This Manual of Bridge Inspection has been prepared in accordance with the provisions of Section 5501.47 of the Revised Code of the State of Ohio which became effective September 28, 1973, and in compliance with the Code of Federal Regulations, Part 650.307. These State and Federal requirements provide for regular and systematic inspection of bridges on, under or over public highways and streets in the interest of public safety and protection of the public investment in such structures.

These requirements establish the areas of responsibility of various authorities regarding inventory requirements, frequency of inspection, qualifications of inspectors, and recording of inspections. Section 5501.47 of the Revised Code provides for the preparation of this Manual to establish standards and procedures for Inspectors representing the several authorities of the State charged with the responsibility of bridge inspection.
REFERENCES

The following publications were used as a guide in preparing this Manual and their use as a reference by Bridge Inspectors is recommended:


"Bridge Inventory and Appraisal Coding Guide," 1992, Ohio Department of Transportation.

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GENERAL INFORMATION

Objectives

The Bridge Inspector will visually inspect all components of the bridge for deterioration, cracks and other defects and will rate each component based on its as-built condition. The visual inspection will be augmented by sounding with a steel rod and/or chipping hammer. All ratings and other findings will be recorded on the Bridge Inspection Report (BR-86).

The Inspector will identify and note all visible defects in the bridge whether as a result of deterioration, construction practice, or original design. He/she will also identify and note areas of potential failure as a result of anticipated deterioration, past construction or maintenance practice and/or inadequate original design.

The Inspector will not be responsible for conditions which are not observable through usual and customary routine visual inspection coupled with standard state-of-the-art testing. (Only if and after a problem is discovered by a visual inspection).

The purpose of systematic and periodic bridge inspections, as well as supplemental inspections immediately following any natural or accidental occurrence which might lessen the integrity of a bridge is to:

1. Provide an information base for immediate action to limit use of or close to traffic any bridge which is revealed by inspection to be hazardous.

2. Determine the extent of any weakness or structure damage, critical or minor, resulting from normal deterioration, or any other cause.

3. Enable bridge maintenance, repair or replacement to be programmed more effectively through early detection of structural deficiencies by which the public investment in the highway system will be safeguarded and repair costs minimized.

Thorough inspection and careful analysis of the facts obtained by the inspection will guarantee uninterrupted traffic flow.
Description of Inspection Types

Inventory Inspection: An Inventory Inspection is the first inspection of a bridge as it becomes a part of the bridge inventory, but the elements of an Inventory Inspection may also apply when there has been a change in the configuration of the structure (e.g., widening, lengthening, supplemental bents, etc.). The Inventory Inspection is a fully documented investigation performed by persons meeting the required qualifications for inspection personnel and it must be accompanied by an analytical determination of load capacity. The purpose of this inspection is twofold. First, it should be used to determine all required Structure Inventory data and all other relevant information not required by the National Bridge Inspection Standards (NBIS) but of the type normally collected and managed by the owner agency. The second important aspect of the Inventory Inspection is the determination of baseline structural conditions and the identification and listing of any existing problems or locations in the structure that may have potential problems. Aided by a prior detailed review of plans, it is during this inspection that any fracture critical members (or details) are noted for subsequent focus and that assessments are made of other conditions that may later warrant special attention. If the bridge subjected to an Inventory Inspection is anything other than a newly constructed structure, it may be necessary to include some or all of the elements of an in-depth Inspections.

Routine Inspection: This is a regularly scheduled, intermediate level inspection consisting of sufficient observations and/or measurements to determine the physical and functional condition of the bridge, to identify any developing problems and/or change from "Inventory" or previously recorded conditions and to ensure that the structure continues to satisfy present service requirements.

The Routine Inspection must fully satisfy the requirements of the National Bridge Inspection Standards with respect to maximum inspection frequency, updating of Structure Inventory and Appraisal Data and the qualifications of the inspection personnel. These inspections are generally conducted from deck, ground and/or water levels and from permanent work platforms and walkways, if such are present. Special equipment (e.g., under-bridge inspection equipment, rigging or staging) is necessary for a Routine Inspection, in circumstances where its use provides the only practical mean of access to areas of the structure that are being monitored.

The results of a Routine Inspection are to be fully documented with appropriate photographs and a written report that includes any recommendations for maintenance or repair and for scheduling of follow-up in-depth Inspections, if necessary. Load capacity evaluations will
be provided to the extent that changed structural conditions would affect any previously recorded ratings.

**Damage Inspection:** This is an unscheduled inspection to assess structural damage resulting from environmental or man-inflicted causes. The scope of inspection must be sufficient to determine the need for emergency load restrictions or closure of the bridge to traffic and to assess the level of effort necessary to make a repair. The amount of effort expended on this type of inspection will vary significantly depending upon the extent of the damage. If major damage has occurred, inspectors must evaluate fractured members, section loss, make measurements of misalignment of members and check for any loss of foundation support. A capability to make on-site calculations to establish emergency load restrictions may be necessary.

This inspection may be supplemented by a timely In-depth Inspection as described below to document more fully the extent of damage and the urgency and magnitude of repairs. Proper documentation, verification of field measurement and calculations and perhaps a more refined analysis to establish or adjust interim load restrictions are required follow-up procedures. A particular awareness of the potential for litigation must be exercised in the documentation of Damage Inspections.

**In-Depth Inspections:** An in-depth Inspection is a close-up, hands-on inspection of one or more members above or below the water level to detect any deficiency(ies) not readily visible using Routine Inspection procedures. Traffic control and special equipment (e.g., under-bridge inspection equipment, staging and work boats), should be provided as necessary to obtain access. Personnel with special skills such as divers and riggers may be required. When appropriate or necessary to fully ascertain the existence of, or the extent of, any deficiency(ies), nondestructive tests and/or other physical and chemical tests may need to be performed.

The inspection may include a load rating to assess the residual capacity of the member or members, depending on the extent of the deterioration or damage.

This type of inspection can be a scheduled supplement to a Routine Inspection, though generally at a longer interval, or it may be a follow-up for Damage or Inventory Inspections.

On small bridges, the In-Depth Inspection, if warranted, should include all critical elements of the structure but for large and complex structures, these inspections may be scheduled separately for defined segments of the bridge or for designated groups of elements, connections or details that can be efficiently addressed by the same or similar inspection
techniques. If the latter option is chosen, each defined bridge segment and/or each designated group of elements, connections or details will be clearly identified as a matter of record and each will be assigned a frequency for re-inspection. To an even greater extent than is necessary for Inventory and Routine Inspections, the activities, procedures and findings of In-Depth Inspections must be completely and carefully documented.

**Interim Inspections:** This is an inspection scheduled at the discretion of the individual responsible for bridge inspection activities. An Interim Inspection is used for monitoring a particular known or suspected deficiency (e.g., foundation settlement or scour, member condition, public’s use of a load-posted bridge, etc.) and can be performed by any qualified person familiar with the bridge and available to accommodate the assigned frequency of investigation. Unless in satisfaction of the NBIS qualification requirements for inspection personnel, the individual performing an Interim Inspection must be carefully instructed regarding the nature of the known deficiency and its functional relationship to satisfactory bridge performance. In this circumstance, guidelines and procedures on what to observe and/or measure must be provided and a timely process to interpret the field results must be in place. The determination of an appropriate Interim Inspection frequency should consider the severity of the known deficiency.

**Definitions**

**Bridge:** Any structure, including supports, of 10 feet or more clear span or 10 feet or more in diameter on, above or below a highway. The span of all bridges will be measured along the centerline of the highway.

**Culvert:** A type of bridge 10 feet or more in span which conveys water or forms a passageway through an embankment and is designed to support super-imposed loads of earth or other fill material plus a live load. Multiple cell culverts under a fill with a distance of 10 feet or more between extreme ends of openings, measured normal to the axis of the culvert, including multiple pipes where the clear distance between openings is less than half of the diameter of the smaller opening, will be regarded as a bridge.

**Highways:** Those highway systems named in Section 5535.01 of the Ohio Revised Code, highways, streets, and roads within municipalities, and any other highway, street, or road used for public conveyance.

**Inspections:** The detailed physical examination of a structure, using such tools and instruments as are necessary to determine the actual condition of the various elements that
make up the structure, recording the information on approved forms, and appropriately filing the data.

**Maintenance:** The preservation and upkeep of a bridge, including all of its appurtenances, in its original condition or as subsequently improved, insofar as practicable.

**Measurement:** Checking location, dimension, size and shape of all members of a bridge, including all of its appurtenances, to determine if there has been movement, distortion, deterioration, or other change in the structure.

**State highways** (Ohio Revised Code, Section 5501.47): "The Director of Transportation is responsible for inspection of all bridges on the state highway system inside and outside of municipalities, all bridges connecting Ohio with another state for which the Department of Transportation has inspection authority, and all other bridges or portions of bridges for which responsibility for inspection is by law or agreement assigned to the department." The director will inspect any bridge on a highway, with a designated representative of the owner, where he has reason to believe that the report of inspection does not reflect the condition of such bridge or that the inspection did not accord with the standards contained in the Manual of Bridge Inspection.

**County Highways** (Ohio Revised Code, Section 5543.20): "The County Engineer will inspect all bridges or portions thereof on the county highway system inside and outside of municipalities, bridges on township roads, and other bridges or portions of bridges for which responsibility for inspection is by law or agreement assigned to the county. If the responsibility for inspection of a bridge is not fixed by law or agreement and the county performs the largest share of maintenance on a bridge, inspection will be made by the County Engineer."

**Township Roads** (Ohio Revised Code, Section 5543.20): The County Engineer will inspect all bridges or portions thereof on township roads. The Board of Township Trustees is not prohibited from inspecting bridges within a township.

**Municipal Roads and Streets** (Ohio Revised Code, Section 723.54): The legislative authority of a municipality will designate a municipal official to have responsibility for inspection of all bridges or portions thereof within such municipality, except for bridges on the state highway system and the county highway system. The municipality is not prohibited from inspecting any bridge within its limits.
In addition to the above requirements of the Ohio Revised Code, the Code of Federal Regulations - 23 highways - Part 650 - Sub-part C - National Bridge Inspection Standards state in part that "these standards will apply to all structures defined as bridges located on all public roads" and that "each highway department will include a bridge inspection organization capable of performing inspections, preparing reports, and determining ratings in accordance with the provisions of the AASHTO Manual and The Standards contained herein."

**Railroad Bridges:** Railroad bridges over or under highways will also be inspected annually. Section 5501.47 (B)(1)(c) states that the definition of a bridge includes "structures" upon which railroad locomotives or cars may travel." The inspector will inspect only those portions of the structure which would directly affect the traveled roadway underneath. Any problems requiring immediate attention should be relayed in writing to the owner of the bridge with a copy to PUCO.

**Pedestrian Bridges, Conveyor Systems, Pipelines:** Any other types of structures over the highway should be inventoried and inspected, regardless of ownership. The inspection need only involve those portions of the structure over the highway.

**BRIDGE INSPECTOR QUALIFICATIONS, SKILLS AND EQUIPMENT**

**Qualifications:** The inspector will be a registered professional engineer who has expertise in the field of bridge design, construction, and maintenance, or a technician who has general knowledge of structural behavior, experience with bridges, attended a comprehensive Bridge Inspector's Training Course and who works under the direct supervision of a professional engineer qualified to perform inspections. Ohio offers a 6 day course that meets the Federal requirements for a comprehensive training course.

The Code of Federal Regulations - 23 highways - Part 650 - Sub-part C requires that:

(a) The individual in charge of the organizational unit that has been delegated the responsibilities for bridge inspection, reporting, and inventory will possess the following minimum qualifications.

(1) Be a registered professional engineer; or
(2) Be qualified for registration as a professional engineer under the laws of the State; or  

(3) Have a minimum of 10 years experience in bridge inspection assignments in a responsible capacity and have completed a comprehensive training course based on the "Bridge Inspector's Training Manual," which has been developed by a joint Federal-State task force.  

(b) An individual in charge of a bridge inspection team will possess the following minimum qualifications.  

(1) Have the qualifications specified in paragraph (a) of this section; or  

(2) Have a minimum of 5 years experience in bridge inspection assignments in a responsible capacity and have completed a comprehensive training course based on the "Bridge Inspector's Training Manual," which has been developed by a joint Federal-State task force or  

(3) Have Level III or IV Bridge Safety inspection certification under the National Society of Professional Engineer's National Certification of Engineering Technologies (NICET) program.  

Skills: The inspector should be capable of climbing structural steel without difficulty. He should have the ability to letter legibly and to read bridge plans, visualize details, draw technical sketches, and operate a camera. He should possess a mechanical aptitude and a working knowledge in the use of measuring devices such as rules, tapes, protractors, and calipers. The inspector should have an awareness of potential hazards and exhibit a serious attitude toward safety precautions to be taken while climbing and inspecting bridges. The inspector must approach each task sincerely and with the proper motivation since his judgment and thoroughness is relied upon to guarantee public safety and to protect public investment with respect to bridges.  

Equipment: The inspector should be equipped with a pocket tape, folding rule, 50 ft. tape, calipers, chipping hammer, scraper, sounding rod, binoculars, camera, safety line, magnifying glass, mirror, flashlight, ladder, marking tools, safety belt, hard-hat, etc.  

Difficulty of access to any portions of the structure should not be allowed to prevent a thorough inspection. However, the inspector should not unnecessarily jeopardize his/her safety and should arrange for ladders, scaffolding and assistance as deemed necessary.
FREQUENCY OF INSPECTION

Periodic Inspections: Each bridge will be inspected at least once each calendar year at approximately 12 month intervals. The report should be reviewed and submitted within 60 days from date of inspection. Under normal circumstances, the inspection should be performed and submitted as close to the 12-month interval as possible, to avoid the possibility of filing two inspections on a bridge in any one calendar year and none in the next year.

Special Inspections: Any bridge experiencing known or suspected damage as a result of collision, fire, major flood, earth shift, or other cause will be inspected as soon after the incident as conditions permit. When it is evident that such damage is localized, only the damaged portion need be inspected; however, if a new inspection report is filed, all items must be recorded.

Interim Inspections: Bridges which are determined to have serious structural defects (General Appraisal of 2 or less) or which have drastic load reductions (75% or more) should be inspected more often then annually.

Records should be kept of each visit to the bridge site for purposes of inspection, even though cursory in nature. Actual BR-86 forms for these interim inspections need not be filled out each time unless conditions have appreciably changed since the last visit.

Posted bridges which exhibit significant changes since last inspection and/or load rating, should be-rated and a revised BR- 87 (Inventory Form) submitted as appropriate.

PROCEDURES FOR INITIATING, REPORTING RECORDING AND DISTRIBUTING BRIDGE INSPECTION REPORTS

State Highways: The District Deputy Director will be responsible for inspection of all bridges presented as State responsibility that are within or contiguous to the District.

The District Bridge Engineer will:

1. Perform, or supervise the inspector who performs, the inspection of each bridge except when the inspection is being performed by a consultant.

2. Prepare, or review and approve, each Bridge Inspection Report.
3. Report immediately to the District Bridge Engineer concerning any structure for which the State has inspection or maintenance responsibility, which is believed to be in immediate danger to life and property, and requires emergency action. This will enable the Engineer to quickly provide the necessary protection and to notify Central Office. See Standard Operating Procedure PH-0-204.


5. Forward a copy of the Bridge Inspection Report to:
   a. The Structure Maintenance and Inspection Engineer, Office of Structural Engineering, if the data was not entered into the Bridge Management system.
   b. Party or parties having responsibility for the maintenance when the State has no responsibility or shares responsibility for the maintenance.
   c. The responsible authority of each municipality in the District for each bridge in such municipality for which the State has inspection responsibility.

6. Maintain a file of all Bridge Inspection Reports.

7. Revise the posting for reduced load limits, and the Bridge Inventory and Appraisal Code Sheet (BR-87) if any change is noted in the structure which warrants such action and send copies of revised records to the Structure Rating and Inventory Engineer, Office of Structural Engineering.

**County Highways:** The County Engineer will:

1. Perform, or supervise the inspector who performs, the inspection of each bridge except when the inspection is being performed by a consultant.

2. Prepare, or review and approve, each Bridge Inspection Report.

3. Report immediately to the Board of Commissioners concerning any bridge, for which he has inspection or any maintenance responsibility, which is in a condition that he believes to be in immediate danger to life and property.
4. Report to the Board not later than 60 days after his annual inspection (more frequently if the Board so requires) the following:

a. The condition of all bridges the County is required to inspect.

b. The identity of any bridge that is in a condition which is believes to be a potential danger to life or property.

5. Forward a copy of each pertinent Bridge Inspection Report to:

a. The Ohio Department of Transportation, District Bridge Engineer, for each structure (original).

b. The party or parties having responsibility for the maintenance when the County has no responsibility or shares responsibility for the maintenance.

c. The Board of Township Trustees of each township for each bridge on the township road system of such township.

6. Maintain a file of all Bridge Inspection Reports (BR-86).

7. Revise the posting for reduced load limits if warranted.

8. Revise and update the Bridge Inventory and appraisal code sheet (BR-87) if any change is noted in the structure which warrants such action and forward to the Ohio Department of Transportation, District Bridge Engineer.

Township Roads: Inspection of bridges on Township roads is the responsibility of the County Engineer.

Municipal Roads and Streets: The municipal official responsible for inspection of bridges will:

1. Perform, or supervise the inspector who performs, the inspection of each bridge except in case of consultant assistance.

2. Prepare, or review and approve, each Bridge Inspection Report.
3. Report immediately to the authority concerning any bridge, for which the municipality has inspection or any maintenance responsibility, which is in a condition that is believed to be an immediate danger to life and property.

4. Report to the legislative authority not later than 60 days after each annual inspection (more frequently if the authority so requires) the following:
   a. The condition of all bridges under the municipal jurisdiction.
   b. The identity of any bridge that is in a condition which is believed to be a potential danger to life or property.

5. Forward a copy of each pertinent Bridge Inspection Report to:
   a. The Ohio Department of Transportation, District Bridge Engineer for each structure (original).
   b. The party or parties having responsibility for maintenance when the municipality has no responsibility or shares the responsibility for maintenance.

6. Update the Bridge Inventory. Revise and update the Bridge Inventory and appraisal code sheet (BR-87) if any change is noted in the structure which warrants such action and forward to the Ohio Department of Transportation, District Bridge Engineer.

REPORTING FORMS

The Bridge Inventory and Appraisal Form (BR-87) and the Bridge Inspection Form (BR-86) are shown in the appendix. Substitute inspection forms may be used for the actual inspection, but the data submitted to the Department must be on the BR-86 Form. Forms can be acquired through the District Bridge Engineer upon request.

ASSISTANCE AND CONSULTING SERVICES

The Director of Transportation will assist and cooperate with governmental units in the development of inspection procedures upon written request. Assistance with inspection of particular bridges and/or in preparation of the inspection forms can be obtained by contacting your District Bridge Engineer or the Structure Maintenance and Inspection Engineer, Office of Structural Engineering, Columbus, Ohio.
The State, counties, and municipal corporations may contract with Consulting Engineers experienced in this field for inspection services. If such Engineers are retained to make the inspection, the work need not be supervised by the governmental authority providing the inspection is made in conformance with this Bridge Inspection Manual, the findings are recorded on approved forms, and the Bridge Inspection Report is turned over to the authority for approval and processing. If the inspection is performed by Consulting Engineers, the firm's name and the name of the reviewer is to appear in the "Reviewed By" blank.

**TESTING (NONDESTRUCTIVE AND DESTRUCTIVE)**

Nondestructive testing (NDT) can be used to augment visual inspection. Generally, NDT is not practical for large scale use on a bridge unless a defect has first been detected by visual means. NDT can then be used to highlight or define the extent of the defect.

The recommended types of NDT for defining cracks in structural steel, listed in order of their usefulness, are:

1. Dye Penetrant
2. Ultrasonics
3. Magnetic Particle

Ultrasonics is also quite useful in determining remaining steel thickness when only one side of the member is accessible.

The most common and useful type of NDT for concrete and timber is a sounding rod or hammer. A sharp ring and/or good rebound generally indicates sound material. A dull thud or hollow sound indicates deterioration. Other types of NDT equipment which can be utilized for inspection of reinforced concrete include the reinforcing steel indicator and the rebound hammer.

In some cases, destructive testing can be used in evaluating bridge materials. This requires taking cores from the various bridge components. Cores from low stress areas of steel beams can help the designer determine the type and strength of the steel. Taking cores out of concrete bridge decks and other bridge components can be very useful in detecting hidden defects in the concrete or for collaborating soundings. Taking small cores from timber members is also used occasionally, but is not generally recommended due to the resultant puncture of the preservative barrier. In all cases, destructive testing is not recommended except in cases where necessary to evaluate the structure prior to major rehabilitation. In all cases (of concrete and timber) it is imperative that the cores be patched and/or plugged with similar material to prevent future deterioration as a result of the coring.
INSPECTION PROCEDURES

General: The field investigation of a bridge should be conducted in a systematic and organized procedure that will be efficient and minimize the possibility of any item being overlooked.

During the initial inspection of a structure, the Bridge Inventory Data should be checked in the field to reflect the "as built" conditions. Before making subsequent inspections the previous Bridge Inspection Report should be reviewed to ascertain the extent of previous deficiencies that may be progressed sufficiently to require immediate attention.

Deteriorated or damaged members which might affect the load carrying capacity of the bridge should be measured for loss of section and evaluated for condition. The measurements and physical evaluation should be recorded in sufficient detail to enable an Engineer to calculate the probable strength of the component being inspected.

The items listed on the blank inspection report form should be used as a guide to assure reasonably complete inspections, but the inspector is cautioned that the list may not be complete and that the inspection should not be restricted by it. The blank form should be regarded just as a check list.

Inasmuch as the report provides space for evaluation by code of the frequently encountered principal structure members or elements only, other items to complete the inspection should be described on the back of the report. In addition to the code evaluation, a brief description of any observed defect should be written in the space to the right of the item or on the back of the report.

A separate note pad should also be kept by the Inspector which notes any repair work that should be scheduled for work with maintenance crews. Any critical needs should be reported to the Engineer immediately.
MATERIALS

To ascertain the extent of deterioration, materials of construction should be examined as follows:

**Concrete:** Concrete surfaces should be examined for spalling, scaling, cracking, inadequate cover or exposure of reinforcement, loss of section or broken reinforcement, and other defects as defined below:

**Scaling:** The gradual and continuing loss of surface mortar and aggregate.

**Spalling:** The separation and removal of a portion of the surface concrete revealing a fracture roughly parallel, or slightly inclined to the surface.

**Cracks:** A crack is a fracture in the concrete and may extend partially or completely through a member. Cracks are classified as transverse, longitudinal, diagonal, pattern or map, D-Cracking, or random. Excessive cracking at areas of maximum moment or any shear cracking should be noted.

**Steel:** Structural steel should be examined for rust, cracks, bends or kinks, and stress concentrations as defined below. Connections and connectors should be carefully examined for looseness and section loss. Inspect structural steel partially encased in concrete at the face of exposure for deterioration and movement.

**Rust:** The decomposition of steel by oxidation from exposure to air, moisture, deicing agents and industrial fumes. Areas of severe rusting should be cleaned and measured for loss of section.

**Cracks:** Cracks in structural steel may vary from hairline to complete fractures. Any type of crack is obviously serious and should be reported immediately. Welds in base metal in regions of tension and stress reversal should be examined closely for evidence of fatigue cracking. Look for cracks radiating from cuts or notches.

**Bends and Kinks:** These conditions develop because of damage arising from thermal strain, overload and collision. Note the members damaged, the type, location, extent of damage and amount of deformation.
Stress Concentrations: Observe the paint film around connections for fine cracks which are indications of large strains due to stress concentrations. Be alert for sheared or deformed bolts and rivets and fractured welds.

Timber: Timber should be examined for decay, crushing, splitting, insect damage and condition of connections as defined below:

Decay: Damage from decay may not be visible at the surface as it can be confined to the interior of the member. Check around connections, splices, bolt holes and other areas where moisture can penetrate.

Crushing and Splitting: Damage caused by collision, overloads or decay.

Stone: Stones should be examined for cracks, spalls, crushing, displacement or other deterioration. Mortar joints, if any, should be checked for cracking and overall soundness.

BRIDGE INVENTORY AND INSPECTION REPORTS

Local Bridge Inventory: Each political subdivision responsible for the inspection of bridges will maintain a complete office inventory (card file, microfilm, etc.) of all bridges for which it has responsibility for inspection except that municipalities will maintain an inventory of all bridges within (or partially within) the municipality. The inventory will contain a complete material and dimensional description of the bridge; the structure type; number of spans; overall and detailed dimensions; load carrying capacity; date of construction; and other pertinent data, including a description of any repairs or alterations made subsequent to initial construction.

The local inventory will name the political subdivision, commission, or company responsible by law or agreement for the inspection, as well as the party responsible by law or agreement for the parties sharing in the maintenance.

The legal authority for both inspection and maintenance responsibilities will be listed.

All "Bridges" as defined previously will have an Inventory and Appraisal Form (BR-87), completed and filed with the Structure Rating and Inventory Engineer, Ohio Department of Transportation.
Bridge Inspection Report: The inspection report for a bridge will be prepared by the inspector during examination of the bridge at the site. The reporting Form BR-86 (see Appendix A) complete with any special notations thereon comprises the Bridge Inspection Report. Inspection Reports for exceptionally large bridges should also be accompanied with photographs. The report should be sufficiently complete so that it can be ascertained from the information contained thereon whether or not loads currently permitted on the bridge can be allowed to continue to operate over the structure safely until the time of the next scheduled inspection. If possible, the report should be complete enough to aid in the preparation of plans for maintenance work which the inspection discloses to be needed.

CODING THE BRIDGE INSPECTION REPORT FORM (BR-86)

Beginning in January 1, 1990, all information already included on the Bridge Inventory and Appraisal Code Sheets (BR-87) will no longer need to be entered on the Bridge Inspection Report (BR-86). This includes all "Material" and "Type" codes. This information will appear as "pre-printed" information in an appropriate place on the pre-printed BR-86 form.

When filling out the BR-86 form for the first time due to a new bridge or any bridge which has not previously been "inventoried", the BR-87 inventory form must be filled out and submitted prior to BR-86 inspection form or submitted at the same time.

Any corrections or changes to any pre-printed information on the BR-86 form must be submitted on a revised BR-87 form first.

HEADING

Structure File Number: This number is the key to processing all bridge data. It is the permanent identification number for the entire data file on any particular structure. The number consists of a seven (7) digit numeral which is assigned specifically for that structure by the appropriate control authority. The first two digits of the number is the numeric code for the Ohio county in which the structure is located. It is imperative that this Structure File Number be entered legibly and accurately so that data will be processed to the proper bridge file. (See Bridge Inventory and Appraisal Coding Instructions for details).
In the case of one road bridged over another road, it is important to remember that only one Structure File Number can exist for that bridge and there can be only one Inspection Report filed for that particular bridge. It is imperative that duplication by two different agencies for the same bridge be avoided.

Bridge Number: The bridge number is made up of three separate parts, which are: A three letter county, township, city or other standardized abbreviation code; the complete route number description; and the unit number which consists of the bridge straight line mileage and any special designation codes for ramps, parallel structures, etc. (See Bridge Inventory and Appraisal Coding Instructions for details.)

Year Built: A four digit inventory item in which the first four digits indicate the year of original construction and the second four digits the latest year of any rehabilitation or major improvements. See Bridge Inventory and Appraisal Coding Guide for further details.

Bridge Type: See Bridge Inventory and Appraisal Coding Guide

Type Service: " "

Feature(s) Intersected: " "

CODING OF INDIVIDUAL ITEMS

This is a physical condition report and therefore all items should be coded based on "as built" condition and should not be coded based on current acceptable standards.

If poor quality construction will result in accelerated deterioration or result in reduced strength of a member, this condition should be noted in the comments and considered in the rating of that item even though it was built that way. An example would be several bolts are missing from a field splice (they were never installed) on a 2 girder bridge.

In order to promote uniformity between bridge inspectors, these guidelines will be used to rate and code the items.

Condition ratings are used to describe the existing, in-place bridge as compared to the as-built condition. 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 will 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, will be coded as if open to traffic.

When rating the individual items, it is essential that the Inspector ask the following question:

**IS IT FUNCTIONING AS DESIGNED?**

All individual item's should be inspected with this question in mind.

The following codes will be used to rate the condition of all items except the Summary Items, the General Appraisal, Paint, Live Load Response, Vertical Clearance and Survey.

1. Good Condition - No repair required
2. Fair Condition - Minor deficiency, item still functioning as designed.
3. Poor Condition - Major deficiency, item in need of repair to continue functioning as designed.
4. Critical Condition - Item no longer functioning as designed.

The following codes will be used to summarize the condition of all Summary Items and the General Appraisal (Specific descriptions will follow for each Summary item):

9. Excellent condition
8. Very good condition
7. Good condition
<table>
<thead>
<tr>
<th>Individual Items</th>
<th>Summary Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Good</td>
<td>9 Excellent</td>
</tr>
<tr>
<td></td>
<td>8 Very good</td>
</tr>
<tr>
<td></td>
<td>7 Good</td>
</tr>
<tr>
<td>2 Fair</td>
<td>6 Satisfactory</td>
</tr>
<tr>
<td></td>
<td>5 Fair</td>
</tr>
<tr>
<td>3 Poor</td>
<td>4 Poor</td>
</tr>
<tr>
<td></td>
<td>3 Serious</td>
</tr>
<tr>
<td>4 Critical</td>
<td>2 Critical</td>
</tr>
<tr>
<td></td>
<td>1 &quot;Imminent&quot; Failure</td>
</tr>
<tr>
<td></td>
<td>0 Failed</td>
</tr>
</tbody>
</table>

The condition coding system used for the Summary Items and the General Appraisal was developed by the Federal Highway Administration and is being used by all agencies across the United States. The 1-4 Individual Item condition code was developed by the State prior to the Federal code.

Exceptions to this correlation should be infrequent. (1%)
The Items on the Inspection Report that are highlighted by condition boxes with bold outlines should carry the most weight in determining the Summary Rating for each subsection as well as the General Appraisal. The summary rating is driven by the box with a bold outline with the worst condition in the worst span, with the exception of expansion joints, bearing devices and backwalls.

**DECK**

The primary function of the bridge deck is to provide a smooth riding surface and to transmit the wheel loads to the supporting members. It also provides a support for curbs, walkways, railings, medians, expansion joints, and provides a surface to transmit drainage off the bridge. There are several deck types, but the majority will consist of reinforced concrete, timber, filled or unfilled steel grid, or corrugated steel.

Concrete decks should be inspected (both bottom and top) for cracking, scaling, spalling, leaching, water saturation, potholing, delamination, and full 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.

While expansion devices may cause serious problems, rarely will the condition rating of the deck be reduced because of these devices.

**Item 1. Floor**

The floor is the primary load carrying member of the deck and should be inspected top and bottom for evidence of leakage, deterioration and structural adequacy. The condition of slab type structures, prestressed concrete box beams and the top flange of prestressed concrete tee beams, should be coded under this item.

**Concrete**

1. Minor transverse cracks (spacing 20' or more)

2. Transverse cracks evident on bottom side (spacing 10' to 20'); some could be leaking. Some spalling may be present (1% - 10% of total deck area)
3. Saturated areas on bottom side indicating deck is saturated with chlorides. Some bottom spalling may be present. Saturated areas and spalling not exceeding 30% of total deck area.

4. Saturated areas or bottom spalling exceeding 30%. Evidence that full depth holes are soon to appear.

**Timber**

1. All boards look good. No deterioration or loose fasteners noted.

2. Some boards/floor clips may be loose. Rotting or deterioration noted on less than 5% of boards.

3. Several boards rotted. Up to 30% of boards noted with decay.

4. Several boards broken, cracked, hanging down. Over 30% of boards rotten, damp, white decay noted.

**Item 2. Wearing Surface (Protective System)**

The primary function of a wearing surface is to provide a smooth riding surface and to protect the underlying floor. It should be examined for smoothness, cracks, drainage, debris, and signs of deterioration.

1. No cracks or spalling noted.

2. Cracking may be noted or spalls may be present not exceeding 5%. Concrete patches are still sound. Asphalt patches still provide a smooth riding surface.

3. Spalling evident not exceeding 30%. Concrete patches are unsound. Asphalt patches are breaking up causing a rough riding surface.

4. Major amounts of spalling or potholes exceeding 30%.
Item 3. Curbs, Sidewalks, Walkways

Curbs, sidewalks and walkways do not normally contribute to the structural strength of the bridge. They are provided mainly for motorist safety and pedestrian convenience and protection. They should be examined for deterioration, security of connections and hazards to pedestrians.

Item 4. Median

The primary function of median is to separate oncoming traffic traveling in the opposite direction. It may be level or raised and may or may not have barrier guardrails. It may be closed or have an open expansion or construction joint. Examine for deterioration, damage and security of connection of the guardrail.

Item 5. Railing

Both pedestrians and vehicular railings should be examined for deterioration, damage, security of connections.

1. No evidence of damage or loose connections. No repairs necessary. Minor concrete cracking (spacing 10' or more)

2. Minor vehicular damage. Minor rusting of system. Cracking with efflorescence (spacing less than 10') or minor spalling.

3. Noticeable deterioration of concrete; several posts loose or bent; post anchors deteriorated.

4. Portions of railing missing or damaged beyond repair.

Item 6. Drainage

Effective drainage is essential for the proper maintenance of a bridge. Examine the drainage system for clogging, ponding, vegetation and adequacy. All structures with deck items require a rating for drainage. Condition of metal drip strips will be considered in rating the drainage item.
Item 7. Expansion Joints

Expansion joints provide for the expansion and contraction of the bridge superstructure. Examine carefully for proper opening, anchorage, and deterioration. Also check beam-to-backwall clearances. Condition of sealed joints or 1" compression seals should be noted but not given a condition rating.

1. All expansion joints open and functioning as designed. Dirt or other obstructions in joints. Minor leakage onto Superstructure.

2. Minor damage to joints. Minor damage to vertical extensions. Major leakage onto the ends of beams.

3. Expansion joints nearly closed (less than ½" opening).

4. Expansion joint tightly closed or beams touching backwall. Not functioning as designed.

Item 8. Deck Summary

The condition of curbs, sidewalks, parapets, bridge rail, and scuppers should be noted on the inspection form. However, their condition will not be considered in the overall deck evaluation.

In arriving at the condition rating for the deck, the condition of the worst span of the deck will dictate the deck rating. Comprehensive rehabilitation of the deck will normally restore the deck element to a rating of 7 or possibly an 8.

The following descriptive codes will be used as a guide in arriving at a Deck Summary:

CONCRETE BRIDGE DECK

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No Obvious Deficiencies</td>
</tr>
<tr>
<td></td>
<td>Top Side (Bare Concrete):</td>
</tr>
<tr>
<td></td>
<td>-no spalls</td>
</tr>
<tr>
<td></td>
<td>-no surface scaling</td>
</tr>
</tbody>
</table>
- no obvious cracks
- no delaminations

Bottom Side:
- no spalls
- no obvious cracks
- no damp areas
- no efflorescence

8 Minor Deficiencies
Top Side (Bare Concrete):
- minor scaling (less than 1/4" deep over 5% of deck surface)
- a few hairline cracks
- no delaminations

Bottom Side:
- minor transverse cracking (cracks > 25' spacing)
- no dampness
- no leakage
- no spalling

7 Minor Deficiencies
Top Side:
- minor scaling (less than 1/4" deep over no more than 10% of deck surface)
- some minor delaminations not cracked or broken out yet
- some obvious transverse cracks

Bottom Side:
- several obvious transverse cracks
- some minor leakage through cracks
- minor efflorescence
- saturated areas of concrete less than 1% of deck area
- no spalling
- Excessive leakage of Ex. Jt. causing accelerated deterioration of steel or concrete

6 Fair Condition
Top Side:
-20% or more scaling (1/2" or less)
-delaminations noted by sounding (10% broken out)
-obvious transverse cracks
-Ex. Jt. nearly closed (less than 1/2" opening) or beams nearly touching backwall

**Bottom Side:**
- obvious transverse cracks (spacing 15'-20')
- some leakage through cracks
- efflorescence noted at majority of cracks
- damp or dark areas 5% or more of deck area
-1% spalling (not including edges)

5  **Generally Fair Condition**

**Top Side:**
- 30% scaling
- obvious delaminations and/or surface patches over 20% of wearing surface
- obvious transverse cracks
- Ex. Jt. tightly closed or beams touching backwall

**Bottom Side:**
- obvious transverse cracks (spacing 10'-15')
- considerable leakage through cracks
- efflorescence noted at majority of cracks
- damp or dark areas 10% or more of deck area
- 5% spalling (not including edges)

4  **Marginal Condition**

**Top Side:**
- obvious delaminations and/or surface patches over at least 25% of deck area
- steel plates covering full depth holes

**Bottom Side:**
- full depth holes visible
- much cracking and white efflorescence with 4" stalactites
- additional dark and damp areas over at least 50% of deck bottom indicates deck should be replaced
-considerable bottom delaminations
-10% spalling (not including edges)

3 Poor Condition
Top Side:
- obvious delaminations and/or patches over 50% of wearing surface area
- very irregular surface causing bridge vibration under live load
- reinforcing steel exposed in holes at several locations
- steel plate covering full depth hole
Bottom Side:
- damp or dark areas over at least 50% of floor
- many cracks with leakage and efflorescence including 2" stalactites
- some full depth patches have been made
- conditions indicate deck should be replaced
- considerable spalling of deck bottom
- 20% spalling (not including edges)

2 Critical Condition
Top Side:
- considerable delaminations
- steel plates covering full depth holes
Bottom Side:
- full depth holes visible
- much cracking and white efflorescence with 4" stalactites
- additional dark and damp areas over at least 50% of deck bottom indicates deck should be replaced
- considerable bottom delaminations

1 Critical Condition - Bridge Closed
Top & Bottom Side:
- several full depth holes through deck
- holes could be repaired to put bridge back in service, but evidence on bottom of deck indicates additional holes are imminent

0 Critical Condition - Bridge Closed:
Top & Bottom Side:
- deck collapsed
- full depth holes throughout deck
### STEEL BRIDGE DECKS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the deck.</td>
</tr>
<tr>
<td>8</td>
<td>Tightly secured to floor system with no rust.</td>
</tr>
<tr>
<td>7</td>
<td>Loose at some connections with minor rusting. A few cracked welds and/or broken grids.</td>
</tr>
<tr>
<td>6</td>
<td>Considerable rusting with indications of initial section loss. Loose at many locations. Some cracked welds and/or broken grids.</td>
</tr>
<tr>
<td>5</td>
<td>Heavy rusting with areas of section loss. Loose at numerous locations. Numerous cracked welds and/or broken grids.</td>
</tr>
<tr>
<td>4</td>
<td>Heavy rusting resulting in considerable section loss and some holes through deck. Majority of welds cracked and/or grids broken.</td>
</tr>
<tr>
<td>3</td>
<td>This rating will apply if severe or critical signs of structural distress are visible.</td>
</tr>
<tr>
<td>2</td>
<td>Many holes through deck.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed. Correction action may put back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Replacement necessary.</td>
</tr>
</tbody>
</table>

### TIMBER BRIDGE DECKS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the deck.</td>
</tr>
</tbody>
</table>
8  No crushing, rotting, or splitting. Tightly secured to floor system.
7  Minor cracking or splitting with a few loose boards/ clips.
6  A number of rotted or crushed boards in need of replacement. Many boards cracked or split. Many loose boards/ clips.
5  Numerous boards cracked, split, rotted, or crushed and in need of replacement. Majority of boards/ clips are loose.
4  Majority of the boards are rotted, crushed, and/or split; necessitating the replacement of the entire deck.
3  This rating will apply if severe or critical signs of structural distress are visible.
2  Advanced deterioration with partial deck failure.
1  Bridge closed. Corrective action may be put back in light service.
0  Bridge closed. Replacement necessary.

SUPERSTRUCTURE

The superstructure is the entire portion of a bridge above the abutment and pier seats, excluding the deck. The superstructure transmits the deck loads to the substructure. The superstructure and the substructure are generally the two most important aspects of the bridge.

The inspector should visually inspect all fracture critical structural members of the bridge within an "arm's-reach" distance. This will require access so that all fatigue prone connections can be inspected within arm's reach. Any cracks discovered and/or suspected as a result of this "hands-on" visual inspection will be documented and will be further defined with the use of dye penetrant, magnetic particle or ultrasonic devices.
Any steel structure with lower lateral bracing, pins and hangers, transverse floor beams and stringers, or any unusual connection details will be carefully inspected for cracks, poorly designed details, or poorly fabricated details.

Any observed section loss on members which are normally analyzed to determine safe load capacity of the bridge, will be measured and documented sufficiently to allow for subsequent reanalysis of the structure.

All pinned connections should be carefully inspected by visual means, within arm's-reach for loss of section, frozen conditions due to pack-rust, and cracks. Non-destructive testing generally does not lend itself to detecting hidden defects in pinned connections, nor is dismantling of the connection considered to be a part of routine annual inspections.

**Item 9. Alignment**

The superstructure should be examined for any discontinuities in the vertical or horizontal alignment due to settling, shifting, accident damage and etc. All bridges with Superstructure items require a rating for Superstructure Alignment.

**Item 10. Beams/Girders or Concrete Slabs**

Longitudinal members transferring deck or floor system loads directly to substructure. Examine carefully for deterioration (particularly loss of member cross sectional area), loose connections, cracks or deformations due to overloading and damage (collision or flood). Indicate on report if beams are weathering steel or galvanized steel (not in coding boxes).

If bridge is made up of only 2 or 3 beams, deterioration on any one beam is significant. If bridge consists of multiple beams, deterioration of exterior beams (for example) is generally not significant and should not cause the entire bridge to be rated lower, based on the condition of the two worst beams.

Deterioration of the edge of a slab (closer than 2 feet to the guardrail face) is generally not significant and should not cause the entire bridge to be rated down. Conversely, slabs with transverse spalls exposing more than a third of the re-bars should be considered in poor condition. (Common at midspan and at abutments)
The concrete Tee beam is a deck and beam system formed in a T-shape. The beams and deck slab act integrally to increase strength and allow for greater spans. Check beam ends for shear cracks. These will occur on the web and project up from the supports diagonally toward midspan. Check at midspan for flexure cracks due to positive moment. Check for exposed tension reinforcement and document section less on exposed bars. Deterioration of beams should not lower the floor condition rating, but deterioration of the deck should be considered in the beam condition rating and the superstructure summary.

Item 11. Diaphragms or Cross frames

Secondary members in beam and girder bridges placed to distribute stresses and improve rigidity. Examine for condition and security of connections. Fatigue prone connections should be closely inspected and reported. This item should not be based solely on the condition of the end cross frames.

Floor System (Items 12, 13, 14)

NOTE: In general, Items 12, 13, 20, 21, 22 and 23 can be considered secondary structural members and although their failure should receive immediate attention, an individual member failure will not render the structure unsafe.

A system of joists and floor beams which transfers the deck load to the main girders or trusses. The joists are sometimes omitted on short panel lengths in which case the floor itself spans between floor beams. Check all members for loss of section, crushing, cracking and security of connection.

All built-in notches at the ends of floor beams and joists will be carefully inspected for fatigue cracking.

Item 12. Joists/Stringers

The joists span between floor beams and provide the primary support for the deck system. The deck loading is transmitted to the joists and through the joists to the floor beams and then to the truss or girder. The condition of exterior joists should not normally dictate the overall condition of this item. Consider all joists in any one span and rate their overall condition.
Item 13. Floor Beams

The transverse members which support the joists or floor and transmit the loads to the main longitudinal girders or trusses.

Item 14. Floor Beam Connections

The end connections or hangers attaching the floor beams to the trusses or main girders are particularly critical where they are exposed to moisture and de-icing chemicals. Check for loose or broken connections and loss of section.

Items 15 - 23

Generally, these Items pertain only to truss type bridges and should only be coded when inspecting a truss bridge.

Remember cracks are considerably more significant in tension members than compression members. Particular attention should be given to the connections of Items 15-23. Check the integrity of all bolts, nuts, rivets, welds and etc.

Item 15. Verticals

Vertical members extending between top and bottom chords which will resist either tension or compression stresses depending on the truss configuration. Most verticals are also main structural members and their failure would usually be critical and render the truss unsafe.

Item 16. Diagonals

The diagonal members extend between successive top and bottom chords and will either resist tension or compression depending on the truss configuration. Most diagonals are also main structural members and their failure would be extremely critical and render the truss unsafe.

Item 17. End Posts

The end compression member of a truss, either vertical or inclined, extending between chords and functioning to transmit the truss end reaction to the bearings.
Item 18. Top Chord

The upper longitudinal member extending the full length of the truss, (from end post to end post). For a simple span, the top chord is designed to always be in compression. Failure of this chord will render the truss unsafe.

Item 19. Lower Chord

The lower longitudinal member extending the full length of the truss. For a simple span, the lower chord is designed to always be in tension. Failure of this chord will render the truss unsafe.

Bracing

The secondary system of members which distributes loads, stabilizes the bridge against torsional and wind loadings, prevents buckling of compression chords, and integrates the separate main member systems. Check all members for condition, alignment, collision damage, and security of connection.

Item 20. Lower Lateral Bracing

The bottom lateral braces lie in the plane of the bottom chord, or bottom girder flange, and provide lateral stability and resistance to wind stresses.

NOTE: In general, Items 12, 13, 20, 21, 22 and 23 can be considered secondary structural members and although their failure should receive immediate attention, an individual member failure will not render the structure unsafe.

Item 21. Top Lateral Bracing

The top lateral braces lie in the plane of the top chord and provide lateral stability between the two trusses and resistance to wind stresses.

Item 22. Sway Bracing

Sway braces are secondary structural members spanning between the trusses at interior panel points which provide lateral stability and shear transfer between trusses. In the case of low
or pony trusses the sway bracing may take the form of knee bracing on the outside of the trusses.

**Item 23. Portals**

A heavy sway frame which is found overhead at the ends of a thru truss and provides lateral stability and shear transfer between trusses.

**Item 24. Bearing Devices**

Bearing devices transmit the superstructure load to the substructure. They also provide for longitudinal movement due to expansion and contraction and rotational movement due to deflection. The bridge bearings are vitally important to the functioning of the structure. If they are not kept in good working order, stresses may be induced into the structure that will shorten the usable life of the bridge. Check all components of bearings for deterioration, movement, alignment, contact, security of connections and lubrication where necessary. Generally, bridges have both fixed and expansion bearing devices. Code the condition of the expansion bearing devices.

**Item 25. Arch**

In general, any structure having throughout its length a curved shape. The curve may be elliptical, circular, parabolic or a combination of shapes. The most common types are the Filled Spandrel Arch, Open Spandrel Arch, Open Spandrel Ribbed Arch and Thru Arch. These are generally constructed of concrete or stone and sometimes of steel. Check all members for deterioration, alignment and signs of failure.

**Item 26. Arch Columns or Hangers**

The vertical members which bear on or hang from the arch and support the superstructure.

**Item 27. Spandrel Walls**

A wall built upon an arch to function as a retaining wall for the roadway in a spandrel filled structure; but, when the spandrel is not filled, to support the floor system and its loads
For Suspension and Movable Bridges See The Rear of This Manual

Item 28. Paint

Painting is the primary means by which steel is protected from the elements and it is imperative that the condition of the paint film be thoroughly inspected. Critical structural areas would be bearing areas, pin connections, fracture critical members and fatigue prone details.

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Paint in excellent condition; no repairs necessary</td>
</tr>
<tr>
<td>2</td>
<td>Paint faded or chalking; or less than 15% rust in critical structural areas</td>
</tr>
<tr>
<td>3</td>
<td>15% - 50% rust; repainting needed within 5 years</td>
</tr>
<tr>
<td>4</td>
<td>At least 50% of paint failed or severe rust in critical structural areas regardless of total area. Immediate need for re-painting.</td>
</tr>
</tbody>
</table>

Percent of rust should be noted in the remarks space.

Inspector should note type of paint and year painted stenciled on the bridge ends and compare to pre-printed information on BR-86. Changes should be noted and reported on the Inventory Form after returning to Office. Do not rate condition of paint on a concrete or weathering steel structure. If a concrete structure has exposed steel piling (such as capped pile piers) which need painting, do not code paint condition, but note in remarks space. The same is true for a weathering steel structure where only the beam ends are painted.

Item 29. Pins, Hangers, Hinges

Inspect all pins, pins and hangers, and seated hinges for evidence of freedom of movement. Check for pack rust which would limit movement and section loss around support areas. Check alignment of the adjoining members. Be particularly cognizant of pack rust developing between the hangers and the beam/girder webs. Also look for evidence of pin and/or hanger wear and loosening of keeper plates or nuts.
The condition of pins/hangers and seated hinges on twin girder structures is particularly important. Multiple girder bridges have built-in redundancy which make them less prone to catastrophic failure.

Pins with exposed ends can be periodically checked using ultrasonic equipment. Consideration should also be given to applying motor oil to the pins and hangers during each inspection.

Please refer to Bridge Inventory and Appraisal Coding Guide Item 28, Hinges, for type codes.

This Item can also be used to code the condition of pins in trusses

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Appears to be functioning as designed</td>
</tr>
<tr>
<td>2</td>
<td>Minor rusting, still functioning</td>
</tr>
<tr>
<td>3</td>
<td>Significant rusting, still evidence of movement</td>
</tr>
<tr>
<td>4</td>
<td>Significant rusting, member is failed or completely inoperative due to pack rust</td>
</tr>
</tbody>
</table>

**Item 30. Fatigue Prone Connections**

This Item pertains mainly to welded steel members subjected to bending. Fatigue cracking is generally not a problem on riveted structures.

Closely observe all connections or other appurtenances which may cause secondary stresses or out-of-plane-bending which could lead to partial or complete failure of the bridge.

On welded structures look closely at all main member welded splices and all other welded connections; especially in tension zones. Twin girder structures are obviously most critical in this respect; however, failure due to stress concentrations in a multiple girder bridge can lead to major traffic disruptions until repairs can be made.

Pay particular attention to:

1. Lower lateral connections (gussets) to main members in the mid-span or positive moment areas.
(2) Floor beam connections (stiffener to web welds) near and over the piers (negative moment areas). Generally speaking, bolted field splices are indicators of zero moment or moment change areas, i.e., positive moment occurs from mid span to bolted splices; negative moment occurs from piers to bolted splices.

(3) The ends of welded cover plates on the bottom flange in mid span.

(4) Connections where beams frame into steel pier caps.

In all of the above look for:

(a) Obvious cracks
(b) Paint peeling or checking

Dye penetrant should be used to check all suspicious areas, especially on twin girder bridges.

Please refer to Bridge Inventory and Appraisal Coding Guide, Item 28 A, Fracture Critical Bridge for type codes.

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>No distress apparent</td>
</tr>
<tr>
<td>2.</td>
<td>Paint discoloration or checking</td>
</tr>
<tr>
<td>3.</td>
<td>Suspicious areas, minor cracking, cracks have not progressed since last inspection.</td>
</tr>
<tr>
<td>4.</td>
<td>Cracks obvious, notify Engineer at once to determine if bridge should be closed.</td>
</tr>
</tbody>
</table>

Refer to "Inspection of Fracture Critical Bridge Members Manual" for further details. Do not rate this item for cross frame connections. Welded cover plates on multiple beam bridges should be rated in this item. Any defects on these welds should be noted.
Item 31. Live Load Response

Observe the bridge from beneath while heavy vehicles (trucks) are crossing so as to ascertain excessive deflection, vibration, unusual noises and other indications of structure defects.

Condition Code

E Excessive
S Satisfactory (normal)

Item 32. Superstructure Summary

This item includes the physical condition of all structural members, and bearings, for signs of distress which may include cracking, deterioration, section loss, and malfunction and misalignment of bearings.

In most cases, the Superstructure rating should not be influenced by the deck rating. Exceptions to this would be composite or integral decks as noted in the Deck Summary.

While bearing devices may cause serious problems, rarely will the condition rating of the superstructure be reduced because of bearings. Bearings for trusses and twin girder bridges should be given full consideration in the superstructure rating.

The inspector should determine if the bridge is fracture critical or has fracture critical components. Fracture critical components should receive careful attention because failure could lead to collapse of a span or the bridge. In-Depth inspections should be scheduled when signs of distress are noted and in some cases partial disassembly may be required to ascertain the condition.

The condition of the paint system or the wearing surface/deck protection will not influence the rating of the superstructure. In arriving at the Superstructure rating including Superstructures with integral decks, the condition of the worst span will dictate the superstructure rating.

Comprehensive rehabilitation of the Superstructure will normally restore the Superstructure to a rating of 8.
Rate and code the conditions in accordance with the previously described general condition ratings and the following descriptive codes which will be used as a guide in evaluating the Superstructure condition.

Two sets of descriptive codes will be used to evaluate this item: (1) the codes applicable to all Superstructures which are not tied to a specific type of material and (2) the codes applicable specifically to concrete, steel or timber Superstructures. The lowest of the codes obtained will be used.

## APPLICABLE TO ALL SUPERSTRUCTURES

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the superstructure.</td>
</tr>
<tr>
<td>8</td>
<td>Problems noted, deficiencies</td>
</tr>
<tr>
<td>7</td>
<td>Some minor problems. No-flexural cracks no rust stain</td>
</tr>
<tr>
<td>6</td>
<td>Structural elements show some minor deterioration. Non-structural cracks. No rust stains.</td>
</tr>
<tr>
<td>5</td>
<td>All primary structural elements are sound but may have minor section loss, cracking, spalling. Flexural cracks with no rust stains.</td>
</tr>
<tr>
<td>4</td>
<td>Advanced section loss, deterioration, spalling. Severe rust stains with extensive spalls and exposed reinforcement.</td>
</tr>
<tr>
<td>3</td>
<td>Loss of section, deterioration. Spalling has seriously affected primary structural elements local failures are possible, shear cracks in concrete may be present. Extensive spalling with exposed reinforced with section loss. Flexural or shear cracks.</td>
</tr>
<tr>
<td>2</td>
<td>Some permanent deformation of a main support member.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed. Corrective action may put back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Replacement required.</td>
</tr>
</tbody>
</table>
## CONCRETE SUPERSTRUCTURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the superstructure.</td>
</tr>
<tr>
<td>8</td>
<td>Minor deficiencies</td>
</tr>
<tr>
<td>7</td>
<td>Some minor problems. Minor spalls or cracks.</td>
</tr>
<tr>
<td>6</td>
<td>Structural elements show some minor deterioration. Moderate spalls no section loss of reinforcement.</td>
</tr>
<tr>
<td>5</td>
<td>All primary structural elements are sound but may have minor section loss, cracking, spalling. Moderate spalls with rust stains and exposed reinforcement.</td>
</tr>
<tr>
<td>4</td>
<td>Advanced section loss, deterioration, spalling. Extensive spalls and exposed reinforcement.</td>
</tr>
<tr>
<td>3</td>
<td>Loss of section, deterioration, spalling has seriously affected primary structural elements local failures are possible. Shear cracks in concrete may be present. Extensive spalling with exposed reinforcement with section loss. Flexural or shear cracks.</td>
</tr>
<tr>
<td>2</td>
<td>Concrete disintegrated around reinforcing steel with loss of bond.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed. Corrective action may put back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Replacement necessary.</td>
</tr>
</tbody>
</table>

## PRESTRESSED CONCRETE SUPERSTRUCTURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the superstructure.</td>
</tr>
<tr>
<td>8</td>
<td>Minor problems noted. Minor deficiencies.</td>
</tr>
<tr>
<td>7</td>
<td>Minor cracking, beams spalling along edge.</td>
</tr>
</tbody>
</table>
Minor cracking. One or two strands exposed. Some joints between beams leaking with subsequent spalling.

Some beam end deterioration. 5 or 6 joints between beams leaking spalling with 5 or 6 strands exposed. No broken strands.

Beam end deterioration. Many joints leaking. Spalling concrete. 10-20% strands exposed. 1 or 2 broken and hanging down.

25%-50% strands exposed. 3-5 broken and hanging down.

Bridge critical. 50%-60% of strands exposed. At least 5 strands broken and hanging down.

Bridge closed. Many exposed strands. Several beams have noticeable sag.

Bridge closed. Nearly all strands are exposed. Many broken strands hanging down. Beams are sagging.

STEEL BEAM SUPERSTRUCTURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noteworthy deficiencies.</td>
</tr>
<tr>
<td>8</td>
<td>Minor surface rusting (5% or less) under expansion joints</td>
</tr>
<tr>
<td>7</td>
<td>Minor surface rusting (5% or less) on all beams; around bearing devices; no section loss.</td>
</tr>
<tr>
<td>6</td>
<td>Surface rusting (10% or less) on all beams/bearing devices. Initial section loss (minor pitting).</td>
</tr>
<tr>
<td>5</td>
<td>Surface rusting (15% or less) on all beams. Some areas of heavy pitting (no perforations) under expansion joints. Fatigue or out-of-plane bending cracks present in non-critical areas.</td>
</tr>
<tr>
<td>4</td>
<td>Minor perforations through web under expansion joints. Heavy pitting on flanges. 5-10% section loss (avg.) all beams. Fatigue or out-of-plane bending cracks present in major structural elements. Hangers frozen due to corrosion.</td>
</tr>
<tr>
<td>3</td>
<td>Extensive perforations through fascia beam webs. Minor perforations through all beams. 10-20% section loss (avg.) all beams.</td>
</tr>
</tbody>
</table>
Extensive rust-through on all beams. Extensive section loss on bottom flanges. 20%-30% section loss (avg.) on all beams. Bridge should be load posted.

Extensive rust-through on all beams. Bridge is closed. Possibility of making welded repairs and/or selective member replacement to re-open bridge.

Extensive rust-through on all beams. Bridge is closed. Cannot be repaired.

STEEL TRUSS SUPERSTRUCTURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noteworthy deficiencies</td>
</tr>
<tr>
<td>8</td>
<td>Minor surface rusting; no section loss.</td>
</tr>
<tr>
<td>7</td>
<td>Minor rusting; flaking paint.</td>
</tr>
<tr>
<td>6</td>
<td>Minor pitting on fascia stringers, bottom chord and bearing devices.</td>
</tr>
<tr>
<td>5</td>
<td>Considerable surface rusting of fascia stringers, bottom chord, bearing devices (less than 5% section loss).</td>
</tr>
<tr>
<td>4</td>
<td>Considerable rusting on all stringers; minor perforations in fascia stringers; 5%-10% section loss on lower chord/floor beam connections. Pack rust at lower chord connections.</td>
</tr>
<tr>
<td>3</td>
<td>Extensive perforations in fascia stringers. Minor perforations through all stringers. 10%-20% section loss on lower chord/floor beam connections. All truss members (verticals, diagonals, end posts) have extensive pitting (no perforations) in splash zone area. Section loss at lower chord connections.</td>
</tr>
<tr>
<td>2</td>
<td>Extensive perforations in all stringers. 20%-30% section loss in lower chord/floor beam connections. Perforations in other truss members in splash zone area (verticals, diagonals, end posts). Bridge should be load reduced.</td>
</tr>
<tr>
<td>1</td>
<td>Extensive rust through in all stringers, floor beams, floor beam connections, verticals, diagonals, end posts. Lower chord rusted through or broken.</td>
</tr>
</tbody>
</table>
Bridge is closed. Possibility of making welded repairs and/or selective member replacement in order to re-open bridge.

0 Extensive rust through of many members. Bridge is closed. Cannot be repaired.

**TIMBER SUPERSTRUCTURE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the superstructure.</td>
</tr>
<tr>
<td>8</td>
<td>Very good condition. No deterioration.</td>
</tr>
<tr>
<td>7</td>
<td>Timber is dry but has minor checking</td>
</tr>
<tr>
<td>6</td>
<td>Timber shows minor deterioration. Less than 2% moist timber with moderate checking.</td>
</tr>
<tr>
<td>5</td>
<td>Timber sound, may have minor section loss cracking. Less than 5% moist or 2% decayed timber with moderate checking.</td>
</tr>
<tr>
<td>4</td>
<td>Advanced deterioration. Greater than 5% decayed timber or heavily checked.</td>
</tr>
<tr>
<td>3</td>
<td>Severe decay, cracking, splitting, or crushing of beams or stringers.</td>
</tr>
<tr>
<td>2</td>
<td>Advanced deterioration of timber. Unless closely monitored it may be necessary to close the bridge until corrective action is taken. Deck structural capacity inadequate.</td>
</tr>
<tr>
<td>1</td>
<td>Bridge closed. Corrective action may put back in light service.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Replacement necessary.</td>
</tr>
</tbody>
</table>
**MASSONRY SUPERSTRUCTURE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the superstructure.</td>
</tr>
<tr>
<td>8</td>
<td>Very good condition. Minor deficiencies.</td>
</tr>
<tr>
<td>7</td>
<td>Some minor problems. Stones intact, isolated locations of shallow mortar deterioration.</td>
</tr>
<tr>
<td>6</td>
<td>Stones show some minor deterioration. Stones intact, extensive areas of shallow mortar deterioration.</td>
</tr>
<tr>
<td>5</td>
<td>Stone mostly sound but may have minor section loss spalling. Minor surface cracking of stones, isolated locations of mortar deterioration.</td>
</tr>
<tr>
<td>4</td>
<td>Advanced stone loss, deterioration, spalling. Displaced stones, extensive areas of mortar deterioration.</td>
</tr>
<tr>
<td>3</td>
<td>Deterioration, spalling has seriously affected primary structural elements local failures are possible. Missing stones, extensive areas of missing mortar.</td>
</tr>
<tr>
<td>2</td>
<td>Several stones displaced or missing. Cracks run through stones. Some settlement. Sag or bulge in shape.</td>
</tr>
<tr>
<td>1</td>
<td>Several stones have fallen out and more imminent. Significant sag or bulging. Bridge closed.</td>
</tr>
<tr>
<td>0</td>
<td>Bridge closed. Many stones have fallen out. Sag or bulging indicates bridge is near collapse.</td>
</tr>
</tbody>
</table>

**SUBSTRUCTURE**

The substructure is that portion of the bridge below the pier and abutment seats, including footers and piling. The substructure transmits the loads and stresses from the deck, superstructure, or other load supporting system, to the ground.
All exposed or readily accessible portions of the substructure will be inspected at close range. Underwater investigation will be done to assure that scour and undermining is not threatening the bridge. This will consist of probing in relatively shallow water and diving in deeper water. Diving inspections will be performed at least once every 5 years on bridges where water depth prohibits visual or probing inspections.

While backwalls may cause serious problems, rarely will the condition rating of the substructure be reduced because of the backwalls. An example of the backwall reducing the summary rating would be if a seriously undermined approach slab which was not adequately supported by a severely deteriorated backwall.

**Item 33. Abutments**

A substructure supporting the ends of a single span or the extreme ends of a multi-span superstructure and, in general, retaining or supporting the approach embankment. Examine abutments for condition, movement, bulging, cracking, settlement, joint integrity, leakage, and scour.

**Item 34. Abutment Seats**

Check bearing areas for cracking, spalling and other signs of failure. The edges are particularly critical under beams or bearing devices on truss and twin girder bridges.

Dirt and debris should be noted but not considered in rating this item. Most slab bridges do not have abutment seats. Any deterioration in the bearing areas should be noted and considered in the abutment condition rating.

**Item 35. Piers**

A substructure supporting the ends of the spans of a multi-span superstructure at intermediate locations between the abutments. Examine for condition, movement or settlement, and scour. Welded steel pier caps will be very carefully inspected by visual means, within "arms reach", for potential fatigue cracks.

**Item 36. Pier Seats**

The uppermost part of a pier upon which the superstructure rests. Check bearing areas for cracking, spalling and other signs of failure. The edges are particularly critical under beams
and bearing devices on truss and twin girder bridges. Most bridges slab do not have pier seats.

**Item 37. Backwall**

The topmost portion of an abutment extending above the bridge seat which functions primarily as a retaining wall for the approach embankment. It may also serve as a support for an approach slab. Check backwalls for condition and amount of clearance between beam ends and face of backwall which may indicate abutment movement or pavement pressures. Semi-integral abutments have a backwall above the construction joint.

1. Excellent condition, no repairs needed
2. Minor cracks or leakage
3. Top of backwall spalled or spalled on face of backwall or some leaning of backwall
4. Backwall is broken out from top side to below expansion joint angle on bottom side or backwall is leaning inward and touching beam ends

**Item 38. Wingwalls**

Extensions of abutments to retain approach embankment. Check for condition and evidence of movement.

**Item 39. Fenders and Dolphins**

Fenders and dolphins around piers or abutments protect the substructure against collision by vessels. They are designed to absorb the energy of physical contact with the vessel. They are also used to deflect debris and ice. Check for condition, damage and security of connection.

**Item 40. Scour**

Check all substructure units for evidence of undermining due to scour. This may be done visually if stream is dry or if water is clear and not too deep for waders. This will require probing in deeper areas from a boat or the use of a diver. During high flow, holes can become deeper or fill in temporarily.

This item requires a two part code. The first box will indicate the type of inspection made:

1. Visual
2. Probing
3. Diving
The second box is the condition:

1. No evidence of scour (past or present). Minor erosion more than 10 feet from abutment or pier.

2. Indication of holes developing around substructure. Portions of the top of the footer may be exposed. Evidence that site has had scour problems, but have been corrected. Deep holes more than 10 feet from abutment or pier. Damage to scour counter measures. Probing indicates soft material in scour hole.

3. Portions of footer is exposed on unknown foundation. Bottom of footer is exposed, but on piling or rock. Drilled shaft is exposed, piling is exposed. Major stream erosion behind wingwall that will threaten abutment. Evidence of movement (vertical or rotational) of piers or abutment.

4. Bottom of footer is exposed and not on piling or rock.

**Item 41. Slope Protection**

Examine slope areas directly under bridge ends for erosion, missing stone, broken concrete, etc. If channel extends all the way to the abutments, there is no slope protection to rate. There is usually no slope protection to rate for walled abutment.

<table>
<thead>
<tr>
<th>Usually</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No repairs necessary</td>
</tr>
<tr>
<td>2</td>
<td>Minor erosion or cracked (0&quot; - 6&quot; ruts)</td>
</tr>
<tr>
<td>3</td>
<td>Significant erosion (6&quot; - 2' ruts)</td>
</tr>
<tr>
<td>4</td>
<td>Major erosion, (2' + ruts) footers exposed, concrete riprap collapsing, repairs should be made immediately</td>
</tr>
</tbody>
</table>
**Item 42. Substructure Summary**

This Item includes the physical condition of piers, abutments, piles, fenders, footings, or other components and conditions as a result of scour or collision.

The Inspector should inspect all substructure elements for visible signs of distress which reduce the capacity of these elements to carry the superstructure and live load. Major problems are cracking, section loss, settlement, and misalignment.

Integral abutment wingwalls will be included to the first construction or expansion joint. For non-integral superstructure and substructure units the substructure will be considered as the portion below the bearings. For structures where the substructure and superstructure are integral, the substructure will be considered as the portion below the superstructure.

The superstructure element will not influence the substructure rating when the superstructure and substructure are integral. For example, the deck or superstructure rating of a slab, concrete T-beam, rigid frame, etc. will not influence the substructure rating even though that portion of the deck or superstructure over the columns may be designed as part of the substructure element.

In arriving at the condition rating for the substructure, the condition of the worst substructure unit will dictate the substructure rating.

Comprehensive rehabilitation of substructure units will normally restore the substructure unit to at least a 7 rating.

Rate and code the conditions in accordance with the previously described general condition ratings and the following additional descriptive codes which will be used as a guide in evaluating the substructure condition.

**REINFORCED CONCRETE SUBSTRUCTURE**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable or noteworthy deficiencies which affect the condition of the substructure. Insignificant scrape marks caused by drift or collision.</td>
</tr>
<tr>
<td>8</td>
<td>Minor deficiencies</td>
</tr>
<tr>
<td>7</td>
<td>Some minor problems. Minor cracks</td>
</tr>
</tbody>
</table>
6  Minor cracking or spalls, minor scour damage.
5  Minor cracking, spalling. Moderate scour damage and undermining.
4  Advanced deterioration, spalling, scour. Spalls on beam seats causing reduced bearing area.
3  Deterioration, spalling or scour have seriously affected piers or abutments. Local failures are possible. Shear cracks in concrete may be present. Heavy scour damage, vertical shear crack, with displacement, requires immediate repair.
2  Concrete pier cap is spalling with bottom row of reinforcing steel exposed with no bond to the concrete. Top of pier cap is split or concrete column has undergone shear failure. Scour is sufficient that substructure is near state of collapse. Pier has settled.
1  Bridge closed. Corrective action may put back in light service.
0  Bridge closed. Replacement necessary.

MASONRY SUBSTRUCTURE

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No deficiencies</td>
</tr>
<tr>
<td>8</td>
<td>Minor deficiencies</td>
</tr>
<tr>
<td>7</td>
<td>Some minor problems. Stones intact, isolated locations of shallow mortar deterioration</td>
</tr>
<tr>
<td>6</td>
<td>Stone shows some minor deterioration. Stones intact, extensive areas of shallow mortar deterioration</td>
</tr>
<tr>
<td>5</td>
<td>Stone sound, but may have minor cracking spalling or scour. Minor surface cracking of stones, isolated locations of mortar deterioration.</td>
</tr>
<tr>
<td>4</td>
<td>Advanced deterioration, spalling or scour displaced stones, extensive areas of mortar deterioration.</td>
</tr>
<tr>
<td>3</td>
<td>Some misalignment of mortar joints. Minor bulging. A few stones missing.</td>
</tr>
<tr>
<td>2</td>
<td>Advanced deterioration of stone. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken. Missing</td>
</tr>
</tbody>
</table>
stones, extensive areas of missing mortar. Repair required immediately. Significant misalignment of mortar joints. Evidence of settlement and/or bulging.

1 Bridge closed. Several stones displaced/missing. Significant bulging/settlement.

0 Portions of substructure is collapsed. Bridge is closed.

CULVERT

Culvert type bridges are structures which convey water or form a passageway through an embankment and are designed to support super-imposed loads of earth or other fill material plus a live load. Generally, prefabricated or corrugated metal structures 10' span or greater are considered to be culvert type bridges Masonry arches with integral spandrel walls, sidewalks and railings will not be coded in this section.

Refer to "Culvert Inspection Manual" for further details.

NOTE: Items will not be coded unless the structure is inventoried as "Culvert Type Structure." The second digit of the Bridge Type should be coded "9" (to indicate a culvert) in the heading of the BR-86 Form.

Item 43. General

Check all culvert type bridges for deterioration, settlement open joints, plugging, cracks or signs of movement. If culvert has been extended, code the worst condition or the most predominant.

Item 44. Alignment

Check the alignment of the culvert barrel being especially critical of discontinuities between any adjacent culvert segments.

Item 45. Shape

Generally only used for corrugated metal culverts. Inspect the barrel of the culvert for evidence of flattening, buckling, bulging, out-of-roundness and other signs that the shape is not equal to original design. This can best be done by approaching the culvert from the ends.
and sighting the sides and top. Also check for signs of pavement depression, guardrail movement, gaps between headwalls and pipe barrel. Dimension check should be made for suspect structures.

1 Good Smooth consistent curvature in barrel. No evidence of flattening

2 Fair Minor flattening, bulging

3 Poor Significant bulging

4 Critical Culvert threatening collapse or collapsed

**Item 46. Seams**

For corrugated metal, multi-plate structures only. All bolted splice seams should be checked for loose or missing bolts, cusping at overlap, and tears or cracks in tin at the bolt lines. This inspection will require a flashlight in most cases.

1 Good- All seams tight

2 Fair- Minor seepage around bolts, cusping less than 1/4", minor cracking around bolts, cracks 1/4" or less in length in only one or two plate sections.

3 Poor- Cusping 1/4" or more, cracks less than 1" long in one half of the plates.

4 Critical- Cusping 1/2" or more in many locations, cracks more than 1" long around bolts in many locations.

**NOTE:** Please write in the space provided the size of the gaps or cusps and the number and length of cracks

**Item 47. Headwalls or End Walls**

Headwalls or endwalls are designed to retain the embankment and prevent the water from undermining the culvert ends. Check all headwalls or endwalls for deterioration, settlement, undercutting and signs of failure.
Item 48. Scour

Check for evidence of scour or undermining around footers and at inlet and outlet of culvert.

1  No evidence of scour at either inlet or outlet of culvert.

2  Minor scour holes developing at inlet or outlet (12" or less deep). Damage to scour counter measures. Probing indicates soft material in scour hole.

3  Significant scour holes developing at inlet or outlet (less than 3' deep). Does not appear to be undermining cutoff walls or headwalls. Major stream erosion behind headwall that threatens to undermine culvert.

4  Major scour holes at inlet or outlet (3' or deeper) undermining cutoff walls or headwalls.

Item 50. Culvert Summary

Corrugated Metal Culverts

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>New condition</td>
</tr>
<tr>
<td>8</td>
<td>Good condition</td>
</tr>
<tr>
<td></td>
<td><strong>Shape:</strong> good, smooth curvature in barrel; span dimension within 10 percent of design</td>
</tr>
<tr>
<td></td>
<td><strong>Seams and Joints:</strong> tight, no openings</td>
</tr>
<tr>
<td></td>
<td><strong>Metal:</strong></td>
</tr>
<tr>
<td></td>
<td>- <strong>Aluminum:</strong> superficial corrosion, slight pitting</td>
</tr>
<tr>
<td></td>
<td>- <strong>Steel:</strong> superficial rust, no pitting</td>
</tr>
<tr>
<td>7</td>
<td>Generally good condition</td>
</tr>
<tr>
<td></td>
<td><strong>Shape:</strong> generally good, top half of pipe smooth but minor flattening of bottom; span dimension within 10 percent of design</td>
</tr>
</tbody>
</table>
Seams or Joints: minor joint or seam openings, potential for backfill infiltration

Metal:
- **Aluminum**: moderate corrosion, no attack of core alloy
- **Steel**: moderate rust, slight pitting

6 Fair condition

**Shape**: fair, top half has smooth curvature but bottom half has flattened significantly, span dimension within 10 percent of design.

**Seams or joints**: minor cracking at bolts is prevalent in one seam in lower half of pipe. Evidence of backfill infiltration through seams or joints

Metal:
- **Aluminum**: significant corrosion, minor attack of core alloy
- **Steel**: fairly heavy rust, moderate pitting

5 Generally fair condition

**Shape**: generally fair, significant distortion at isolated locations in top half and extreme flattening of invert, span dimension within 10 to 15 percent greater than design.

**Seams or joints**: moderate cracking at bolt holes along one seam near bottom of pipe, deflection of pipe caused by backfill infiltration through seams or Joints

Metal:
- **Aluminum**: significant corrosion, moderate attack of core alloy
- **Steel**: scattered heavy rust, deep pitting

4 Marginal condition

**Shape**: marginal significant distortion throughout length of pipe, lower third may be kinked, span dimension within 10 percent to 15 percent greater than design, noticeable dip in guardrail over pipe.
Seams or Joints: Moderate cracking at bolt holes on one seam near top of pipe, deflection caused by loss of backfill through open joints.

Metal:
- **Aluminum**: extensive corrosion, significant attack of core alloy
- **Steel**: extensive heavy rust, deep pitting, heavy loss of section, chipping hammer could easily punch a hole thru metal.

3 Poor condition

Shape: poor with extreme deflection at isolated locations, flattening of crown, crown radius 20 to 30 feet, span dimension in excess of 15 percent greater than design

Seams or Joints: 3 inch long cracks at bolt holes on one seam

Metal:
- **Aluminum**: extensive corrosion, attack of core alloy, scattered perforations
- **Steel**: extensive heavy rust, deep pitting, scattered perforations

2 Critical condition

Shape: critical, extreme distortion and deflection throughout pipe flattening of crown, crown radius over 30 feet, span dimension more than 20 percent greater than design

Seams or Joints: plate cracked from bolt to bolt on one seam

Metal:
- **Aluminum**: extensive perforations due to corrosion
- **Steel**: extensive perforations due to rust

1 Critical condition

Shape: partially collapsed with crown in reverse curve
Seams or joints: failed
Road: closed to traffic

0  Critical condition
Pipe: totally failed
Road: closed to traffic

**Corrugated Metal Pipe Arches**

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>New condition</td>
</tr>
<tr>
<td>8</td>
<td>Good condition</td>
</tr>
</tbody>
</table>

*Shape:* good with smooth curvature; span dimension with less than 3 percent greater than design

*Joints or seams:* good condition

*Metal:* minor construction defects, protective coatings intact

- *Aluminum:* superficial corrosion, slight pitting
- *Steel:* superficial rust, no pitting

7  Generally good condition

*Shape:* generally good, smooth curvature in top half, bottom flattened but still curved; span dimension within 3 to 5 percent greater than design

*Joints or seams:* minor joint or seam openings, infiltration of backfill possible

*Metal:

- *Aluminum:* moderate corrosion, no attack of core alloy
- *Steel:* moderate rust, slight pitting
6 Fair condition

Shape: fair, smooth curvature in top half, bottom flat, span dimension within 5 percent greater than design

Joints or seams: minor cracking all along one seam, minor joint openings with evidence of infiltration

Metal:
- Aluminum: significant corrosion, minor attack of core alloy
- Steel: fairly heavy rust, moderate pitting

5 Generally fair condition

Shape: generally fair, significant distortion in top in one location; bottom has slight reverse curvature in one location

Joints and seams: moderate cracking at bolt holes along a seam in one section, backfill being lost through seam or joint causing slight deflection

Metal:
- Aluminum: significant corrosion, moderate attack of core alloy
- Steel: scattered heavy rust, deep pitting

4 Marginal condition

Shape: marginal, significant distortion all along top of arch, bottom has reverse curve; span dimension more than 7 percent greater than design, noticeable dip in guardrail over pipe.

Joints and seams: moderate cracking all along one seam; backfill infiltration causing major deflection

Metal:
- Aluminum: extensive corrosion, significant attack of core alloy
Steel: extensive heavy rust, deep pitting, heavy loss of section, chipping hammer could easily punch a hole thru metal.

3 Poor condition

Shape: poor, extreme deflection in top arch in one section; bottom has reverse curvature throughout; span dimension more than 7 percent greater than design

Seams: seam cracked 3 in. on each side of bolt holes

Metal:

- Aluminum: extensive corrosion, attack of core alloy, scattered perforations
- Steel: extensive heavy rust, deep pitting, scattered perforations

2 Critical condition

Shape: critical, extreme deflection along top of pipe; span dimension more than 7 percent greater than design

Seams or joints: seam cracked from bolt to bolt down one seam

Metal:

- Aluminum: extensive perforations due to corrosion
- Steel: extensive perforations due to rust

1 Critical condition

Shape: structure partially collapsed

Seams or joints: seam failed

Road: closed to traffic
Critical condition

**Shape:** structure collapsed

**Road:** closed to traffic

**Precast Concrete Culverts**

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>New condition</td>
</tr>
<tr>
<td>8</td>
<td>Good condition</td>
</tr>
</tbody>
</table>

**Alignment:** good, no settlement or misalignment

**Joints:** tight with no defects apparent

**Concrete:** no cracking, spalling, or scaling present; surface in good condition

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Generally good condition</td>
</tr>
</tbody>
</table>

**Alignment:** generally good; minor misalignment at joints; no settlement

**Joints:** minor openings, possible infiltration or exfiltration

**Concrete:** minor hairline cracking at isolated locations; slight spalling or scaling present on invert

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Fair condition</td>
</tr>
</tbody>
</table>

**Alignment:** fair, minor misalignment and settlement at isolated locations

**Joints:** minor backfill infiltration due to slight opening at joints; minor cracking or spalling at joints allowing exfiltration

**Concrete:** extensive hairline cracks, some with minor delamination or spalling; invert scaling less than 0.25 in. deep or small spalls present
Generally fair condition

Alignment: generally fair; minor misalignment or settlement throughout pipe; possible piping

Joints: open and allowing backfill to infiltrate; significant cracking or joint spalling

Concrete: cracking open greater than 0.12 in. with moderate delamination and moderate spalling exposing reinforcing steel at isolated locations; large areas of invert with surface scaling or spalls greater than 0.25 in. deep

Marginal condition

Alignment: marginal, significant settlement and misalignment of pipe; evidence of piping, end sections dislocated about to drop off

Joints: differential movement and separation of joints, significant infiltration or exfiltration at joints

Concrete: cracks open more than 0.12 in. with efflorescence and spalling at numerous locations; extensive surface scaling on invert greater than 0.5 in.

Poor condition

Alignment: poor with significant ponding of water due to sagging or misalignment of pipes; end section drop off has occurred

Joints: significant openings, dislocated joints in several locations exposing fill material; infiltration or exfiltration causing misalignment of pipe and settlement or depressions in roadway

Concrete: extensive cracking, spalling, and minor slabbing; invert scaling has exposed reinforcing steel

Critical condition

Alignment: critical; culvert not functioning due to alignment problems throughout

Concrete: severe slabbing has occurred in culvert wall, invert concrete completely deteriorated in isolated locations
1  Critical condition
   Culvert: partially collapsed
   Road: closed to traffic
0  Critical condition
   Culvert: total failure of culvert and fill
   Road: closed to traffic

Cast-in-Place Culverts

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>New condition</td>
</tr>
<tr>
<td>8</td>
<td>Good condition</td>
</tr>
<tr>
<td></td>
<td>Alignment: good, no settlement or misalignment</td>
</tr>
<tr>
<td></td>
<td>Joints: tight with no defects apparent</td>
</tr>
<tr>
<td></td>
<td>Concrete: no cracking, spalling, or scaling present; surface in good condition</td>
</tr>
<tr>
<td></td>
<td>Footings: good with no invert scour</td>
</tr>
<tr>
<td>7</td>
<td>Generally good condition</td>
</tr>
<tr>
<td></td>
<td>Alignment: generally good; minor misalignment at joints; no settlement</td>
</tr>
<tr>
<td></td>
<td>Joints: joint material deteriorated at isolated locations</td>
</tr>
<tr>
<td></td>
<td>Concrete: minor hairline cracking at isolated locations; slight spalling or scaling present on invert or bottom of top slab</td>
</tr>
<tr>
<td></td>
<td>Footings: good with only minor invert scour</td>
</tr>
<tr>
<td>6</td>
<td>Fair condition</td>
</tr>
<tr>
<td></td>
<td>Alignment: fair, minor misalignment and settlement at isolated locations</td>
</tr>
</tbody>
</table>
Joints: joint material generally deteriorated, minor separation, possible infiltration or exfiltration; minor cracking or spalling at joints allowing exfiltration

Concrete: extensive hairline cracks, some with minor delaminations; scaling less than 0.25 in. deep or small spalls present on invert or bottom of top slab

Footings: minor scour near footings

5 Generally fair condition

Alignment: generally fair; minor misalignment or settlement; possible piping

Joints: open and allowing backfill to infiltrate; significant cracking or spalling at joints

Concrete: cracking open greater than 0.12 in.; significant delamination and moderate spalling exposing reinforcing steel; large areas of surface scaling greater than 0.25 in. deep

Footings: moderate scour along footing; protective measures may be required

4 Marginal condition

Alignment: marginal; significant settlement and misalignment; evidence of piping

Joints: differential movement and separation of joints, significant infiltration or exfiltration at joints

Concrete: extensive cracking with cracks open more than 0.12 in. with efflorescence; spalling has caused exposure of rebars which are heavily corroded; extensive surface scaling on invert greater than 0.5 in.

Footings: scour along footing with slight undermining, protection required

3 Poor condition

Alignment: poor with significant ponding of water due to sagging or misalignment of pipes; end section drop off has occurred
**Joints:** significant openings and differential amount; infiltration or exfiltration causing misalignment of culvert and settlement or depressions in roadway

**Concrete:** extensive cracking with spalling, delaminations, and slight differential movement; scaling has exposed reinforcing steel in bottom to top slab or invert

**Footings:** severe undermining with slight differential settlement causing minor cracking or spalling in footing and walls

---

**2 Critical condition**

**Alignment:** critical; culvert not functioning due to severe misalignment

**Concrete:** severe cracks with significant differential movement; concrete completely deteriorated in isolated locations in top slab or invert

**Footings:** severe undermining with significant differential settlement causing severe cracks

---

**1 Critical condition**

**Culvert:** partially collapsed

**Road:** closed to traffic

**Footings:** severe undermining resulting in partial collapse of structure

---

**0 Critical condition**

**Culvert:** total failure of culvert and fill

**Road:** closed to traffic

---

**Stone Culverts**

<table>
<thead>
<tr>
<th>Code</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>New condition</td>
</tr>
</tbody>
</table>

64
8  Good condition

**Alignment:** good, no settlement or misalignment

**Mortar:** tight with no defects apparent

**Masonry:** no cracking, no missing dislocated masonry present; surface in good condition

**Footings:** good with no invert scour

7  Generally good condition

**Alignment:** generally good; minor misalignment at joints; no settlement

**Mortar:** willow mortar deterioration at isolated locations

**Masonry:** surface deterioration at isolated locations

**Footings:** good with only minor invert scour

6  Fair condition

**Alignment:** fair, minor misalignment or settlement

**Mortar:** extensive areas of willow deterioration; missing mortar at isolated locations; possible infiltration or exfiltration; minor cracking

**Masonry:** minor cracking of masonry units

**Footings:** minor scour near footings

5  Generally fair condition

**Alignment:** generally fair; minor misalignment or settlement

**Mortar:** mortar generally deteriorated, loose or missing mortar at isolated locations, infiltration staining apparent

**Masonry:** minor cracking; slight dislocation of masonry units; large areas of surface scaling
Footings: moderate scour along footing; protective measures may be required

4 Marginal condition

Alignment: marginal; significant settlement and misalignment

Mortar: mortar severely deteriorated, significant loss of mortar, significant infiltration or exfiltration between masonry units

Masonry: significant displacement of individual masonry units

Footings: scour along footing with slight undermining, protection required

3 Poor condition

Alignment: poor with significant ponding of water due to sagging or misaligned pipes; end section drop off has occurred

Mortar: extensive areas of missing mortar; infiltration or exfiltration causing misalignment of culvert and settlement or depressions in roadway

Masonry: individual masonry units in lower part of structure missing, or crushed

Footings: severe undermining with slight differential settlement causing minor cracking or spalling of footing and minor distress in walls

2 Critical condition

Alignment: critical; culvert not functioning due to severe misalignment

Masonry: individual masonry units in top of culvert missing or crushed

Footings: severe undermining with significant differential settlement causing severe cracks in footing and distress in walls

1 Critical condition

Culvert: partially collapsed

Road: closed to traffic
Footings: severe undermining resulting in partial collapse of structure

Critical condition

Culvert: total failure of culvert and fill

Road: closed to traffic

CHANNEL

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, and slope protection. Be particularly concerned with visible signs of excessive water velocity which may affect undermining of slope protection or footings, 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 and included in the condition rating.

Item 51. Alignment

The channel should align with and cause the stream to flow under the center of the structure. The channel banks should be parallel with the substructure, such as piers and abutments.

1. Channel has straight alignment for more than 100 feet upstream.

2. Flows thru 1 out of 2 pipes; Flows along one abut. Doesn’t flow under center of the bridge; minor curve (20°-40° angle); Splits into 2 or more small channels; Flows diagonally under the bridge.

3. Flows into abutment causing erosion (50°-70° angle); No flow in center span.

4. 80°-90° turn at the bridge; Erosion behind wingwall caused by channel flow.

Item 52. Protection

The method, if any, used to protect the bridge and the upstream channel banks from scour and other degradation caused by the stream action. Note and rate the condition of all channel protection and spur dikes. Vegetation is a form of channel protection.
1. No noteworthy deficiencies which affect the condition of the channel protection 100 feet upstream.

2. Bank is beginning to slump; There is minor stream bed movement evident. Several groundhog holes; most of stone has washed away; Minor erosion. Broken up concrete channel protection at inlet of a culvert.

3. Channel protection is severely undermined; Stone is completely washed away; Major erosion; Failed concrete channel protection at inlet of a culvert.

4. Channel protection has failed; channel has moved to where the bridge and approach roadway are threatened.

Item 53. Waterway Adequacy

Scour and stream bed degradation are actually the result of inadequate waterway areas. The geometry of the channel, the amount of debris carried during high water periods, and the adequacy of freeboard should be considered in determining waterway adequacy. Where large quantities of debris and ice are expected, sufficient freeboard is of the greatest importance. Check for scour of stream beds and banks, sandbars or debris which could change the direction of flow, or other obstructions which could influence the adequacy of the waterway. Accumulation of drift and debris on the superstructure and substructure should be noted on the inspection form and included in the condition rating.

Condition Codes

1. No restriction of flow thru the channel.

2. Silt and Gravel buildup causing flow thru one of 2 pipes; Silt and Gravel buildup restricts half of the channel; Tree or bush growing in the channel; Cattle fence attached to bridge; Rock dam under bridge.

3. Occasional over topping of bridge deck and roadway approaches with significant traffic delays; Debris caught in cross frames.

4. Frequent overtopping of bridge deck and roadway approaches with significant traffic delays.
Culverts:

1. Culvert waterway blockage is less than or equal to 5% of the cross sectional area.
2. Culvert waterway blockage is greater than 5% and less than or equal to 40%.
3. Culvert waterway blockage is greater than 40% and less than or equal to 80%.
4. Culvert waterway blockage is greater than 80%.

**Item 54. Channel Summary**

The following descriptive codes will be used a guide in evaluating the condition of the channel and channel protection.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<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 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 waterway.</td>
</tr>
</tbody>
</table>
3 Bank protection has failed. River control devices have been destroyed. Streambed degradation or lateral movement has changed the waterway to now threaten the bridge and/or approach roadway.

2 The waterway has changed to the extent the bridge is near a state of collapse.

1 Bridge closed because of channel failure. Corrective action may put back in light service.

0 Bridge closed because of channel failure. Replacement necessary.

Channels should be examined to determine whether any condition exists that could in any way cause damage to the bridge, embankment or other areas surrounding the bridge. Note the alignment, protection and adequacy of all waterways.

**APPROACHES**

A smooth transition between the roadway pavement and the bridge deck is important for the reduction of impact forces acting upon the bridge and for driving safety. A difference in elevation between the bridge deck and the approach pavement increases impact and vibration as the vehicle reaches the bridge. Rough approaches will also cause vibration in the vehicle, which in turn, transmits added vibration to the bridge.

**Item 55. Pavement**

Note and rate the condition of the approach pavement.

**Item 56. Approach Slabs**

Note and rate the condition, settlement or other signs of failure of the approach slab.

1 Approach slabs in excellent conditions, no repairs necessary.

2 Slabs may be cracked, minor spalls, but not settled.

3 Some settlement of the approach slab ends (no more than 1"); still flush with top of backwall.
4. Major settlement of approach slab ends (more than 1") or pulled away from backwall and dropped down more than 1".

**Item 57. Guardrail**

Note the condition of the approach guardrail. Check for integrity of posts and condition of the rail panels.

1. No noteworthy deficiencies which affect the condition of the guardrail 100 feet from the end of the bridge.

2. Minor collision damage; minor decay of posts; Guardrail is noticeably higher or lower than the standard 27 inches; Guardrail panels are very rusty; Several blockouts are missing.

3. Major collision damage; 50% loss of section of posts due to decay; Several guardrail panels are not attached to posts; Poor attachment to the end of the bridge causing a snag point; Poor installation of guardrail end assembly.

4. Guardrail is no longer functioning; Major decay of post (90%)

**Item 58. Relief Joints**

Relief joints are transverse openings in concrete pavements which are filled with asphalt concrete or other compressible material. These joints are placed in the vicinity of bridges to help alleviate the pressure on backwalls caused by pavement expansion in the summer months. Determine the presence of and rate the condition of these joints.

**Item 59. Embankment**

Note the general condition of the approach embankment for indications of settlement, bulging, stream scour and saturation from entrapped water.

1. No noteworthy deficiencies which affect the condition of the embankment up to 100 feet away from the bridge.

2. Minor erosion caused by drainage; Several groundhog holes.
3. Major erosion caused by drainage or channel; Evidence of foundation settlement; Loss of edge of pavement due to poor compaction of embankment.

4. A lane of traffic is closed due to embankment failure; Several guardrail posts are hanging due to major channel erosion.

Item 60. Approaches Summary

The condition of the approaches will be summarized by the Inspector or the reviewer.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>No noticeable defects</td>
</tr>
<tr>
<td>8</td>
<td>Hairline cracks in pavement. Minor scaling.</td>
</tr>
<tr>
<td>7</td>
<td>Minor problems. Very small potholes, no settlement.</td>
</tr>
<tr>
<td>6</td>
<td>Minor pavement deterioration, minor potholes, cracking or minor settlement</td>
</tr>
<tr>
<td>5</td>
<td>Minor cracking, spalling. Moderate potholes, cracking, with settlement and misalignment.</td>
</tr>
<tr>
<td>4</td>
<td>Broken pavement with settlement and misalignment.</td>
</tr>
<tr>
<td>3</td>
<td>Major potholes and settlement. Repairs required immediately.</td>
</tr>
<tr>
<td>2</td>
<td>Significant pavement settlement/cracking. Embankment washed out next to pavement.</td>
</tr>
<tr>
<td>1</td>
<td>Road Closed. Impending pavement and/or embankment failure</td>
</tr>
<tr>
<td>0</td>
<td>Road closed. Embankment and/or pavement failed, impassable.</td>
</tr>
</tbody>
</table>
GENERAL

Items in this section are of a general nature and do not relate to specific bridge elements.

Item 61. Navigation Lights

Determine whether all required navigation lights are operating and properly located. Examine the lighting fixtures for condition, visibility, electrical connections and security of attachment to insure uninterrupted service.

1. All lights operating, no repairs necessary to system
2. All lights operating, however, mounting brackets may need attention or wiring conduit may be partially disconnected
3. All lights operating, however lenses may be broken
4. Some lights burnt out or wiring circuitry non-functioning or both

Item 62. Warning Signs

All signs which advise the traveling public of restricted load limits, restricted width, restricted vertical clearance and reduced speed limits are to be inspected for legibility and condition, including any advance warning signs. Notations should be made on back side of BR-86 as to required signs which are missing or are in need of replacement due to damage or weathering.

1. All signs proper and legible.
2. Signs faded, bent, minor damage
3. Signs barely legible due to vandalism or fading
4. Signs missing or not legible

Item 63. Sign Supports

All bridge mounted traffic sign supports will be inspected for deterioration and security of connection.
The sign inspections will be primarily visual in NDT being required only if a defect is first noted visually. The inspections should concentrate primarily on the sign support anchor bolts. The attachments for signs attached to the outside of parapets should also be inspected for integrity including vibration, cracks, loose nuts or missing nuts. Attachments or connections not easily accessible within "arm's reach" should be "eyeballed" or inspected with binoculars from the bridge deck. It is not expected that the Inspector climb the sign supports to perform the inspection. Any defects noted as a result of the above-noted actions should be immediately reported to the Traffic Department so that a more In-Depth inspection can be performed by appropriate personnel with the use of their bucket truck.

**Item 64. Utilities**

All bridge mounted utility supports for gas, electric, water, telephone, lighting, etc. will be inspected for deterioration and security of connection. Additionally, the utilities themselves should be inspected for deterioration, loose connections, bare wires, etc. Any defects noted should be reported to the appropriate utility owner. The Inspector should compare the utilities on the bridge with the pre-printed inventory information and if changes are necessary, the inventory should be changed after returning to the office.

**Item 65. Vertical Clearance**

Indicate if a vertical clearance restriction exists for vehicular traffic which passes either on or below the bridge using the following codes:

1. A restriction exists above or below the bridge. (25' or less)
2. The restriction changed since the last inspection. (Due to changed conditions such as resurfacing).

N  Does not apply to this bridge.

A check should also be made to determine if the necessary signing is in place for structures with 13'-6" vertical clearance or less.

**Item 66. General Appraisal and Operational Status**

This is a two part item. The first box is for coding the general, overall condition of the bridge. The second box is for coding the operational status of the bridge. The general appraisal will be based on the existing condition of the bridge as compared to its as-built
condition. The load carrying capacity will not be used in evaluating condition items. The fact a bridge was designed for less than current legal loads and may be posted, will have no influence upon condition ratings.

The determination of which code applies to each of the items will be based on evaluation of all relevant factors and information. When rating an item, it is not necessary that all listed conditions be met to arrive at a numerical rating. It is recognized that there are unique situations where judgment will be required.

Portions of bridges that are being supported or strengthened by temporary members will be rated based on their actual condition, i.e. the temporary members are not considered in the rating of the item.

This rating is the same as the lowest rating of either the Superstructure Summary (Item 32), or the Substructure Summary (Item 42).

A bridge with more than 3 steel plates covering large full depth holes in a deck would be a rare example where the deck summary could influence the general appraisal.

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>As built 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, or spalling. Secondary elements may have significant deterioration.</td>
</tr>
<tr>
<td>4</td>
<td>Poor condition - advanced section loss, deterioration, or spalling.</td>
</tr>
<tr>
<td>3</td>
<td>Serious condition - loss of section, deterioration, or spalling have seriously affected primary structural components. Local failures or cracks in concrete or both may be present.</td>
</tr>
</tbody>
</table>
Critical condition - advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present. Bridge should be closed or closely monitored, until corrective action is taken.

"Imminent" failure condition - major deterioration or section loss present structural components. Bridge is closed to traffic but corrective action may put back in light service.

Failed condition - out of service - beyond corrective action.

The operational status of the bridge should be coded using the following:

"A"  Open, no restriction

"B"  Open, posting recommended but not legally implemented (all signs not in place)

"D"  Open, would be posted or closed except for temporary shoring, etc. to allow for unrestricted traffic

"E"  Open, temporary structure in place to carry legal loads while original structure is closed and awaiting replacement or rehabilitation.

"G"  New structure not yet open to traffic

"K"  Bridge closed to all traffic

"P"  Posted for load-carrying capacity restriction (may include other restrictions)

"R"  Posted for other than load-carrying capacity restriction (speed, number of vehicles on bridge, etc.).

"X"  Bridge closed for reasons other than condition or load-carrying capacity.
Item 67. Inspected By

The inspector is to sign the inspection report and code the date of the inspection along with first, middle and last initials in the appropriate boxes. The Inspector will also type or print their name directly under the signature.

Item 68. Reviewed By

The reviewer of the report is to sign the report and code the date along with his first, middle, and last initials in the appropriate boxes. A reviewer's signature is not required if the inspector is a registered professional engineer. The reviewer must be a professional engineer registered in the State of Ohio if the inspector is not. The signature should be followed by a "P E" in the two boxes to indicate that the reviewer (or inspector) is a registered professional engineer. In cases where the inspection is performed by a consultant, the report should contain a signature along with the firm's name. The reviewed date must always be subsequent to the inspected date.

Item 69. Survey

These eight boxes are currently being used to gather data which relates to the traffic safety features of the bridge. All eight boxes must be filled in for this survey to be valid.

The codes to be used are:

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Inspected feature does not meet currently acceptable standards.* Code &quot;O&quot; for a condition where guardrail is required and none is provided.</td>
</tr>
<tr>
<td>1</td>
<td>Inspected feature meets currently acceptable standards.*</td>
</tr>
<tr>
<td>N</td>
<td>Not applicable.</td>
</tr>
</tbody>
</table>

*Until a national set of standards is approved, it will be the responsibility of the inspecting authority to determine what are acceptable standards and what are not.
Box No. Meaning

(1) Bridge railings: Some factors that affect the proper functioning of bridge railing are height, material, strength, and geometric features. Railings must be capable of smoothly redirecting an impacting vehicle. Bridge railings should be evaluated using the AASHTO "Standard Specifications for Highway Bridges" as a guide for establishing a currently acceptable standard. Bridge on the national Highway system should be crash tested per FHWA policy and meet NCHRP 350 acceptance criteria.

Bridge railings which are typically considered to be acceptable on Ohio bridges are:

- Reinforced concrete deflective parapet as per Standard Drawing BR-1.

- Deep beam guardrail with steel tubular backup mounted on W6 x 25 steel posts as per Standard Drawing DBR-2-73.

- Double aluminum tubes/posts mounted on concrete parapets on bridges with sidewalks inside municipalities on streets with curbs and gutters, as per Standard Drawing BR-2-82. NOTE: Railing consisting of concrete safety curbs and parapets topped with aluminum railing (Standard Drawing AR-1-57) are considered acceptable. Some large trusses as well as culvert type bridges, have been retrofitted with singular or multiple steel tubes which were specifically designed for the particular application and as such are considered to be acceptable.

(2) Transitions: The transition from approach rail to bridge railing requires that the approach rail be firmly attached to the bridge railing. It also requires that the approach railing be gradually stiffened as it comes close to the bridge railing. The ends of curbs and safety walks need to be gradually tapered out or shielded.

Transitions which are typically considered to be acceptable on Ohio bridges are:

- A nested thrie beam rigidly fastened to a thickened deflective parapet as detailed on Standard Drawing GR 3.1 is the current standard.

- Bridge terminal assembly consisting of Type 5 guardrail rigidly attached to concrete deflective parapet (unthickened) with lower section of rub rail as per Standard Drawing GR-3 has been superseded by GR 3.1, but still is considered to be acceptable for existing bridges.
-Bridge terminal assemblies as detailed on Standard Drawing GR-3A and GR-3B are still considered to be acceptable on existing bridges.

-For bridges with deep beam guardrail across the bridge, Standard Drawings GR-3, GR-3.3 and GR-3.4 depict acceptable transitions.

-Other transitions may be acceptable providing they fulfill the requirements noted in paragraph (2).

(3) Approach guardrail: The structural adequacy and compatibility of approach guardrail with transition designs should be determined. A barrier stop at the end of a bridge is rarely needed. Thus an approach guardrail with adequate length and structural qualities to shield motorists from the hazards at a bridge site needs to be installed. In addition to being capable of safely redirecting an impacting vehicle, the approach rail must also facilitate a transition to the bridge railing that will not cause snagging or pocketing of an impacted vehicle. Acceptable guardrail design suggestions are contained in the AASHTO Guide for Selecting, Locating, and Designing Traffic Barriers.

Typical acceptable guardrails are:

-Type 5 guardrail consisting of deep beam guardrail blocked out and mounted on posts at 6' 3" centers. (See Standard Drawing GR-2.1).

-Deep beam guardrail with no blockouts mounted on posts at 12'-6" centers (see Standard Drawings GR-2C, GR-2A, GR-2.3) for roads where traffic counts less than 400 VPD.

-Wire rope and steel ribbon rail are not considered acceptable as guardrail approaching bridges.

(4) Approach rail ends: As with guardrail ends in general, the ends of approach rails to bridges should be flared, buried, made breakaway, or shielded. Design treatment of guardrail ends is given in the AASHTO Guide for Selecting, Locating, and Designing Traffic Barriers.
(5) Pavement Marking: At or on the structure - centerline or lane lines, edge lines for structure with berm. See Ohio Manual of Uniform Traffic Control Devices (OMUTCD).

(6) Restriction Signing: Regulatory signing such as load limit or spacing. See OMUTCD

(7) Warning Signing: Narrow bridge. One lane, Vertical Clearance. See OMUTCD

(8) Bridge End Markers: Delineation at ends of structure for narrow structures. See OMUTCD

The data collected will apply only to the route on the bridge. Collision damage or deterioration of the elements are not considered when coding this item.

SUSPENSION BRIDGES

If inspecting a suspension or moveable bridge, two forms must be used. The applicable Items on the standard BR-86 form are to be filled out as well as the supplemental form (see appendix). For copies of the supplemental form, please contact the District Bridge Engineer.

Item 68. Main Cables

The large cables or eyebar chains which are draped over the towers and bent posts and from which the superstructure is suspended form make up the main cables. Check these cables for evidence of broken wires and leakage from within. Occasionally (once every 10 years) portions of the main cables should be unwrapped and checked for the above noted deficiencies as well as general condition (paint, rust, etc.).

Item 69. Suspenders

The generally vertical wire cables, metal rods or bars designed to engage a cable band or other device connecting them to the main suspension cable at one end and to the suspended superstructure at the other end, thus permitting them to assist in supporting the bridge floor system and it’s superimposed loads by transferring loads to the main suspension members of the structure.

A member serving to support another member in a vertical or an inclined position against sagging, twisting, or other deformation due to its own weight.

Check for worn or broken wires and relative tension in adjacent suspenders.
Item 70. Cable Bands

The clamps around the main cables over which the suspenders are looped. Check for missing bolts, looseness of band, evidence of downhill slippage, lack of caulking between bands and main cables, and rotation of band on the main cable.

Item 71. Suspender Connections

The suspender ends or sockets which are attached to the superstructure. Look for evidence of disintegrated or frayed wires at the sockets. Also check the integrity of the bracket which is attached to the superstructure.

Be particularly cognizant of debris and rust-through of any connections in the splash zone.

Item 72. Towers

A large pier or frame extending well above the roadway and serving to support the cables or chains of a suspension type bridge at the ends of the main span.

Check the base connections for integrity. Carefully check all areas subject to drainage and splash.

Item 73. Tower Saddles

The saddles at the top of the towers in which the main cables rest. Check for evidence of movement of the main cable within the saddle and proper caulking.

Item 74. Bent Posts

The shorter towers at the ends of the bridge which support the main cable or chain. Generally, the cable or chain is nearly horizontal at this point and then abruptly changes direction and goes immediately down to the anchorages.

Check for evidence of movement, deterioration in the splash zone, and integrity of the base connections.
Item 75. Anchorage

The point at which the cable or chain terminates in the foundation. Check for broken and rusted wires where they are splayed and looped around pins and eyebars. Also check eyebars for section loss where they are embedded in the concrete. Check for unusual dampness or standing water.

Item 77. Summary

See General Appraisal Codes

MOVABLE BRIDGES

Items 78. - 99.


Item 78. Gears - Check for misalignment; tooth wear; evidence of lubrication.

Item 79. Shafts - Check for wear; vibration; cracks.

Item 80. Bearings - Check for evidence of wear; vibration; adequate lubrication.

Item 81. Electric Motors - Make continuity/resistance tests.

Item 82. Auxiliary Engines - Check for ease of starting; lubrication.

Item 83. Center Locks - Check for proper engagement, lubrication, wear, cracks.

Item 84. Tail Locks - Check for proper engagement, lubrication, wear, cracks.

Item 85. Reducers - Check for lubrication, gear alignment, tooth wear.

Item 86. Couplings - Check for tightness.

Item 87. Wire Ropes - Check for broken or frayed ropes.

Item 88. Sockets - Check for evidence of slippage; corrosion of wire rope where it enters socket.
Item 89. Span Balance - Check for smoothness of operation, excessive impact upon closure.

Item 90. Buffers - Check for proper operation, excessive wear, fluid leakage.

Item 91. Brakes - Check for wear.

Item 92. Transformers - Check for leakage; make appropriate electrical tests.

Item 93. Circuit Breakers - Test for proper operation.

Item 94. Limit Switches - Test for proper operation.

Item 95. Traffic Gates/Lights - Check operation, visibility, damage, wear.

Item 96. Lubrication - Check for evidence of proper lubrication, presence of dirt in grease.

Item 97. General Operation - Check for smoothness of operation, housekeeping.

Item 99. Summary

MISCELLANEOUS ADDITIONAL INFORMATION FOR CODING THE BR-86 FORM

Do not enter more than one character in any coding box. The condition code should be selected which indicates the "most representative" or "least adequate" condition. See individual item descriptions for specific instructions. The "X" code is not allowed in any condition box. Send in original reports only. The copies should be kept in the District file or the County office. Always use the preprinted forms, not hand written ones, to assure accuracy of the bridge information year after year. The only exceptions for using blank BR-86's are

1) Newly inventoried bridges (inspections which are submitted at the same time as the corresponding BR-87 or bridges which were filed after the time of printing of the preprinted BR-86 Forms).

2) Critical condition bridges which need to be inspected more than once a year.
If a pre-printed BR-86 is received for a bridge that has been replaced, destroy the pre-printed BR-86 and fill out a blank BR-86. In this instance, the old bridge must have already been retired and a new BR-87 submitted for the new bridge, as described in the Bridge Inventory and Appraisal Coding Guide.

An inventory sheet (BR-87) must always be on file for a particular bridge before the corresponding inspection report BR-86 can be accepted.

For non-culvert type bridges, all applicable Summary Items must be filled in (except Item 50) in order to generate a sufficiency rating for the bridge.

For culvert type bridges, only Summary Items 50, 54, 60 and 64 must be filled in to obtain a sufficiency rating.