 100% hands-on inspection is met

When one of the above minimums is met, exemption will be provided as directed by this TA.
# TECHNICAL ADVISORY

**ISSUED BY:**
OFFICE OF STRUCTURES - STRUCTURES EVALUATION SERVICES BUREAU

**APPROVED BY:**
R. Marchione, Deputy Chief Engineer (Structures) - Acting

**SUBJECT:**
Types and Required Intervals of Bridge and Diving Inspections

**DATE:**
02/19/2013

**SUPERSEDES:**
Refer to Implementation Section of this Technical Advisory.

## PURPOSE

The purpose of this Technical Advisory is to update the terminology and categories that are used for bridge and diving inspections. The inspection categories will be programmed into the Bridge Data Information System (BDIS), which is currently in the development phase. The new inspection terminology will become effective with the rollout of BDIS, which is currently estimated to occur in January of 2014.

## GUIDELINES

1. Five types of bridge inspections will be recorded in the BDIS system and they are as follows:

   1. **General:** General inspections are required for all highway bridges at a maximum interval of 24 months. These inspections encompass both biennial and interim inspections as defined in the Uniform Code of Bridge Inspection (UCBI). Inspection intensity and documentation for the general inspections will be the same regardless of the criteria that triggered the need for the inspection. Scheduling of inspections will be governed by the requirements that are defined in both the Code of Federal Regulations (CFR) and the UCBI.

   2. **Special in-lieu of:** This category of inspections is used for granting and documenting special in-lieu of inspections for bridges that are scheduled for inspection due to the UCBI interim requirements. In no case will a special in-lieu of inspection be granted in back to back inspection seasons. Note that a special in-lieu of inspection requires written approval of the Deputy Chief Engineer (Structures). See the UCBI for specific details regarding special in-lieu of inspections.
CONTINUATION SHEET

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3. **Special Events**: Information collected during these inspections does not directly impact the condition ratings of a structure. Use of these type inspections will not follow the normal Quality Control / Quality Assurance workflow that is utilized for bridge and diving inspections. Information will be able to be added directly by users with privileges to do so in BDIS. The information will typically be available as an attachment that can be reviewed and downloaded:

   a. **Flood Watch**: This sub-category will be utilized to attach summary forms of flood watch inspections.
   b. **Post-Flood Inspection**: This sub-category will be utilized to attach summary forms of post-flood inspections.
   c. **Post-Seismic Event**: This sub-category will be utilized to attach summary forms of post-seismic inspections.
   d. **Impact Assessment**: This sub-category will be utilized to attach summary forms of bridge impact assessments.
   e. **Found Structural Flag Repair**: This sub-category will be utilized to summarize the instance when a structural flag repair is found, the structural flag can be removed and there is no other reason to inspect the structure. In such instances, the inspector shall fully document the findings, work with the Region to remove the structural flag and re-designate the type of inspection from general /special in lieu of to found structural flag repair.
   f. **Other**: This sub-category will be utilized to attach summary forms of other instances of non-scheduled inspection events.

4. **In-depth Inspection**: This category will be utilized to attach summary forms of bridge in-depth inspections.

5. **None Due to Construction (under contract)**: This category of inspections is used for bridges that are closed to all traffic due to reconstruction. Note that temporary structures constructed within a work zone to handle staged traffic are the contractor's responsibility and do not get inspected as part of the general bridge inspection program and are, therefore, not covered by this inspection type. Note further that a general inspection must be performed within 60 days of reopening to traffic of the newly constructed bridge or any portion thereof. The inspection must occur after opening to traffic in order to ensure that the inspector can view the structural behavior of the bridge after having experienced live load conditions in all directions. Any portion of an existing bridge that is under contract and carries traffic remains on the inspection schedule.

II. Four types of diving inspections will be recorded in the BDIS system and they are as follows:

1. **Diving**: Diving inspections are required at a maximum interval of 60 months. Scheduling of inspections will be governed by the requirements that are defined in both the Code of Federal Regulations (CFR) and the UCBI.
2. **Special Events:** This category is reserved for events that are typically not scheduled, where, however, a Diving Inspection is performed. Information collected during these inspections does not directly impact the scheduling or condition ratings of a structure. Use of these type inspections will not follow the normal Quality Control / Quality Assurance workflow that is utilized for bridge and diving inspections. Information will be able to be added directly by users with privileges to do so in BDIS. The information will typically be available as an attachment that can be reviewed and downloaded:

   a. **Flood Watch:** This sub-category will be utilized to attach summary forms of flood watch inspections.
   b. **Post-Flood Inspection:** This sub-category will be utilized to attach summary forms of post-flood inspections.
   c. **Post-Seismic Event:** This sub-category will be utilized to attach summary forms of post-seismic inspections.
   d. **Impact Assessment:** This sub-category will be utilized to attach summary forms of bridge impact assessments.
   e. **Found Structural Flag Repair:** This sub-category will be utilized to summarize the instance when a structural flag repair is found, the structural flag can be removed and there is no other reason to inspect the structure. In such instances, the inspector shall fully document the findings, work with the Region to remove the structural flag and re-designate the type of inspection from general/special in lieu of to found structural flag repair.
   f. **Other:** This sub-category will be utilized to attach summary forms of other instances of non-scheduled inspection events.

3. **In-depth Inspection:** This category will be utilized to attach summary forms of bridge in-depth inspections.

4. **None Due to Construction (under contract):** This category of inspections is used for bridges that are closed to all traffic due to reconstruction. Note that temporary structures constructed within a work zone to handle staged traffic are the contractor's responsibility and do not get inspected as part of the general bridge inspection program and are, therefore, not covered by this inspection type. Note further that a general inspection must be performed within 60 days of reopening to traffic of the newly constructed bridge or any portion thereof. The inspection must occur after opening to traffic in order to ensure that the inspector can view the structural behavior of the bridge after having experienced live load conditions in all directions. Any portion of an existing bridge that is under contract and carries traffic remains on the inspection schedule.
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IMPLEMENTATION

Implementation of the noted changes will occur as follows:

1. The new bridge and diving inspection categories will be programmed into BDIS. These changes will also be incorporated into the updated Bridge Inspection Manual that is scheduled for release January of 2014.
2. BDIS will be programmed to schedule inspections based upon the new inspection categories that have been noted.
3. The Section of the current Bridge Inspection Manual titled “Special Considerations for Interim Inspections” will be superseded with the release of BDIS and will be removed from the updated Bridge Inspection Manual.

BACKGROUND

One of the more notable changes in this Technical Advisory is the change to interim inspection documentation. Interim inspection reports will now contain full documentation without reference to prior reports. Advances in photography and report preparation have eliminated the need to condense interim inspection reports in order to save time.