KYTC Staff
4-24-17

Kentucky Bridge Inspection Procedures Manual

Due to the constant demands on Kentucky's bridge inspection program and, thus, the need to make revisions to maintain the highest standards with our bridge inspection program please use the link in BrM for the most current version of this manual.

000 – Table of Contents

100 – Introduction

This manual has been prepared by the Kentucky Transportation Cabinet, Division of Maintenance, Bridge Preservation Branch to outline the general practices and procedures which are used to inspect and evaluate bridges in this state. This manual has been written to explain, in a simple manner, the reference materials, regulations and instructions which govern the inspection, data collection, and documentation of bridge information. The goals of this manual are:

1. To provide, in one source, KYTC's general procedures concerning the different bridge inspections preformed, bridge condition evaluations for structural capacity and for screening and evaluating bridges for potential scour vulnerability.

2. To provide a basis for uniformity between KYTC Districts in performing and reporting bridge inspections.

3. To provide a basis for uniform application of procedures between KYTC and the Federal Highway Administration with regard to bridge management system activities.

The Division of Maintenance, Bridge Preservation Branch, is physically located on the Third Floor of the Transportation Cabinet Office Building at 200 Mero Street in Frankfort, Kentucky 40622. The telephone number is (502) 564-4556.

Design of Manual

Highlighted text still needs attention. Proposed changed should be directed to the Chief Bridge Inspection Engineer or Chief Bridge Inspector in Central Office to be considered for inclusion in the next version of the manual.

The most current version of the manual will be available on N:BRMAINT\Manuals. Revisions will be posted there and emailed as they occur.

Abbreviations

The following abbreviations, when used in this Manual, represent the full text shown.

AASHTO	American Association of State Highway and Transportation Officials
ADEs	Agency-Developed Elements
ADT	Average Daily Traffic
AISC	American Institute of Steel Construction
ASCE	American Society of Civil Engineers
ASD/ASR	Allowable Stress Design/Rating
AWS	American Welding Society
BMS	Bridge Management System
BMEs	Bridge Management Elements
BrM	AASHTOWARE BRIDGE MANAGEMENT
CBMNIR	Critical Bridge Maintenance Needs Inspection Report
DBE	District Bridge Engineer
FC	Fracture Critical
FHWA	Federal Highway Administration
FOG	Field Operations Guide
KYTC	Kentucky Transportation Cabinet
LARS	Load Analysis and Rating System
LFD/LFR	Load Factor Design/Rating
LRFD/LRFR	Load & Resistance Factor Design/Rating
MBEI	AASHTO Manual for Bridge Element Inspection
MSE	Mechanically Stabilized Earth
NBEs	National Bridge Elements
NBI	National Bridge Inventory
NBIS	National Bridge Inspection Standards
NHI	National Highway Institute
OSHA	Occupational Safety and Health Administration
PCIB	Prestressed Concrete I Beam
PPCDU	Precast Prestressed Concrete Deck Unit
QA/QC	Quality Assurance/Quality Control
RCBC	Reinforced Concrete Box Culvert
RCDG	Reinforced Concrete Deck Girder
RSPG	Riveted Steel Plate Girder
SIA	Structure Inventory and Appraisal
USCG	United States Coast Guard
USGS	United States Geologic Survey
WSPG	Welded Steel Plate Girder

References & Standards

All highway bridge inspections shall comply with the specifications contained in:

- The National Bridge Inspection Standards, 2004
- AASHTO's The Manual for Bridge Element Inspection, 1st Edition/2013 and 2015 Interim
- FHWA's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nations Bridges, 1995, Report No. FHWA-PD-96-001, "The Coding Guide"
- Occupational Safety and Health Standards as promulgated by the Occupational Safety and Health Administration
- Field Operations Guide

Additional References:

- FHWA's Bridge Inspector's Reference Manual, 2006
- AASHTO's Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges, 1st Edition and 2005 Interim
- AASHTO's Standard Specifications for Highway Bridges, 17th Edition with addenda, 2002
- AASHTO LRFD Bridge Design Specifications, 5th Edition and 2010 Interims
- Inspection of Fracture Critical Bridge Members. See FHWA No. 03-001: Bridge Inspector's Reference Manual (Section 8), December 2006
- Underwater Inspection of Bridges. See ASCE Manuals and Reports on Engineering Practice No. 101 called Underwater Investigations Standard Practice Manual, 1982
- U.S. Forest Service: Timber Bridges - Design, Construction, Inspection, and Maintenance, 1990
- FHWA NHI – 01-001 - Hydraulic Engineering Circular No. 18, Evaluating Scour at Bridges, Fourth Edition, 2001
- FHWA NHI – 01-001 - Hydraulic Engineering Circular No. 20, Stream Stability at Highway Structures, Third Edition, 2001

Electronic sources:

- N:\BRMAINT
- N:\Bridge Scans – scanned bridge plans
- Planning maps: http://transportation.ky.gov/Maps/Pages/default.aspx
  - Truck Weights: http://transportation.ky.gov/Planning/Pages/Truck-Weight-Classification.aspx
- Planning Reports:
  - Extended Weights: http://apps.transportation.ky.gov/His_EWBridge/
  - Route Log: http://apps.transportation.ky.gov/DMI_Reports/
  - Coal Haul: http://transportation.ky.gov/Planning/Pages/Coal-Haul.aspx
- BrM: http://brm.kytc.ky.gov/BrM521/
- FTP site: https://ftp.ky.gov
- LARS permanent file
- Division of Structural Design archives (H&J)
- FOG Manual: http://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/Field%20Operations%20Guide.pdf

- Maintenance Guidance Manual: http://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/Maintenance.pdf
- Standard Drawings: http://transportation.ky.gov/highway-design/pages/standard-drawings.aspx
- KY OSHA: https://www.osha.gov/dcsp/osp/stateprogs/kentucky.html

Background

On December 15, 1967, the 2,235-foot Silver Bridge, at Point Pleasant, West Virginia, collapsed into the Ohio River. At the time of collapse, the bridge was loaded with vehicles stopped by a traffic light. Forty six people were killed. This tragic event aroused national interest in the safety inspection and maintenance of highway bridges.

The "Federal Highway Act of 1968" included a section which required the Secretary of Transportation to establish national bridge inspection standards and develop a program to train bridge inspectors.

Published in 1971 and revised in 1979, 1988 and 2004, Title 23, Code of Federal Regulations, Part 650, Subpart C sets forth the National Bridge Inspection Standards for bridges on public roads. NBIS defines bridges, specifies inspection procedures and frequencies, and indicates minimum qualifications for personnel. Reporting, inventory, load posting and inspection record keeping requirements are also stated.

The "Surface Transportation Assistance Act of 1978" required that all public bridges over 20 feet in length be inventoried and inspected in accordance with NBIS by December 31, 1980.

Over the past 30 years, several hundred steel bridges have developed cracks, mostly due to fatigue. Although these localized failures have been extensive; very few U.S. bridges have actually collapsed as a result of cracking.

The first was the above mentioned Silver Bridge over the Ohio River at Point Pleasant, West Virginia. This structure was an eyebar chain suspension bridge with a 700 foot main span that collapsed without warning on December 15, 1967.

The second collapse occurred on June 28, 1983 when a suspended two-girder span carrying I-95 across the Mianus River in Greenwich, Connecticut failed. These failures led to an emphasis on fatigue and fracture critical bridges.

Approximately 86% of the National Bridge Inventory bridges are built over waterways. The April 1987 collapse of New York's Schoharie Creek Bridge pointed out the need for underwater inspection and evaluation of bridges with potential vulnerability to scour. Most bridge failures are related to underwater problems. Several Tennessee bridges including the Perkins Road/Nonconnah Creek Bridge and the U S 51/Hatchie River Bridge in Tipton County are tragic examples of such failures.

The Federal Highway Administration published in the December 14, 2004, Federal Register the 2005 final Rule revising the NBIS. The revision was the result of continued analysis of the National Bridge Inventory data, more flexibility in team leader qualifications, an emphasis on bridge inspection efforts on certain bridges, bridge elements which pose a higher than normal potential for collapse should they fail and the need for improved record keeping and positive management procedures to identify, inspect and evaluate the critical elements of some bridges.

The 2004 NBIS are divided into the following nine sections:

1. Purpose
2. Applicability
3. Definitions
4. Bridge inspection organization
5. Qualifications of personnel
6. Inspection frequency
7. Inspection procedures
8. Inventory
9. Reference manuals

200 – Inventory

NBIS Mandate

The National Bridge Inspection Standards (NBIS) mandates by federal law that each state inventory, inspect and load rate all bridges on all public roadways. The Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges is a document prepared and published by the U.S. Department of Transportation for use by all the States in accumulating a bridge inventory database. Specifically it outlines recording and coding procedure for all the various elements of the structure inventory and appraisal data. This data is used for various reports but primarily for those in connection with the Moving Ahead for Progress in the 21st Century, or MAP-21. A report is submitted annually to the FHWA which, in turn influences KYTC's bridge funding.

Although Kentucky's report closely follows the suggested form in the Coding Guide there are some additions, clarifications and interpretations which were originally published in 1979 by the Division of Maintenance. The following is an update of the affected items which replaces the earlier 1979 edition. All data stored in KYTC's NBI database is now collected and stored electronically through BrM software. Unless specifically stated in the update, all Bridge inventory reporting shall follow the latest edition of the Coding Guide. Any request for further interpretation of the Coding Guide or the Department update should be made to the Division of Maintenance, Bridge Preservation Branch. Changes in the following "Exceptions to the Coding Guide" will only be made with consent of the NBIS Program Manager, with approval by the Branch Manager for Bridge Preservation, Division of Maintenance.

NBI Data Updates

An important function of bridge maintenance is a complete, accurate and current record of each bridge on the highway system. Section 650.315(a) of 23 CFR (12/14/04) requires the Kentucky Transportation Cabinet (KYTC) to prepare and maintain an inventory of all the bridges subject to the National Bridge Inspection Standards (NBIS). Certain Structure Inventory and Appraisal (SI&A) data must be collected and retained by the State and Federal agency for collection by the FHWA as requested.

Newly completed structures, modification of existing structures which would alter previously recorded data in the inventory or placement of load restriction signs on the approaches to or at the structure itself must be entered on inspection reports and the computer inventory as soon as practical, but no later than 90 days after a change in status of the structure for bridges under KYTC's jurisdiction (On-System Bridges) and no later than 180 days after the change in status of the structure for other bridges on public roads (Off-System Bridges) within the Commonwealth.

Electronic bridge inspection reports shall be entered to the database server no later than 5 business days after the inspection completion date for both on-system and off-system bridges.

Exceptions/Inclusions to Coding Guide

Approach Roadway Pavement: Measurement in feet of the roadway pavement including usable shoulders (4 positions). See coding guide Item #32 for further details regarding shoulders.

Bridge Description: Describe all spans by length and type whenever possible. Use acceptable abbreviations where possible. (Example: 30'-40'-30' R.C.D.G. Spans) (55 positions)

Asphalt thickness: Measure in inches the depth of asphalt overlay on the bridge deck. (2 positions).

Road Class: Code the truck weight classification of the route carried by the bridge. This data can be found in the Commonwealth of Kentucky's Truck Weight classification book or the Trucking Highway map of Kentucky found on KYTC website. The code for all city streets/county roads is "C" (4 positions).

Approach Sight Distance and Speed:

- **Length 1**: Indicate in feet the clear sight distance where the centerline of the bridge is visible, traveling the route by increasing mile point. (3 positions)
- **Speed 1**: Indicate the speed limit approaching the bridge. (2 positions)
- **Length 2**: Indicate in feet the clear sight distance exiting the bridge. (3 positions)
- **Speed 2**: Indicate the speed limit exiting the Bridge. (2 positions)

Road Name: List the road name on which the bridge is located. If the route has no formal name indicate between what towns or communities, or between what routes the bridge lies. County road names can be obtained from a county road aid map. (35 positions)

Memorial Bridge Name: If the structure has been dedicated as a memorial to a historical figure or event, indicate the formal memorial name. (25 positions)

Kentucky Road System: From the Kentucky State Primary System, list the 2 position number to indicate the road system which the Bridge is located:

01 = interstate
02 = parkway
03 = state primary
04 = state secondary
05 = MP unclassified
06 = State property (parks, etc.)
07 = Rural secondary
08 = urban Federal
09 = county road/ city street

Paint Date: Indicate the month and year of the Bridge's last painting. (4 positions)

In-depth Inspection: "Indicator and Date" indicate, if applicable, the agency that performed in in-depth inspection on the bridge (State agency; Consultant), and the month and year the inspection was performed.

Station Number: Indicate the lowest station number of the bridge from the beginning of its designated section- Can be found on bridge plans or drawings. (10 positions)

Material Type of major elements of Bridge: Deck type; Superstructure type; Substructure type. (1 position each)

Not Applicable (P)
Unknown (NBI)
0 = Other
1 = Concrete

2 = Concrete Continuous
3 = Steel
4 = Steel Continuous
5 = Prestressed Concrete
6 = P/S Conc. Continuous
7 = Wood or Timber
8 = Masonry
9 = Aluminum or Iron

ConSpan: Precast segmental concrete structures commonly known as "ConSpans" should be coded as Culverts, Item 43B = 19.

Memorial Bridge indicator: Indicates yes or no if a structure has been dedicated as a memorial. (1 position)

Critical Facility: Indicates by a yes or no if a structure has been determined to be a critical facility (see FHPM, Vol. 6, Chapter 10 section 2) (1 position)

Analysis Location: Indicates, if available, where the bridge analysis was performed (e.g. hand analysis by district = district; analysis by C.O. analysis staff= Central office)

Type Load 1, 2, 3, 4: Indicate in tons, the bridge analysis strength @ 69% yield for each type of truck. (Central Office Analysis staff only) Truck weight types 1-4.

County Bridge Number: Combination of 3 position codes for the county number and a 3 position code for the "B or C" number. Example Adair Co. would be 001C00099N.

U.P.N., "Uniform Project Number": Specific number used by the Division of Accounts to reference all money and time expenditures to each specific bridge. (16 positions)

Vertical Clearances {Eastbound or Northbound}: Indicate in feet and inches the vertical clearance for a 10 ft. section of roadway in the eastbound or northbound lanes of a route going under a structure with dual or multiple openings. (4 positions)

Vertical Clearances {Westbound or Southbound}: Indicate in feet and inches the vertical clearance for a 10 ft. section of roadway in the eastbound or northbound lanes of a route going under a structure with dual or multiple openings. (4 positions)

School Bus Route: Indicate by yes or no if the structure is located on a known school bus route. (1 position)

Sufficiency Rating: Numerical rating based on the guidelines set by the Federal Highway Administration for determining sufficiency rating. This rating combines factors of condition and function to determine an overall rating for a bridge, which is also used in setting priorities for eligible candidates for Federal Bridge replacement. Sufficiency Rating formula can be found in the coding guide.

Structure Notes: This note field is to be used for commentary for history and permanent record of evaluation for the Structure. All entries become a part of each inspection on file and shall be marked with author's name and date of entry.

Inspection Notes: This note field can be used for commentary specific to the inspection performed on the date of record. All entries shall be marked with the author's initials and date as well as all names of the inspection team members present during the inspection.

Structure Name: Record moniker of bridge, if any, by which the bridge is commonly referred to (e.g. Roebling Bridge).

Agency Admin Area: Identifies current administrative area of service

Emergency Route Identifier: Indicate by yes or no if the structure is located on a known emergency evacuation route. (1 position)

Fracture Critical Details: Identify type of Fracture Critical detail requiring detailed inspection

Agency Bridge Items:

Number of Barrels: record number of openings in structure
Culvert Length (long.): as measured along centerline of roadway
Culvert Width (Trans.): as measured perpendicular to centerline of roadway
Height: record height of largest opening (round to nearest tenth of foot)
Fill Height: record depth of fill material over culvert (round to nearest tenth of foot)
Gas line:
Water line:
Sewer line:
Fiber Optic line:
Telephone Line:
Cable Communication line:
Electric Line:
USGS Gauging Station:
Inspection Schedule Month
Inspection Schedule Year

Bridge Location: (optional) if necessary provide a locally recognized description of bridge location
Field Posted Date: No field in BrM yet.
Date Painted: indicate date bridge was painted
Paint Color: indicate color of paint applied to bridge
Paint Type: if known. Indicate type of paint applied to bridge
Paint Area: Central Office use
Paint Weight: Central Office use
Lead Paint: Central Office use
Bat Activity Indicators: indicate by type, signs of bat occupancy
Drawing Numbers: record drawing number of original or corrected plans
Field Postings: record posting values **as they appear in the field** for Gross Posting OR individual truck types (see Load Rating Chapter for more guidance)
Signs Posted: indicate by yes or no whether weight signs are present at cardinal and non-cardinal approaches; this item should be marked regardless of acceptability of signage (non-compliance issues recorded in notes). This is for weight signs not clearance signs.
Overlay Y/N: indicate by yes or no whether bridge deck has an overlay
Overlay Type: indicate by type of overlay on bridge deck
Overlay Thickness: indicate in inches depth of overlay on bridge deck (round to nearest tenth)
Overlay Year: enter the year the overlay was added, if known
Paint Condition: indicate overall condition of paint coating on bridge
Recommended Scour Critical: using descriptions and codes for item #113 indicate observed vulnerability to scour. See chapter 500.
Road Type: Central Office use
State System: Central Office use
Snow Route: Central Office use

Scheduling:

Summary:

Inspection Date: Date of completion for current inspection
Inspector: indicates by inspector credentials author of report
Primary Type: indicate, by highest priority, the type of inspection performed
Inspection Group: KYTC or Contract

Types of Inspection Performed: indicate by yes or no each type of inspection **performed on *current* inspection**

National Bridge Inspection (NBI): see inspection definition in chapter 300
Element Conditions: see inspection definition in chapter 300
Fracture Critical: see inspection definition in chapter 300
Other Special: see inspection definition in chapter 300
Underwater: see inspection definition in chapter 300

Schedule: Execute calculate next function at each inspection.

Bridge Inspection Resources: (optional)

Next inspector: used to facilitate inspector rotation cycles
Bridge Group: user defined field
Crew hours: used to track support staff needs/usage
Flagger hours: used to define traffic control needs/usage
Helper hours: used to track support staff needs/usage
Snooper hours: used to track snooper needs/usage
Special Crew hours: used to track support staff needs/usage
Special Equipment hours: used to track support equipment needs/usage

Work Candidates:

Select type of work
Candidate ID: user defined; for inventory of work needs
Structure Unit:
Action: See Dropdown
Priority: See Dropdown
Date Recommended:
Date Completed:
Target Year:
Assigned: See Dropdown
Work Assignment: See Dropdown
Status: See Dropdown
Note field: Appropriate note for action selected.

Numbering of Bridge Components

When conducting an inspection it is mandatory that the Inspector use the standard numbering sequence to identify bridge components. The correct procedure is to number from South to North; or West to East, depending on the orientation of the route carried by the bridge, by ascending mile point. Also when numbering subcomponents such as trusses or girders, numbers should run from left to right as the Inspector faces the cardinal direction. Illustrations 1 and 2 illustrate the correct procedure. See the Exhibit #9201.

NOTE: Where the physical orientation of a route is counterintuitive to the compass direction, ascending mile points should be used to determine orientation. In instances where either directive would cause confusion, the bridge file (both electronic and hardcopy) must include a permanent, conspicuous note clearly identifying methods used for establishing numbering sequence.

NOTE: Data associated with underwater evaluations and stream profiles should be numbered from left to right while facing downstream and referenced as upstream or downstream face. (Numbering of data points and/or information pertaining to this section only; substructure units illustrated in the graphs will be numbered as described above).

Vertical Clearance Measurements

When field measurements are taken for bridge vertical clearances several considerations must be taken into account. In collecting field data two primary items will be obtained from your measurements:

1. Item #10, Minimum Vertical Clearance (the minimum measurement of a 10 foot width of pavement or traveled part of the roadway) shall be recorded in feet and inches;
2. Item #53, Minimum Vertical Clearance over the bridge roadway shall be recorded in feet and inches;
3. Item #54, Minimum Vertical Under Clearance (the minimum vertical clearance from the roadway or RR track beneath the structure to the underside of the superstructure) shall be recorded in feet and inches.

The method of taking measurements will be as follows: Facing forward along the direction of inventory route mile-point, a measurement shall be in five primary locations:

1. Left edge of roadway shoulder
2. Left edge of pavement
3. Centerline of pavement
4. Right edge of pavement
5. Right edge of roadway shoulder

In the case of multiple lanes, measurements shall be taken at all edges and centerlines of marked lanes.

In the case of multiple openings of traffic lanes, both or all openings shall have measurements taken at the specified points.

Indicate, in notes, any exception that would have a more restrictive clearance, such as an attached sign or utility that is hanging below the bridge superstructure.

New measurements shall be taken after any change in pavement elevation.

If for any reason measurements cannot be taken in a safe manner, please contact Central Office Bridge Preservation staff for guidance.

300 – Inspection

Each type of inspection will describe its own unique requirements, but all types will involve these elements:

- Qualifications of Bridge Program Personnel
- Frequency of Bridge Inspections
  - Categorization of Bridge Types for Prioritizing In-Depth Inspection
- Equipment List for Bridge Inspections
  - Under Bridge Crane Policy
  - Specialized Inspection Equipment
- Field Measurement Accuracy
- Subsequent Inspections
- Inspection Report
  - Outline of Required Report Sections
  - Distribution List for Bridge Inspection Reports
- Critical Findings for All Inspections

These types of inspections will be described in following sections:

- Initial Inspection
- Routine Inspection (Standard)
- Sub-Standard Inspection
- Interim Inspection (Special)
- Damage Inspection (Special)
- Fracture Critical Inspection
- Complex Bridge Inspection
- Underwater Inspection
- Element Level Bridge Inspection (BrM)
- In-Depth Inspection
- Post-Earthquake Inspection

Qualifications of Bridge Program Personnel

Purpose: Provide the qualifications necessary for personnel in the Bridge Inspection Program to perform the various functions required for bridge inspection and bridge evaluation. These qualifications may be based on Federal and/or State of Kentucky guidelines.

A qualified team leader or acting team leader who meets the team leader qualifications shall be present during all bridge inspections.

Irrespective of the type of bridge inspection being performed, the Program Manager, Analysis staff, Team Leaders and divers shall meet these qualifications.

Position: Program Manager
The individual in charge of the unit, that has been assigned or delegated the duties and responsibilities for bridge inspection, reporting, or inventory. The program manager provides overall leadership and is available to inspection team leaders to provide guidance.

Qualifications: A program manager must possess, at a minimum, the following qualifications:

1. Be a registered professional engineer, or have ten years bridge inspection experience; and,
2. Successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.

Position: Chief Analysis Engineer
The individual charged with the overall responsibility for determining load ratings of bridges.

Qualifications: The Manager of Bridge Inspection and Evaluation must possess, at a minimum, the following qualifications:

1. The individual must be a registered professional engineer.

Position: Team leader
The individual charged with the overall responsibility for performing the field inspections for the bridges he or she is responsible.

Qualifications: There are five ways to qualify as a team leader. A team leader must meet all the qualifications listed in at least one of the five sections listed below:

1. Be a registered professional engineer and have successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.
2. Have five years bridge inspection experience and have successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.
3. Be certified as a Level III or IV Bridge Safety Inspector under the National Society of Professional Engineer’s program for National Certification in Engineering Technologies (NICET) and have successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.
4. Have all of the following:

   a. A bachelor's degree in engineering from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology;
   b. Successfully passed the National Council of Examiners for Engineering and Surveying (NCEES) Fundamentals of Engineering examination;
   c. Two years of bridge inspection experience; and
   d. Successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.
5. Have all of the following:
   a. An Associate's degree in engineering or Engineering Technology from a college or university accredited by or determined as substantially equivalent by the Accreditation Board for Engineering and Technology ;
   b. Four years of bridge inspection experience; and
   c. Successfully completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.

Position: Diver

The individual responsible for completing the underwater inspection of bridge substructures.

Qualifications : A Professional Engineer, certified commercial diver with experience in underwater bridge inspection assignments and who has completed a Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course or other FHWA approved underwater bridge inspection training course,

Position: Other Bridge Inspection Personnel Not Listed Above

The KYTC encourages all other bridge inspection personnel not directly listed above attend a two (2) week Federal Highway Administration (FHWA) approved comprehensive bridge inspection training course.

Frequency of Bridge Inspections

All bridges on public roads in Kentucky shall receive a Routine Inspection at intervals not to exceed two (2) years. Other types of inspections may be scheduled in addition to the regular two (2) year inspection cycle. Underwater Inspection intervals shall not exceed five (5) years. All inspections shall comply with the NBIS requirements.

Categorization of Bridge Types for Prioritizing In-Depth Inspection
The KYTC prioritizes structures for in-depth inspection by bridge type, size and A.D.T. All fall into either category A or B, which are defined below.

All Bridges in Category A receive first priority for In-depth inspections, followed by bridges in descending order of rank in the B Category. Structures within each category and sub-category are sorted for order, first by Trucking classification of roadway carried, followed by ADT of route carried. See Exhibit #9301.

Category A
Major structures which includes all Ohio River Crossings, other tied arches, deck trusses, through-truss spans over 360’ in length, and Complex Bridges (bridges with complex or unusual design characteristics) are Category A bridges.

Category B
All other structures fall into one of nine subunits of Category B as follows:

- B.1 Non-redundant girder systems, super spans and multi-plate arches. Several varieties of non-redundant girder systems exist. The most fracture critical systems are those which contain E or E’ fatigue details on welded connections. Riveted girders should receive lower priority for inspection than welded plate girder but should still receive ample attention due to fracture critical status.
- B.2 all trusses of any type up to 360’ in length
- B.3 Redundant continuous steel girder /beam systems
- B.4 Redundant simple steel girder/beam systems
- B.5 Timber superstructures and substructures
- B.6 Side-by-side pre-stressed, pre-cast concrete boxes (top of boxes act as deck)
- B.7 Side-by-side pre-stressed, pre-cast concrete boxes with reinforced concrete slab
- B.8 Pre-stressed, pre-cast concrete girders
- B.9 All other concrete

The districts should concentrate efforts for in-depth inspection toward completion of the higher categories first before moving down the priority list.

Equipment List for Bridge Inspections

The Equipment List for Bridge Inspection gives a summary of the type of equipment needed and how the equipment is used in order to accomplish the mission of bridge inspection. See the Exhibit #9302, "Equipment List for Bridge Inspection".

Where alignment and/or elevation observations are included in the procedure, surveying equipment such as a transit, level, plumb bob and level rod will be required. Access equipment such as ladders, rigging, scaffolds, boats, barges, and access vehicles will be used as required.

Under Bridge Crane Policy
Purpose: To provide guidelines for the use of under-bridge cranes.

Procedure: All applicable OSHA and/or KyOSH standards for fall protection shall be observed during snooper use including the use of a Class III full body harness with shock absorbing lanyard attached to anchors provided on the unit and an accepted rescue plan on file with the District Safety Coordinator and Central Office Staff. Rescue plans will vary based on District staffing and competency for rescue procedure. All districts are encouraged to have at least one person of the inspection staff trained in rescue techniques. Questions for developing an acceptable rescue plan or training can be directed to Josh Rogers or Rick Rogers at Central Office (502) 564-4556.

Prior to use, all personnel operating any of the Snoopers (ground personnel, drivers and bucket operators) shall complete training for safety, operation, pre-use inspection and basic maintenance for the specific unit being used, at frequencies to maintain competency for proper use.

No one other than snooper operators or authorized mechanics is permitted to tamper with the mechanics of these units at any time. Any deficiencies found on the units prior to or during operation should be immediately reported to Harry Greer, Josh Rogers, or Rick Rogers.

Specialized Inspection Equipment
Several pieces of specialized equipment are available for use by the Inspectors. Three bridge inspection cranes (snoopers) are available and are scheduled on a rotating monthly basis among the districts. Three under-bridge work platforms; the Hydro platform (hydraulically articulated unit) and a semi-static parapet mounted unit, are also available to the districts. Reporting of repair or maintenance needs; or special scheduling of the units beyond the normal schedule of use should be directed to either Harry Greer office(502) 782-5583 cell (502) 330- 6706, Josh Rogers office(502) 782-5600 cell (502) 382-7872 or Rick Rogers Office(502) 782-5622 Cell (606)776-5022.

Various non-destructive testing equipment, including dye Penetrant test kits, AC Magnetic particle units, and electric drills, are available through Central Office Maintenance. Call Harry Greer Office (502) 782-5583 Cell (502) 330- 6706, Josh Rogers Office (502) 782-5600 Cell (502) 382-7872 or Rick Rogers Office (502) 782-5622 Cell (606)776-5022.

14’ Jon boats powered by electric trolling motors are distributed to 4 regional sites. These are:

Districts 1, 2, & 3	Madisonville, District 2 Contact: Jonathon Beasley (270) 824-7080
Districts 4, 5, & 7	Frankfort Central Office Contact: Harry Greer Office (502) 782-5583 Cell (502) 330 6706
Districts 6, 9, & 10	Flemingsburg, District 9 Contact: Blake Jones (606) 845-2551 or (606) 748-9242
Districts 8, 11, & 12	**No Jon boats at this time.**

Field Measurement Accuracy

The following limits of accuracy are generally ample for field measurement:

Concrete Members	Nearest 1/2" (13 mm)
Asphalt Surfacing	Nearest 1/2" (13 mm)
Steel Rolled Sections	Necessary accuracy to identify section
Span Lengths	Nearest 0.1 foot (30 mm)
Elevation (water surface)	Nearest 0.1 foot (30 mm)
Elevation (footings)	Nearest 0.1 foot (30 mm)
Elevation (Underpass Vertical Clearance)	Nearest 1/2” (13 mm)

Field measurements to monitor changes in joint openings, rocker positions and substructure plumb shall be measured to the nearest 1/8" (3 mm). Measurements to document the size of concrete or steel cracking shall be measured to the nearest 1/32" (1 mm).

Measurements for tracking of suspected or observed substructure tilting or movement should be made using permanent monitoring datum markings on the structure. Measurement of surface area, depth and location of defects and deterioration is preferred over visual estimates.

Subsequent Inspections

During each inspection the inspection team shall have access to the most recent previous inspection report so that comparisons may be made to detect any changes to the structural condition. Any changes in the structural condition shall be noted with photographs included in media tab; and, if necessary, sketches or drawings with appropriate dimensions shall be provided.

Inspection Report

Report Format: All pictures, sketches, drawings, correspondence, etc. which comprise any "Bridge Inspection Report" or copies of reports generated herewith shall be stored electronically for the life of the bridge. The District Bridge inspection staff shall maintain a hard copy file with Inspector signed copies of reports and all other correspondence or information regarding the structure. An electronic inspection report shall be completed or uploaded to the BrM server within five (5) business days of field inspection for each structure inspected.

Outline of Required Report Sections

- **A. MAP**: A location map for the bridge with the direction of route indicated.
- **B. RECOMMENDATIONS: This is not an option in BrM at this time.**
- **C. PHOTOGRAPHS**: Basic mandatory photographs must be maintained in the electronic file in accordance with the BrM Media Training Manual. Photographs should be **digital,** color, of good quality and clarity, and each tagged with structure number, type of inspection performed, and date. Update these photos when structure changes are made. (**minimum** 4-6 photographs required for a single span bridge in Good or Fair Condition):
    1. **IDENTIFICATION**: View of the bridge number painted on the bridge (as time allows)
    2. **TOP SURFACE**: View across the bridge showing the condition and type of the bridge deck wearing surface, curbs, plinth and rails (required)
    3. **PROFILE**: Elevation view of the bridge preferably on the upstream side so that drift accumulation would show in the picture (required)
    4. **SOFFITT**: View(s) of underside of bridge showing deck undersurface, beams, bracing, condition of culvert barrels/pipes, etc. for each span. Views of typical spans may be used for structures with a very large number of spans provided the spans show no significant damage or deterioration. Spans with significant damage and/or deterioration shall be photographed (required)
    5. **SUBSTRUCTURE**: Photos of each, including bearing devices
    6. **CHANNEL**: Views at the top of both channel banks looking both upstream and downstream. The same exact views shall be shot during subsequent inspections to allow for comparative analysis (required for structures over water)
    7. **SIGNS**: Photographs at each approach of weight limit posting signs, closure signs and/or barricades, vertical clearance posting signs on each side (required if present). If proposed signs or barricades are missing, take a photo to prove they are missing.
    8. **DEFICIENCIES**: Include, as required, photographs of problem areas found during the inspection.
    - **Additional photographs are required to illustrate any NBI rating of "4" or below** and/or any BrM element condition recommending structural evaluation or analysis. New photos of these conditions should be taken on subsequent inspections to document deterioration.
- **D. REPORT**: The completed "BRIDGE INSPECTION FORM, including:
    1. **CONDITION COMMENTS**: Space is provided at the bottom of the inspection fields for the Inspector to record comments to support the ratings. Comments shall include but are not limited to: type of deficiency, location, size or area of defect and recommended maintenance action, if needed.

2. **NOTES are mandatory to explain any NBI rating of "6" or below** and/or any element condition recommending structural evaluation or analysis.

E. SUMMARY: Summary of the inspection.

F. SKETCHES: Sketches of deterioration/damages found during the inspection, sketches of problems or deterioration/damage that was found to be worse than shown in the previous inspection report and plots of stream bed/scour hole elevations compared to previous stream bed/scour hole, foundation and/or pile tip elevations. For bridges having Fracture Critical Members, a mandatory sketch identifying all FC members shall be included in the electronic and hard copy bridge files.

G. PLANS: The design plans are to be either included in the report or referenced in the documentation along with field measurements photographs and observations as required to establish the baseline condition of the bridge.

Distribution List for Bridge Inspection Reports

Inspection reports being placed into the BrM Database:

- An electronic copy of the report shall be prepared and loaded into the BrM Database Server.

Inspection reports belonging to bridge owners other than the State of Kentucky:

- A hard copy file of all the structures will be made and submitted, with necessary correspondence, to the bridge owner (e.g. County Judge Executive, Mayor etc.). See Exhibits #9103-9105.

Initial Inspection

Purpose: To provide guide lines for performing and documenting Initial Inspections.

Definition: The first inspection of a bridge as it becomes a part of the bridge inventory or when there is a change in the configuration of a bridge (e.g., widening, lengthening, supplemental bents, etc.) that would cause a new inventory number to be assigned to the structure. The purpose of this inspection is twofold. First, it should be used to determine all Structure Inventory and Appraisal (SI&A) data required by the Federal Highway Administration and all other relevant information not required by the NBIS. The second important aspect of the Initial Inspection is the determination of baseline structural conditions and the identification and listing of any existing problems or locations in the bridge that may have potential problems. AASHTO elements shall be gathered at this time.

Frequency: When a bridge becomes a part of the bridge inventory or when there is a change in the configuration of a bridge (e.g., widening, lengthening, supplemental bents, etc.) that would cause a new inventory number to be assigned to the structure. The completed Initial Inspection report shall be uploaded to the BrM server and filed no later than 90 days of completion of the work (open to public travel) for all "on-system" bridges, and no later than 180 days of completion of the work (open to public travel) for all "off-system" bridges.

Procedures: The procedures used in the Initial inspection are designed to verify plan dimensions or to secure as-built dimensions. The inspection should also document the initial deficiencies. The procedures used depend largely on the bridge type, the materials used and the general condition of the bridge. Therefore the inspector must be familiar with the basic inspection procedures for a wide variety of bridges.

The first step in the inspection procedure is to establish the orientation of the bridge plans with the site, direction of the route and North direction. Plans, for newer structures, usually have the North direction and direction of the route indicated on the layout sheet. The Initial Bridge Inspection is to be conducted in a systematic and organized manner so as to minimize the possibility of overlooking any element of a bridge requiring a Regular Inspection.

Basic Guidelines:

Approaches: Check for unevenness, settlement, or roughness. Also check the condition of the shoulders, slopes, drainage, and signing and approach guardrail.

Decks: A crack survey should be made on the deck, curb and sidewalk. The size, extent, and location of each defect should be noted. The location should be referenced using the centerline or curb line, the span number and the distance from a specific pier or joint. The survey should include both the top and underside of the deck. If prestressed concrete deck panels have been used, a survey of the panels should be made and their condition documented.

The following deck and sidewalk locations shall also be examined:

The primary locations for timber deck inspection include:

- Areas exposed to traffic
- Bearing and shear areas
- Tension areas between support points
- Deck surface

Outside edges of deck

The primary locations for concrete deck inspection include:

Both the top and bottom deck surfaces.
Areas exposed to traffic
Areas exposed to drainage
Bearing and shear areas
Top of slab at supports
Bottom of slab at supports and midspan
Stay in Place Forms
Anchorage zones of prestressed slab tie rods

The primary locations for steel deck inspection include:

Bearing areas
Primary bearing devices
Areas where water can be trapped
Connections

Examine expansion joints for:

Alignment and freedom for movement
Clearance and sufficiency of opening
Record ambient temperature and Width of opening at each curb line
Adequate seal

Inspect deck joints for:

Dirt and debris accumulation
Proper alignment
Damage to seals including membranes or glands
Improper asphalt or gravel wearing surface overlays especially those which impede normal joint functioning
Joint supports (support bars in modular and finger joints)
Joint anchorage devices

Inspect the following deck drainage elements to see that they are open and functioning:

Grates
Deck drains and inlets
Drainage troughs Outlet pipes

Inspect safety features including:

Bridge rail
Approach guardrail
Transitions
End treatments
Median barriers

Inspect signs for:

Placement and condition
Condition of sign support welds and bolts
Typical signs include:
Bridge Paddleboards
Bridge posting signs

Vertical clearance signs
Lateral clearance signs
Narrow underpass signs
Speed limit signs
Directional or routing signs

Inspect lighting anchorage and lenses on:

Roadway lighting
Traffic control signals
Aerial obstruction lighting
Navigational lighting
Sign lighting

Superstructures: Inspect to verify dimensions and connections (integrity of welds and tightness of bolts) for main supporting members. Thoroughly inspect all the main supporting members including:

Beams and girders
Floor beams and stringers
Steel Gusset Plates
Trusses
Catenary and suspender cables
Eyebar chains
Arch ribs
Frames
Pins and hangar plates
Lateral Tension Rods
Longitudinal Shear Keys
Bearings – Note the difference between rocker tilt and a fixed reference line, and the ambient air temperature
Bracing (lateral, x-brace and diaphragms)

Substructure: Reference points should be set and reference lines scribed for use in checking the piers and bents for tilt. Also inspect for:

Condition of scour countermeasures Settlement Vertical movement
Lateral movement
Scour- perform a Regular Scour Inspection (see “Underwater Inspection”)
Rotational movement

For concrete, Failure of material as evidenced by:
- Cracking
- Spalling
- Scaling
- Crushing
- Exposed reinforcement

For stone masonry, Failure of material as evidenced by:
- Weathering
- Spalling
- Splitting
- Mortar cracking and deterioration

For steel, Failure of material as evidenced by:
- Corrosion
- Cracking
- Buckling

For timber, Failure of material as evidenced by:
- Decay
- Insects
- Vermin damage
- Weathering
- Fire damage

Waterways: On structures over waterways, ground line profiles are to be documented. See the section titled "Scour Detection Survey, Ground line Profiles, Reporting and Action Procedures" for detailed instructions on how to create ground line profiles. See Page 500-1

As Built Plans: In cases where the design plans for a structure are not available, the bridge inspection office shall prepare "As-Built" plans showing span lengths, beam size and spacing, deck type and thickness, bracing, bearings and substructure details. The "As-Built" plans shall be dated and marked with the bridge number. The layout sheet shall be marked to indicate the North direction, the direction of route and (if over a waterway) the direction of stream flow. The plans in the electronic report sent to the Central Office shall be LEGIBLE. The following items require special attention and documentation:

1. Clearly show beam size. Steel beams details should show original flange width, flange thickness, beam depth and web thickness. If corrosion has produced section loss, then estimate the percent loss to the top flange, web and bottom flange for each location. Clearly show bracing and splice details and clearly indicate if the beam is continuous or simply supported at each substructure support.

2. Indicate the size of timber deck planking. If a timber deck has been replaced, show the size of the new planks. For timber bents, show pile spacing, pile size, length of cap, cap size, distance from left end of cap to first pile and distance from left end of cap to the first beam. Any pile or cap beam splices shall also be indicated.

3. Indicate the type and dimensions of the deck-thickness, width curb-to-curb and out-to-out, curb height and width.

Copies of design plans shall be obtained from the Central Office for bridges designed by the Department of Transportation or from local governments and/or Engineering Consulting firms whenever possible. Copies of the design plans or “As-built” plans shall be taken to the bridge site and used during on-site bridge inspections.

Routine Inspection (Standard)

Purpose: To provide guide lines for performing and documenting Routine Inspections.

Description: A Routine Inspection is an inspection with sufficient observations and/or measurements to determine the physical and functional condition of the bridge, to identify any developing problems and/or change from the "Initial" or previously recorded conditions and to ensure that the structure continues to satisfy present service requirements. A Routine Inspection checks all members above, and where accessible by wading, below the water level to detect any deficiency(ies) not readily visible. Routine Inspections should always include an updated ground line profile for those bridges over waterways. See the section titled "Scour Detection Surveys, Ground line Profiles, Reporting and Action Procedures" for further details. Routine Inspection procedures are also used in Damage Inspections for the bridge elements involved. The Routine Inspection procedures will be applied to all bridges greater than 20' (6.1 m.) in length.

Frequency: Routine Inspections are to be performed at intervals not to exceed twenty-four months.

Procedures: Personnel with special skills 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. On small bridges, the Routine Inspection should include all critical elements of the structure, but for 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 element 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 of inspection.

Approaches: Check the bridge approaches for smoothness, existence and condition of guardrail, settlement, erosion and function of drainage.

Decks: Inspect top and bottom of decks for changes in cracking, leaching, scaling, pot-holing, spalling and other evidence of deterioration. Inspect asphalt wearing surfaces for evidence of deck deterioration not shown in earlier inspections. If the deck underside cannot be visually inspected due to stay-in-place forms, etc. this will need to be noted in the parent element notes.

Expansion Joints: Inspect the joints for alignment, freedom for movement, deterioration and damage not shown in previous inspections.

Railings, Sidewalks and Curbs: Inspect for changes since previous inspection. Look for misalignment, collision damage, deterioration and corrosion of anchorage.

Bridge Drainage: Inspect the bridge drainage condition.

Signing: Inspect sign supports for deterioration, cracking, broken welds, and loose bolts.

Lighting: Inspect the bridge lighting system for changed condition since the previous inspection. Look for new collision damage, and deterioration of anchorage.

Deck Overlays: Inspect the deck overlay for changes in its overall condition since the previous inspection.

Concrete Deck Inspections: When performing Routine Inspections on structures over parking lots, pedestrian walkways, and especially public roads, if deck deterioration and delamination are detected on the bottom of the deck, the inspector shall sound all suspected areas of the bottom of the bridge deck to determine the "soundness" of the concrete and remove (at that time) all loose scaled and de-bonded concrete over areas subject to any vehicle traffic flow or pedestrian traffic. The interruption to traffic flow, necessary for such inspection measures, is justified in the interest of public safety.
If no areas of bottom of deck deterioration and/or spalled concrete are found, inspection may proceed as normal. If the deteriorated areas of the bottom of the bridge deck are larger than the inspector can remove at the time of inspection, District bridge repair shall be notified to remove all loose concrete immediately. If these areas are larger than District forces can repair, District bridge inspection shall notify Central Office of the need for assistance in doing deck repairs by contract. Regional forces, shall install temporary plywood boards between beams so as not to allow concrete to fall on traffic below. The bridge will be placed on a Priority list for contract repair plans development.

Superstructure: Check of all structural members for changes since the previous inspection. These changes may be due to deterioration, damage, and fatigue.

Steel Beams, Girders and Box Sections:

- Primary structural steel members should be inspected for changes in section and checked for out-of-plane bending in webs or connecting plates. Compression flanges should be checked for buckling.
- Box members should be entered and inspected from within where accessible.
- Check for fatigue cracks near welded ends of stiffeners and gusset plates.
- Fracture critical members shall have a fracture critical member inspection defined as a hands-on inspection of fracture critical member or member components that may include visual or other nondestructive evaluation.
- Weathering steel structures should be inspected for changes at details or other conditions which promote continuous wetting of the steel or pitting of the steel surface.

Reinforced Concrete Beams and Girders:

- Inspect all reinforced concrete superstructures for changes in cracking, spalling and delamination. Check the position of the girders, on the bearing seats, for excessive movement or misalignment.

Prestressed Concrete Beams, Girders and Box Sections:

- Inspect prestressed concrete members for increased cracking or spalling, look for evidence of rust at cracks.
- Identify any exposed or broken prestressed strands. Report any broken strands and their location to the Chief Analysis Engineer

Floor Systems:

- Inspect stringers, floor beams and overhang brackets for new cracking and loss of section due to rust.
- Inspect expansion devices for freedom of movement and condition of seal (leaking, strip seal joints).

Trusses:

- Inspect for changes in alignment of the trusses, bowed or kinked compression members that were not shown in the last report. Inspect the trusses and bracing members for traffic damage.
- Check the condition of all pins and connections for changed conditions.

Cables:

- Inspect cables for breakage, fraying and surface pitting.

Diaphragms and Cross Frames:

- Inspect diaphragms and cross frames on steel bridges for new cracking particularly at the points of attachment to main structural elements. Welded attachment plates in the tensile zones of girders are fatigue sensitive and may induce out-of-plane bending in girder webs. These locations should be inspected for new cracking.

Lateral Bracing, Portals and Sway Frames:

- Inspect lateral bracing and sway frame connection plates for new fatigue cracking and loss of section. Inspect truss portal members for new collision damage or misalignment.

Rivets, Bolts and Welded Connections:

- Sound suspected loose bolts with a hammer for audible sounds of distress and movement.
- Riveted connections should be inspected for loss of rivet heads and condition of the joint. Suspected loose rivets should be sounded with a hammer.
- Welded connections should be inspected for new fatigue cracks.

Bearings:

- Inspect bearings for proper functioning and check anchor bolts to see that the nuts are properly tightened. Check concrete around the anchor bolts for cracking that may indicate improper functioning of bearings.

Paint:

- Inspect the paint on the structure and make a judgment on its condition. Document any increases in corrosion which has occurred since the previous inspection.

Utilities:

- Inspect utility lines attached to bridges for failure of the utility or its attachment system.

Substructure: A Routine Inspection of the sub-structure of a bridge consists of an examination and recording of changes in signs of damage, deterioration, movement and if in flowing water, evidence of changes in stream bed elevations due to scour or channel migration.

Abutments: Inspect abutment caps and bridge seats for changes in cracking and deterioration since the previous inspection. Investigate for foundation changes due to scour. Examine all concrete surfaces for changes in cracking and deterioration. Check for changes in horizontal and vertical position of the superstructure relative to the abutment. Check encased structural steel for deterioration and movement relative to the concrete. Inspect masonry joints and all walls for changes due to rotation or shifting. Inspect abutment drains and weep holes for changes in the drainage. Inspect foundations and piling for changes due to erosion and scour condition or rip-rap protection.

Piers and Bents: Inspect caps and bridge seats for changes since the previous inspection. Inspect for increased scour/and or erosion damage or undercutting. Exposed piling should be inspected for changes in soundness. Inspect riprap for changes in stability. Examine exposed concrete, steel and stone masonry for changes which have occurred since the last inspection. Inspect for changes in the vertical and lateral position. Note increases in drift and soil deposits.

Bridge Stability and Movements: Check the structure for changes in the vertical and horizontal position. Examine rockers, rollers and hanger elements for movement or inclinations. Compare with notes from previous inspection.

Waterways: Updated ground line cross-sectional views for any structure over water are required to be included in Routine inspections. See the section titled "Scour Detection Surveys, Ground line Profiles, Reporting and Action Procedures" for detailed instructions on how to create ground line profiles.

No Underwater Inspection Required: If a structure is over water and the water depth is less than 3.5 feet, perform a visual inspection and probing of the channel bed. The report will indicate "Diver not required" in these cases.

Report: To an even greater extent than is necessary for the "Initial Inspection", the activities, procedures and findings of a "Routine Inspection" must be well documented. All of the inspection data must be assembled into an electronic "Bridge Inspection Report". See the section titled "Outline of Required Report Sections" for the order of material in the electronic Bridge Inspection Report.

Sub-Standard Inspection

Purpose: To provide guide lines for performing and documenting Sub-standard Inspections.

Description: A Sub-standard Inspection is an inspection with sufficient observations and/or measurements to determine the physical and functional condition of the bridge, to identify any developing problems and/or change from the "Initial" or previously recorded conditions and to ensure that the structure continues to satisfy present service requirements. A Sub-standard Inspection checks all members above and, where accessible by wading, below the water level to detect any deficiency(ies) not readily visible. Sub-standard Inspections should always include an updated ground line profile for those bridges over waterways. See the section titled "Scour Detection Surveys, Ground line Profiles, Reporting and Action Procedures" for further details. Sub-standard Inspection procedures are also used in Damage Inspections for the bridge elements involved. The Sub-standard Inspection procedures will be applied to all bridges greater than 20' (6.1 m) in length that have been recommended for load postings less than the legal allowable load for route which the structure carries and; structures that are sub-standard due to restricted horizontal, or vertical clearances and have primary structural members exposed to vehicular impact (e.g. through trusses, through girders, pony trusses etc.).
Frequency: Sub-standard Inspections are to be performed at intervals not to exceed twelve months.

Procedures: Personnel with special skills 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. On small bridges, the Sub-standard Inspection should include all critical elements of the structure, but for 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 element 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 of inspection.

Posting Signage: Check to assure proper signage, as required in MUTCD, is posted at each approach to bridge with recommended maximum loading for each type of loading. Mark corresponding fields in bridge inspection report detailing whether posting is present or missing at each approach with actual posting recommendations observed.

Approaches: Check the bridge approaches for smoothness, existence and condition of guardrail, settlement, erosion and function of drainage.

Decks: Inspect top and bottom of decks for changes in cracking, leaching, scaling, potholing, spalling and other evidence of deterioration. Inspect asphalt wearing surfaces for evidence of deck deterioration not shown in earlier inspections.

Expansion Joints: Inspect the joints for alignment, freedom for movement, deterioration and damage not shown in previous inspections.

Railings, Sidewalks and Curbs: Inspect for changes since previous inspection. Look for misalignment, collision damage, deterioration and corrosion of anchorage.

Bridge Drainage: Inspect the bridge drainage condition.

Signing: Inspect sign supports for deterioration, cracking, broken welds, and loose bolts.
Lighting: Inspect the bridge lighting system for changed condition since the previous inspection. Look for new collision damage, and deterioration of anchorage.
Deck Overlays: Inspect the deck overlay for changes in its overall condition since the previous inspection.
Concrete Deck Inspections: When performing Sub-standard Inspections on structures over parking lots, pedestrian walkways, and especially **public roads**, if deck deterioration and delaminations are detected on the bottom of the deck, the inspector shall sound all suspected areas of the bottom of the bridge deck to determine the "soundness" of the concrete and remove (at that time) all loose scaled and de-bonded concrete over areas subject to any vehicle traffic flow or pedestrian traffic. The interruption to traffic flow, necessary for such inspection measures, is justified in the interest of public safety. If no areas of bottom of deck deterioration and/or spalled concrete are found, inspection may proceed as normal. If the deteriorated areas of the bottom of the bridge deck are larger than the inspector can remove at the time of inspection, district bridge repair shall be notified to remove all loose concrete immediately. If these areas are larger than district forces can repair, District bridge inspection shall notify Central Office of the need for assistance in doing deck repairs by contract. Regional forces, shall install temporary plywood boards between beams so as not to allow concrete to fall on traffic below. The bridge will be placed on a Priority list for contract repair plans development.
Superstructure: Check of all structural members for changes since the previous inspection. These changes may be due to deterioration, damage, and fatigue.
Steel Beams, Girders and Box Sections: Primary structural steel members should be inspected for changes in section and checked for out-of-plane bending in webs or connecting plates. Compression flanges should be checked for buckling. Weathering steel structures should be inspected for changes at details or other conditions which promote continuous wetting of the steel or pitting of the steel surface.
Reinforced Concrete Beams and Girders: Inspect all reinforced concrete superstructures for changes in cracking, spalling and delamination. Check the position of the girders, on the bearing seats, for excessive movement or misalignment.
Prestressed Concrete Beams, Girders and Box Sections: Inspect prestressed concrete members for increased cracking or spalling look for evidence of rust at cracks. Look for any exposed or broken prestressed strands.
Floor Systems: Inspect stringers, floor beams and overhang brackets for new cracking and loss of section due to rust. Inspect expansion devices for freedom of movement and condition of seal (leaking, strip seal joints).
Trusses: Inspect for changes in alignment of the trusses, bowed or kinked compression members that were not shown in the last report. Inspect the trusses and bracing members for traffic damage. Check the condition of all pins and connections for changed conditions.
Cables: Inspect cables for breakage, fraying and surface pitting.
Diaphragms and Cross Frames: Inspect diaphragms and cross frames on steel bridges for new cracking particularly at the points of attachment to main structural elements. Welded attachment plates in the tensile zones of girders are fatigue sensitive and may induce out-of-plane bending in girder webs. These locations should be inspected for new cracking.

Lateral Bracing, Portals and Sway Frames: Inspect lateral bracing and sway frame connection plates for new fatigue cracking and loss of section. Inspect truss portal members for new collision damage or misalignment.

Rivets, Bolts and Welded Connections: Sound suspected loose bolts with a hammer for audible sounds of distress and movement. Riveted connections should be inspected for loss of rivet heads and condition of the joint. Suspected loose rivets should be sounded with a hammer. Welded connections should be inspected for new fatigue cracks.

Bearings: Inspect bearings for proper functioning and check anchor bolts to see that the nuts are properly tightened. Check concrete around the anchor bolts for cracking that may indicate improper functioning of bearings.

Paint: Inspect the paint on the structure and make a judgment on its condition. Document any increase in corrosion which has occurred since the previous inspection.

Utilities: Inspect utility lines attached to bridges for failure of the utility or its attachment system.

Substructure: A Sub-standard Inspection of the sub-structure of a bridge consists of an examination and recording of changes in signs of damage, deterioration, movement and if in flowing water, evidence of changes in stream bed elevations due to scour or channel migration.

Abutments: Inspect abutment caps and bridge seats for changes in cracking and deterioration since the previous inspection. Investigate for foundation changes due to scour. Examine all concrete surfaces for changes in cracking and deterioration. Check for changes in horizontal and vertical position of the superstructure relative to the abutment. Check encased structural steel for deterioration and movement relative to the concrete. Inspect masonry joints and all walls for changes due to rotation or shifting. Inspect abutment drains and weep holes for changes in the drainage. Inspect foundations and piling for changes due to erosion and scour condition or rip-rap protection.

Piers and Bents: Inspect caps and bridge seats for changes since the previous inspection. Inspect for increased scour/and or erosion damage or undercutting. Exposed piling should be inspected for changes in soundness. Inspect riprap for changes in stability. Examine exposed concrete, steel and stone masonry for changes which have occurred since the last inspection. Inspect for changes in the vertical and lateral position. Note increases in drift and soil deposits.

Bridge Stability and Movements: Check the structure for changes in the vertical and horizontal position. Examine rockers, rollers and hanger elements for movement or inclinations. Compare with notes from previous inspection.

Waterways: Updated ground line cross-sectional views for any structure over water are required to be included in Regular inspections. See the section titled "Scour Detection Surveys, Ground line Profiles, Reporting and Action Procedures" for detailed instructions on how to create ground line profiles.

Report: To an even greater extent than is necessary for the "Initial Inspection", the activities, procedures and findings of a "Sub-Standard Inspection" must be well documented. All of the inspection data must be assembled into an electronic "Bridge Inspection Report".

Interim Inspection (Special)

Purpose: To provide guide lines for performing and documenting Interim Inspections.

Definition: Interim Inspections are inspections used to monitor a particular known or suspected deficiency (e.g. foundation settlement, channel erosion and/or degradation, scour, member condition, the public's use of a weight posted bridge, posting signage, etc.) and/or any repairs made to a structure.

Frequency: An Interim Inspection is scheduled at the discretion of District Bridge Engineer in responsible charge of bridge inspection activities. As specified in the NBIS, Interim and cursory inspection frequency shall be determined based on age, traffic characteristics and structural deficiencies.

Examples of bridges which may require Interim inspection are:

- Posting Signage
  - ➢ Those structures that become substandard within a 24-month inspection frequency due to updated load rating analysis. Interim Inspection (Special) + NBI inspection will be required at the time of posting verification. Also, verify that structure is on a 12-month inspection frequency.
- Recently Repaired bridges
- Those with potential foundation and scour problems
- Those with outmoded details, which are known to be failure prone, in the original design
- Those with potential fatigue problems
- Those in questionable condition

Examples of events requiring one time cursory inspections are:

- Floods on streams susceptible to scour or channel migration
- Accumulation of drift on substructures of bridges located on scour susceptible streams

Report: Each Interim Inspection shall be documented in a brief narrative report. The Interim Inspection shall be submitted as an electronic report into the database with required changes/modifications to inventory coding data as needed. If changes are recorded in the interim inspection report that would change operational status recorded in the most recent NBI inspection (e.g. posting status for item #41, closed for admin area, etc.), an NBI inspection must also be performed with the following narrative included in the inspection notes:
XX/XX/20XX this special inspection was performed and NBI Items ***XXX, XXX, XXX, and XXX*** were updated. No other NBI items were inspected or changed from the last NBI inspection dated ***XX/XX/20XX. (Provide explanation of changes to NBI Items)*** This special inspection was performed by, ***INSPECTOR 1, INSPECTOR 2, and INSPECTOR 3***.

Photographs and sketches as necessary to describe changes in deterioration since the previous inspection should be attached. Photographs for posting signage and any deficiency warranting a change in any NBI item are required.

Damage Inspection (Special)

Purpose: To provide guide lines for performing and documenting Damage Inspections.

Definitions: A Damage Inspection is an unscheduled inspection to assess structural damage resulting from environmental factors or human actions. Structural damage accruing from human actions include collision by land and water vehicles, such as cars, buses, trucks, trailers, trains, boats, or barges, and by adjacent dredging or excavation activities. Environmental causes include potentially damaging events such as earthquakes* or major floods.

Frequency: Damage Inspections are performed as soon as practical after the District Bridge Engineer receives word that the bridge has been damaged.

Procedures: The scope of inspection must be sufficient to determine the need for emergency load restrictions or closure of the bridge to vehicular or marine traffic and to assess the level of effort necessary to affect 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 for misalignment of members and check for any loss of foundation or bearing support. “Routine” and/or “In-depth” Inspection procedures, as defined in this same section, shall be used to fully document the extent of damage, the urgency and magnitude of repairs and to change operational status of the structure in the KY NBI. If changes in the operational status are found an NBI inspection should be performed.

Report: Proper documentation of the inspection’s field measurements and observations is required. This documentation includes photographs, sketches and narrative of the inspection. Reporting must be of such detail so that a more refined analysis by the Central Office Bridge Preservation office can be performed to establish or adjust interim Load restrictions or follow-up procedures. A particular awareness of the potential for litigation must be exercised in the documentation of Damage Inspections. The Damage Inspection shall be submitted as an electronic report into the database. For reporting change of any NBI items, include the following note:

XX/XX/20XX this damage inspection was performed and NBI Items, ***XXX, XXX, XXX, and XXX*** were updated. No other NBI items were inspected or changed from the last NBI inspection dated ***XX/XX/20XX. (Provide an explanation of changes to NBI items***) This special inspection was performed by, ***INSPECTOR 1, INSPECTOR 2, and INSPECTOR 3***.

* See separate section on Post-Earthquake Inspection.

Fracture Critical Inspection

Purpose: To provide guide lines for performing and documenting inspections of Fracture Critical Bridge members.

Definitions:

Fracture Critical Member (FCM): As defined by AASHTO, is "a steel member in tension, or with a tension element, whose failure would probably cause a portion of or the entire bridge to collapse".

Fracture Critical Member inspection: A hands-on inspection of a fracture critical member or member components that may include visual or other nondestructive testing.

In-depth inspection: A close-up inspection of one or more members above or below the water level to identify any deficiencies not readily detectable using routine inspection procedures; hands-on inspection will be necessary at all members of the bridge.

Redundancy: The ability of other members to help carry the load when a member becomes weak or fails. These other members have the capacity to temporarily carry additional load, to prevent collapse of the bridge. On non-redundant bridges, the redistribution of load may not be possible or may cause additional members to also fail, resulting in a partial or total collapse of the bridge. There are three basic types of redundancy in bridge design, however, only load path redundancy defines a FCM. Load path redundant bridge designs have three or more main load carrying members (load paths). If one member fails, load would be redistributed to the other members, and bridge failure would not occur.

Failure Mechanics: Describing the process by which a member fails when subjected to fatigue is called failure mechanics. Fatigue is the primary cause of failure in fracture critical members. The fatigue failure process of a member consists of the following three phases:

1. **Crack initiation**: A crack first initiates from points of stress concentration in structural details. Stress concentrations can result from flaws, geometric details or out-of-plane distortions. The most critical conditions for crack initiation at structural details are those combining:
   a. High stress concentrations due to flaws
   b. High stress concentrations due to geometric details
   c. High stress concentrations due to out-of-plane distortions
2. **Crack propagation**: Once a fatigue crack is initiated, applied cyclic stresses propagate the crack across the section of the member until it reaches a critical size, at which time the member fractures.
3. **Fracture**: Fracture of a member is separation of the member into two parts. The fracture of a critical member causes the span, or a portion of it to collapse.

The most critical conditions for fatigue crack initiation are those which involve stress concentrations. The need to connect girders, stringers, floor beams, diaphragms, bracing, truss members, hangers, and other members makes it impossible to completely avoid stress concentrations. Bridge structures, particularly those that are welded cannot be fabricated without details which cause some level of stress concentrations.

Frequency: Fracture Critical inspection shall not exceed twenty-four month intervals. Fracture Critical Inspections may be performed in conjunction with Initial or Regular Inspections. The inspection schedule can be adjusted to provide more frequent inspections based on the condition of the bridge's FCMs.

Procedures: The Central Office and District Offices shall maintain a FCM master list of all bridges that require fracture critical inspection. For each bridge on the FCM master list, descriptions and/or sketches identifying the location of the FCMs, the required fracture critical inspection frequency and detailed inspection procedures shall become a permanent part of the electronic bridge file.

The District Bridge Engineer shall prepare an inspection plan to identify unique requirements of the specific bridge and to specify the inspection methods to be used. A Fracture Critical Access Procedures form will need to be filled out and uploaded to the media tab (see **Exhibit #9107**).

The FCM Inspection is conducted in a systematic and organized manner so as to minimize the possibility of overlooking any FCM bridge element. A Fracture Critical inspection is performed on all FCMs at the prescribed frequency. The inspector is required to pay particular attention to fatigue prone areas of the FCMs. The inspector shall perform arm's length inspections on FCMs identified in plans or listing and may include NDT methods.

Inspection procedures for FCMs shall comply with those presented in the FHWA publication no. FHWA NHI 2006 BRIDGE INSPECTOR’S REFERENCE MANUAL. The “Procedures” section lists in detail the steps required to inspect FCM for cracks.

Reports: All of the FCM Inspection data is to be assembled in an electronic "FCM Inspection Report".

Complex Bridge Inspection

Purpose: To provide guide lines for performing and documenting Complex Bridge Inspections.

Definition of a Complex Bridge: Any movable, suspension, cable-stayed, or other bridge with unusual characteristics.

Frequency: Inspection procedures and intervals should be outlined in initial Consultant Engineering firm inspection report, however, "Routine" and "Fracture Critical" inspections shall not exceed twenty-four months.

Procedures: As outlined in Consultant Engineering Firm initial inspection or design manual for each individual bridge.

Underwater Inspection

Purpose: To provide guidelines for performing and documenting underwater inspections.

References:

- FHWA 2006 – BRIDGE INSPECTOR'S REFERENCE MANUAL
- ASCE Manuals and Reports on Engineering Practice No. 101 -"Underwater Investigations Standard Practice Manual"

Definition: Underwater Inspection is the inspection of the underwater portion of a bridge substructure and the surrounding channel , which cannot be inspected visually at low water by wading or probing, generally requiring diving or other techniques, in water 3.5 feet and greater in depth to visually hands on inspect and measure bridge components. Congress and the Federal Highway Administration (FHWA) have stressed the importance of underwater inspection of bridges in:

> Title 23, Code of Federal Regulations, Part 650, Subpart C sets forth the National Bridge Inspection Standards (NBIS) for bridges on public roads. Section 650.313 – paragraph (e) (2) requires states to give a location and description of each underwater element to be inspected, define the frequency of inspection and give the procedures in the inspection records for each bridge requiring an underwater inspection.

Frequency: All bridges on public roads in Kentucky with substructures located in water levels that prohibit normal inspection practice shall receive an underwater inspection using an underwater camera or a qualified diver (see "Qualifications of Bridge Inspection Program Personnel") and/or in some cases with the aid of a work boat and tactile inspection, at frequencies not to exceed five (5) years. Certain underwater structural elements may require inspection at less than sixty (60) month intervals. Establish criteria to determine the level and frequency to which the members are inspected considering items such as construction materials, environment, age, scour characteristics, condition rating from past inspections and known deficiencies Deteriorated underwater members or bridges which are located in unstable channels may require shorter inspection intervals. These intervals vary depending upon severity of deterioration or foundation conditions and are determined by the Central office Staff in consult with the District Bridge engineer.

Sometimes certain events and conditions affecting a bridge require that non-scheduled underwater inspections of bridges be made to meet the urgency of the contingencies. These events may include, but are not limited to:

- Unusual or Major floods
- Vessel impact
- Build-up of debris at piers or abutments
- Evidence of deterioration or movement

Normally, water less than three and one half (3.5) feet in depth should be safe for a District inspection team to make an adequate underwater evaluation without divers as a part of the "Routine Inspection". Reference to underwater Inspection in this document means an underwater inspection performed by a qualified diver.

Procedures: There are two (2) types of inspections for bridge substructures located in less than 3.5 feet of water. These inspections are performed by the bridge inspection teams:

1. **Interim Inspection** is observations and/or probing made during low-flow periods for signs of undermining or substructure deterioration. These inspections are performed to ensure that structure continues to be safe for continued use by the traveling public. A cursory review of the substructure should first be made to determine if there has been significant change to it since the previous inspection. Significant change can be determined by observing vertical alignments of the substructure. Scour holes, head-cutting, bank migration/failures, etc. in the vicinity of foundations shall also be measured to determine if significant changes have occurred since the last inspection. If significant change has occurred, the inspection team shall determine if the bridge is safe for continued use by the traveling public. If the bridge is not considered safe for continued use by the traveling public (requires closing), immediate action will be taken by the inspection team to have the bridge closed. The established procedures for bridge posting or closing notification shall be adhered to in all cases.
2. **Regular Inspections** are to ascertain the existence of or the extent of deficiencies found in normal, but wadeable flows.

Three Levels of Underwater Inspection: For bridges located in water greater than 3.5’, underwater inspections performed by a qualified diver are required. There are three intensity levels of underwater inspection. The levels of underwater inspection are indicative of the effort required and provide a standard underwater inspection terminology. The three underwater inspection intensity levels are:

Level I Underwater Inspection: A swim-by overview underwater inspection with minimal cleaning to remove marine growth involves arm's length visual examination, or tactile examination using large sweeping motions of the hands where visibility is limited. A Level I examination is usually conducted over the total exterior surface of each underwater structure element. It must be detailed enough to detect major damage or deterioration due to over-stress, corrosion, or scouring, and confirm the continuity of the full length of the members.

Level II Underwater Inspection: A detailed inspection involving limited measurements of damaged or deteriorated areas that may be hidden by surface biofouling. Marine growth is cleaned from a sample of underwater members in critical areas. Generally, the critical areas are near the low water line, near the mud line and midway between the low waterline and the mud line. On piling 10 inch wide bands should be cleaned at designated levels to enable close inspection. The locations should include:

- Rectangular piles - the cleaning of three sides
- Octagonal piles - at least six sides
- Round piles - at least three-quarters of the perimeter
- H-piles - at least the outside faces of the flanges and one side of the web
- Large faced elements such as piers - 1 foot by 1 foot areas at three levels on each face

The extent and severity of all damaged areas shall be measured and documented.

<u>Level III Underwater Inspection</u>: A highly detailed inspection to detect hidden or interior damage and loss in cross sectional area. Procedures include utilizing nondestructive tests such as ultrasound or minimally destructive tests such as coring of wood or concrete and in situ hardness tests.

The Underwater Inspection is to be conducted in a systematic and organized manner so as to minimize the possibility of overlooking any underwater damage or problem. New or changed defects found in the various substructure elements should be thoroughly investigated to determine and evaluate their cause.

The Underwater Inspection shall consist of:

A. Appropriate Level of Inspection:
   1. A Level 1 inspection of 100% of the underwater surfaces for the detection of deterioration, deficiencies or damages and the measurements to verify as-built conditions. If irregularities or deficiencies are any concern, move to a level II inspection.
   2. A Level II inspection for further documentation of all deficiencies identified by the Level I inspection. **Use of underwater cameras:** The use of underwater cameras is not appropriate for level II inspections.
   3. If the results of the Level I & II inspections require more detailed inspections, additional Level II and/or Level III inspections shall be performed at the direction of the KYTC.

B. A “regular” underwater inspection shall be performed on exposed piling under footings. The inspection shall consist of Level II inspections of extensive areas of the piling and limited Level III inspections to determine the soundness of the piling.

C. Inspect the channel bottom for scour by:
   1. Making soundings at 10' intervals from each end and side of pier facings and extending the lesser of a distance of 50' from the pier face or one half the spans as appropriate.
   2. Identifying the channel bottom material (such as silty clay, firm clay, sand, rock, etc.).
   3. Investigate and measure void areas under or near pier footings as detected.

D. If a sub-footing exists for a pier, and it is exposed, measure the dimensions.

E. Measure the dimensions of exposed pier footings, and column shaft(s); measure from a known elevation such as the top of a pier (beam or girder seat) to the top of the footing(s) and determine water surface and the channel bed elevation relative to the top of pier (include the date and time of the water level measurement in the inspection report).

F. Other diver investigations include:
   1. Laying out a grid pattern and taking depth measurements.
   2. Sampling soils to determine backfilling of scour holes.
   3. Probing to check for refilling.
   4. Detecting undermining and scour holes.
   5. Detecting small diameter but deep scour holes around piles.
   6. Protection system evaluation (e.g. rip rap)

G. In order to assess NBIS Item #60, a visual inspection of the full height/face of any substructure that has the potential to be underwater shall be inspected by the consultant underwater team.

H. Stream Profiles of all scour critical bridges should be performed during the underwater inspection.

Report: All of the underwater inspection data shall be assembled in an electronic "Underwater Inspection Report". The order of material in the underwater inspection report shall be presented as shown below:

- Cover Page – Include photograph of structure, facility carried, intersection feature, county, structure number, and date of inspection.
- Executive Summary – Includes brief narrative of the underwater inspection, notable defects and the coding for NBI Items 60, 61, 92B, 93B and the recommended 113 coding.
- Table of Contents
- Purpose and Scope of Work
- General Description of Structure
- Method of Investigation
- Existing Conditions
- Evaluation and Recommendations
- Inspection photographs – detailed photographs with descriptions of deficiencies noted.
- Appendices for Figures – Figures should include a vicinity map, substructure plan views, pier elevation views, hydrographic surveys and cross sections.

Using the above guideline, prepare a written report for each bridge documenting the condition of previous repairs and all the findings of the inspection. The report shall include detailed drawings and sketches as necessary to fully document the measurements taken during the inspection. Research of Item 60 with the current routine inspection shall be performed as to compare NBI Item 60 in the underwater inspection report so that the Substructure Rating does not conflict with the condition above or below the water line. A recommended coding for Item 113 shall be given so that the KYTC Scour Engineer may update.

"Under Record" Inspections for Structures Not Carrying Public Roads

Purpose: To provide guidelines for performing and documenting inspections of structures spanning over public roadways that do not carry public vehicular traffic. These may include railroads, pedestrian bridges, or even buildings.

Description: The NBIS applies to all structures carrying public roads; however, there is an obligation to the motoring public for safety related to driving under these types of structures. The Coding Guide mentions minimal NBI data items in Item 5A that must be collected for an "Under Record" route; therefore, an inspection of privately owned structures over the public roadway must be entered to ascertain horizontal and vertical clearances, substructure and superstructure critical maintenance needs, and the placement of the required warning signs (horizontal or vertical clearance signs). If revisions are made to Item 10, then corresponding revisions must be made to Item 54.

When documenting these types of inspections, the following is a guideline for BrM Entry:

- A Standard/Routine, NBI inspection must be checked as the Primary Type in the Schedule Tab.
- Code NBI Items 58, 59, and 60 as "N N/A (NBI)":
- Review and update, if necessary, the coding for NBI Items in 5A.
    - Inspection Notes: provide an overview of the findings as well as the following narrative in the inspection note:

        XX/XX/20XX This inspection was performed to only verify NBI Items in Item 5A due to this structure being private but over a public roadway. The under record NBI Items were reviewed and updated as needed. Inspection performed by, *INSPECTOR 1, INSPECTOR 2, and INSPECTOR X….*

    - Structure Note: Provide a statement indicating ownership and maintenance responsibility in the structure notes.
    - Media Tab: upload PDF photo log (Vertical posting signs for example).

Distribution for Inspection Reports:

- A hard copy file of inspection reports for these structure(s) will be made and submitted, with necessary correspondence, to the bridge owner.
- Correspondence shall include: Official letter outlining any critical findings including horizontal and vertical clearance signage found during the inspection, BrM inspection report, and a vicinity map of the structure.

Element Level Inspection

Purpose: To provide guide lines for performing and documenting Bridge Element Level Inspections.

Description: For more in-depth information on performing Element Level Bridge inspection, see the AASHTO Guide Manual for Bridge Element Inspection First Edition 2013 provided by KYTC. This manual is designed to aid the bridge inspector in assessing and inspecting bridges using element level. MBEI uses NATIONAL BRIDGE ELEMENTS (NBEs), BRIDGE MANAGEMENT ELEMENTS (BMEs), and AGENCY-DEVELOPED ELEMENTS (ADEs) to describe the structural elements of a bridge, such as decks, slabs, girders, trusses, floor beams, stringers, hinges, columns, abutments, pier caps, railing, expansion joints, bearing devices, culverts, and wings on culverts, etc. Each element in the MBEI has condition state language, unit of measure, and notes regarding environment assignment, quantification, and special cases.

Definitions of MBEI Terms:

Condition State: This describes the current condition of the element. An element can have from one to four states of Condition State Language, with 1 being the Best Condition and 4 being the worst. The Condition State Language for each element is described in the MBEI.

Element: An element is a fundamental part of a bridge for which condition is assessed. The elements set presented within the Manual includes two types: identified as National Bridge Elements (NBEs) or Bridge Management elements (BME's). The combination of these two element types comprise the full AASHTO element set. But to accommodate elements that cannot be captured with NBEs and MBEs KYTC has its own Agency Developed Elements (ADEs). All of the elements, whether they are NBEs, BMEs, or ADEs have the same general condition assessment characteristics.

NATIONAL BRIDGE ELEMENTS (NBEs): The National Bridge Elements represent the primary structural components of bridge necessary to determine the overall condition and safety of the primary load carrying members. The NBEs are a refinement of the deck, superstructure, substructure, and culvert condition ratings defined in the Federal Highway Administration's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. Additional elements included in this section are bridge rail and bearings. The NBEs are designed to remain consistent from agency to agency across the country in order to facilitate and standardize the capture of bridge element conditions at the national level. In order to capture the diversity of new element design types and materials, many elements in this category have an "other" element type defined.

BRIDGE MANAGEMENT ELEMENTS (BMEs): Bridge Management Elements include components of bridges such as joints, wearing surfaces, and protective coating systems and deck/slab protection systems that are typically managed by agencies utilizing Bridge Management Systems. The BMEs are defined with a recommended set of condition assessment language that can be modified to suit the agencies' needs as these elements are not intended to be utilized for the purposes of national policy-making. The BMEs defined within this manual were purposefully left fairly general in nature to provide the flexibility to develop agency-specific elements that best suit the local bridge management practices. Agencies may choose to develop additional BMEs as necessary following the agency-developed element conventions discussed in the AASHTO Manual for Bridge Element Inspection, Appendix A. When considering additional elements, the agency should consider such factors as element performance, deterioration rates, feasible actions, and preservation costs, as well as the practical considerations of training and inspection costs.

AGENCY-DEVELOPED ELEMENTS (ADEs): The elements presented within provide the flexibility for an agency to define custom elements in accordance with the defined element framework that may be sub-elements of NBEs or BMEs, or may be agency-defined elements without ties to the elements defined in this manual. By defining a comprehensive set of bridge elements necessary for robust bridge management and the minimum set of elements necessary to assess the condition of primary components of bridges, this manual provides a flexible element set that can be tailored to the needs of all agencies. The identification numbers 800 and above are not used in this manual for any elements and are reserved for agency purposes. See Below a list of our current ADEs or KYTC Specific Elements with condition states.

> KYTC ADEs that are considered structural elements and exist as part of the Bridge or Culvert shall be captured. For example, Tension Rods, Drains, Longitudinal Shear Keys, Curbs, Culvert Headwalls, Culvert Wingwalls, Sidewalks, Steel Closed Web/Box Cross Girders. Quantities are 1 or Linear feet. All other ADEs will be captured on an as-needed basis. For example, Channel Drift, Debris on and around superstructure, Embankment Erosion, Utilities, Channel Alignment, etc. See Chapter 600 for complete list of ADEs.

Environment: One of four classifications that describes the rate of deterioration of an element:

1. Benign
2. Low
3. Moderate
4. Severe

Typically all elements in Kentucky are placed in Environment 3 – Moderate. BrM will default to 3.

Scenario: A Scenario is a part of the BrM Computer program that uses Inspection Data along with other data such as material costs, inflation and NBI data to predict bridge repair cost and/or replacement over a programmed period of time.

Defects: Bridge inspections based on the MBEI consist of defining the elements (pieces of the bridge) and total quantities that exist at each bridge. The condition of each element is determined by performing a field inspection and recording quantities of the element that have identified defects that correlate to the severity of the defects defined in the particular condition state definition of this manual. The condition assessment is complete when the appropriate portion of the total quantity is stratified over the defined condition states. For agencies utilizing bridge management systems, the appropriate element defects, and environment shall be recorded for use in deterioration modeling.

In this manual, the element represents the aggregate condition of the defined element inclusive of all defects. The specific listing of all defects is optional; however, the element condition must be inclusive of all defined defects. Element defects are typically to be used when the element reaches Condition State 2 or lower and they essentially act to break down the overall element condition into one or more specific observed problems. The defects defined within this manual shall always assume the units of the element with which they are associated. For example, the scour defect may be applied to a column or a pier wall. The defect language is the same for both elements; however, the units for the column defect would be each and the units for the pier wall would be linear feet. In some cases, multiple defects may operate in the same defined space. In this case, the inspector shall report the defect in the most severe condition state. If two defects in the same condition state operate in the same defined space, the inspector shall determine the predominant defect for reporting. For example, if a reinforced concrete bridge deck is cracked throughout and also has a spall in a portion of the deck, the spalling would likely be determined to be the predominant defect.

This manual attempts to cover the vast majority of all bridge elements found on highway bridges in the United States. During the course of an inspection, the inspector may find materials or elements that are not defined. In these cases, the inspector should use judgment to select the closest element match or use the "other" element type. In a similar vein, there may be cases when the specific condition observed in the field is not defined in this manual. In these cases, the inspector should use the general description of the condition states to determine the appropriate condition.

Defects and how they correlate with the NBEs, and BMEs.

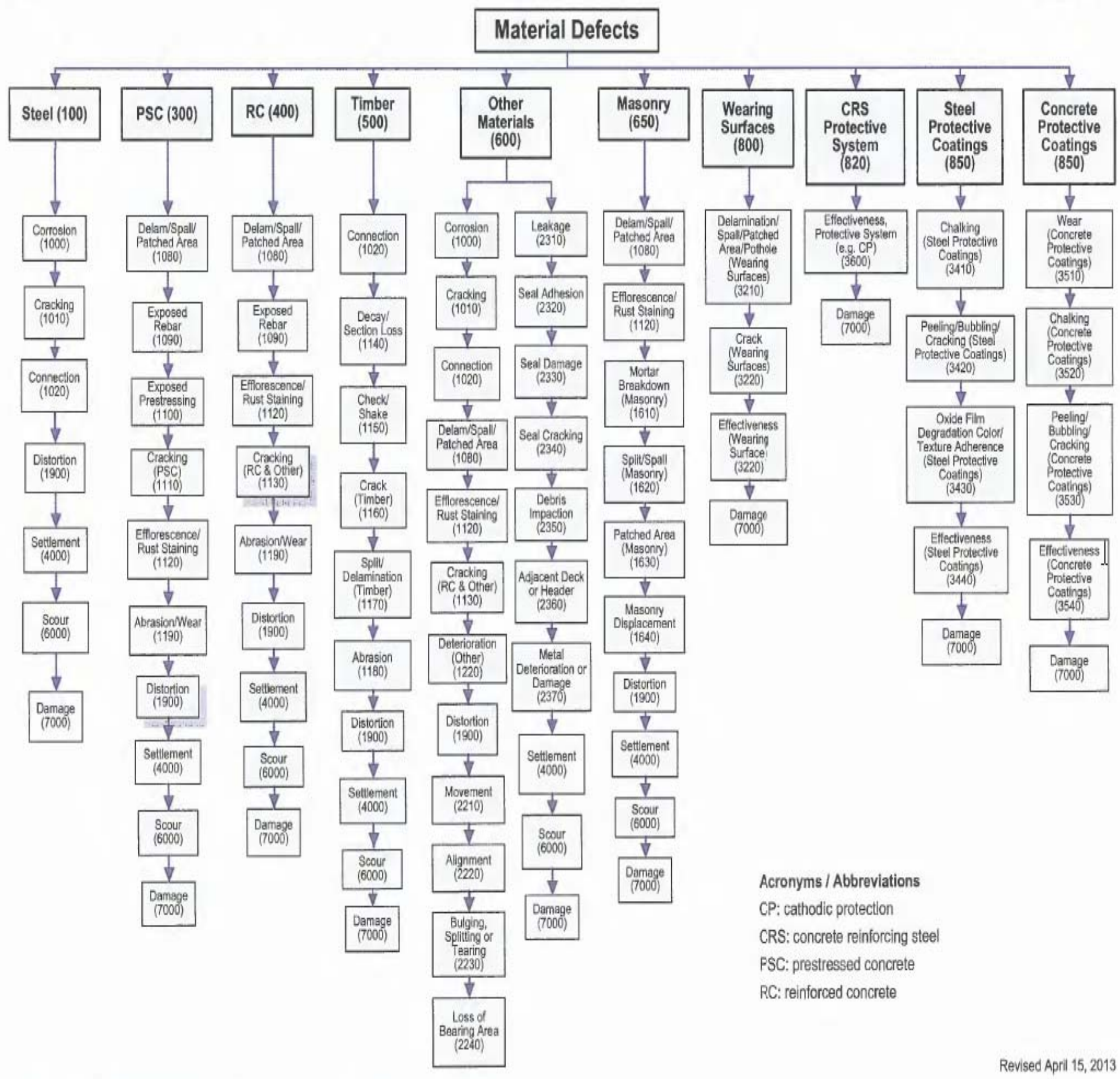


Figure D-1 Material Defects (*courtesy of Federal Highway Administration*)

Manual for Bridge Element Inspection D-21

Frequency: Element level Inspections are to be performed at intervals not to exceed two (2) years.

Procedures: It is important to note that the collection of element condition data does not substitute for traditional NBI safety inspections. Narrative descriptions, photographs, sketches, and data for all other NBI items are collected in the Routine Bridge Inspection. Furthermore, element condition data should not be relied on as the only means of determining the seriousness of a defect. A mid-span vertical crack in a girder is certainly more critical on a simple span bridge than is a similar crack near the end of the span; however, the element condition state description would be the same for both cracks. It is therefore very important to use standard procedures for identifying critical findings and assuring that prompt remedial action is taken.

Identification of Elements: For the purpose of accurate coding, elements are defined as portions of a bridge which perform load-carrying functions or are safety features for the entire bridge. To properly code a bridge using Element level inspection methods, the inspector will identify the appropriate elements for that bridge, and provide the appropriate quantity of each element. Note that elements have different units of measure, typically EACH, LINEAR FEET/METERS and SQUARE FEET/SQUARE METERS.

Estimating Quantities: Quantities of elements are typically estimated based on the number of elements times the span length or bridge width. For example, If the Deck is 20 feet wide O/O and 30 feet in length the calculated area is 20' x 30' = 600 square feet of area. Wearing surface will be calculated C/C x the length. If there are 10 floor beams on a structure and the bridge length is 30 feet, you can estimate the total quantity as 10 x 30 = 300 lf. For Protective Coatings reference the ASCI Steel Manual, Plans, or the KYTC Barrier Multipliers located in the \\Kytcd00t11\data\BRMAINT\BrM & Bridge Element References. Also, see section 600 for Bridge Element Reference Material. For many elements, decisions need to be made relative to the limits of measurement or conventions that should be used in determining total quantities.

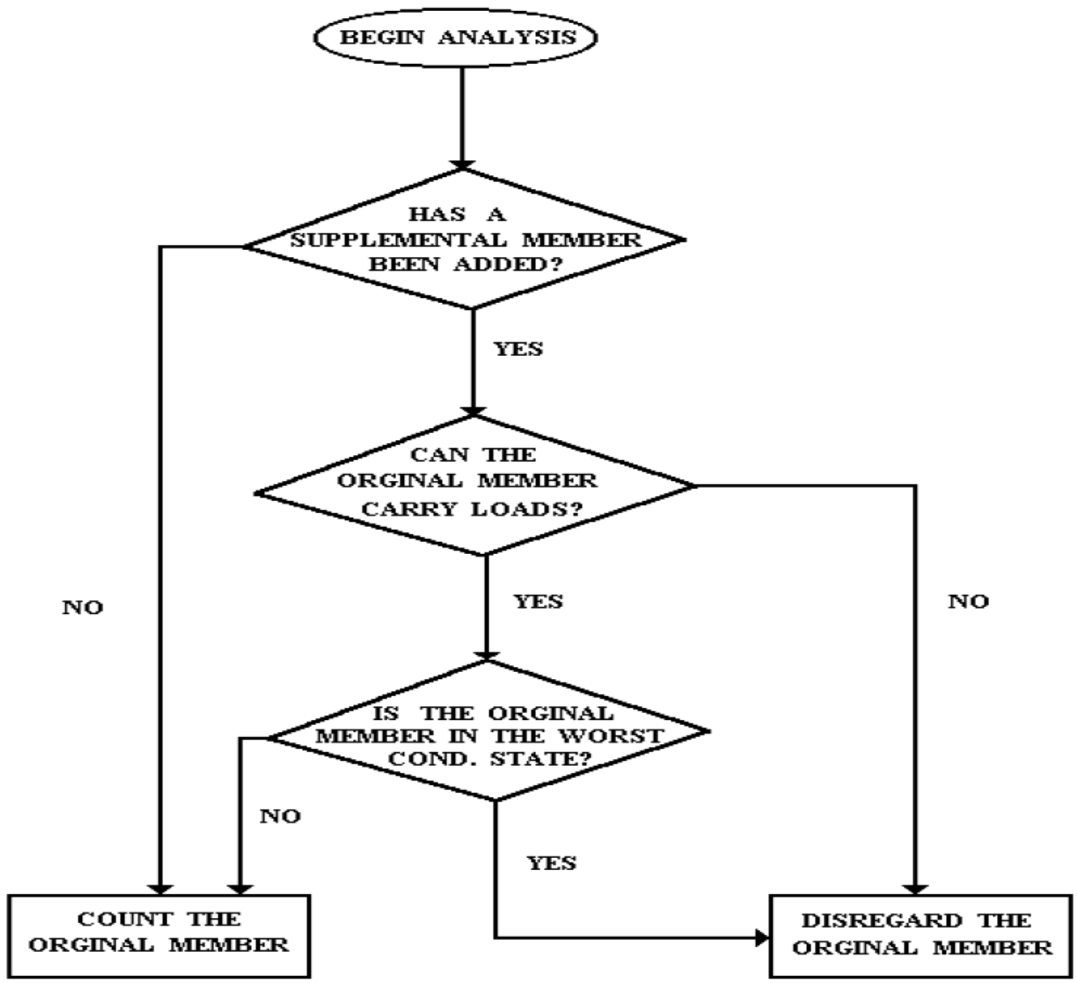
The Initial Assessment: Before a bridge can be inspected, the elements and their corresponding environments and quantities must be determined. This is done most easily by using the original plans. The individual elements are identified and recorded. Each element is then assigned an environment number. This environment number tells BrM at what rate the element will deteriorate. A 1 indicates that the environment of the bridge is considered Benign where a 4 would indicate a severe environment. In general, all elements in Kentucky are placed in environment 3 (Moderate). Each element also requires a quantity. These quantities can be computed using the original plans, and later 'visually verified' at the bridge site. Most elements, such as girders, railing, abutments, culverts, and expansion joints, are quantified in a linear unit of measure (feet). Others, such as columns, and bearing devices, are quantified by how many there are (or each). Decks, Wearing Surface, and Protective coating will be area, square feet.

The Inspection: Once the initial assessment is completed, the actual inspection can begin. The condition state language describes the criteria by which portions of an element are rated and placed in a corresponding condition state. Each element has four condition states (Condition State I being the best condition) which describe the deterioration level of the element. A new bridge may have problems and they should be recorded in the element inspection. As a rule of thumb, elements that cannot be inspected either above ground or underwater should not be coded. Examples of these type elements might include certain bearing designs, joints, and piles. Condition data cannot be collected for elements that are not visible for inspection. One of the main goals of collecting quantified condition state data is to enable the prediction and tracking of deterioration rates for various elements. Giving each element a quantity allows for a detailed assessment of the element's condition. MBEI allows for each element to have portions with different deteriorations to be placed in different condition states. In other words, a given element is not restricted to being placed entirely in one condition state. For example, a reinforced concrete culvert (Element # 241) has a cracked region with leaching and staining, but the remainder of the culvert is in good condition. In this case, a couple feet of the culvert are placed in Condition State 2, with the remainder of the culvert being in Condition State 1. A defect can now be added for cracking (if you decide that is the predominate defect). This quantity cannot exceed the parent element quantity in condition state 2. For example, see section 600 for Bridge Element Reference Material.

Decks and slabs are now assessed slightly different. We can now put the deck in varying condition state. For example, if you have 600 square feet of deck (element #12) and have 6 square feet of exposed rebar (defect #1090) with measureable section loss, 6 square feet will be in condition state 3 of the parent deck element #12 and the remainder can remain in condition state 1 or 2. The quantities for decks and slabs are calculated in square feet (Length X O/O).

Certain types of deterioration not covered by the condition state language for the elements are addressed with the use of Defects. Defects are similar to elements in that they have condition states which describe the deterioration level of the element. Defects, however, describe a condition of the bridge and are used only when a problem exists. For example, Delamination/Spall/Patched area Defect (#1080) is used only if delamination /spall/patched areas exists in the surface of the deck. If there are no delamination /spall/patched areas in the deck, then the Defect is not coded. The condition state language for the Defects is written so that condition state 1 indicates in most defects that there is no problem, but in a 'minor problem' or 'minor deterioration' rather than good condition as seen in the element condition state language.

Supplemental Members: When supplemental members have been added to a structure, such as new timber piles added to replace deteriorated piles or a girder added to reduce load on existing girders, the flow chart below, should be used to determine the appropriate quantity of the element that should be included for MBEI purposes. Occasions will arise where original members have been completely replaced and no longer serve any structural purpose. It is not necessary to collect element data if the member is no longer serving any structural purpose.



Distribution: All element data shall be entered into the BrM Database following the steps below. Every District bridge inspection team leader will have at least one computer loaded with BrM.

Loading Inspections into the BrM Database: Currently, all inspection input in the field to the database server is performed through direct input by connection to Citrix server. All inspection input in the office can be accessed through the BrM website.

In-Depth Inspection

Purpose: To provide guidelines for performing and documenting In-depth Inspections.

Definition: An in-depth inspection is defined as an inspection which places the Inspector close enough to all structural elements to be reasonably certain that no structure-threatening deficiency exists.

Frequency: Inspection intervals for In-depth inspections should be adhered to as described in "Categories and Recommended intervals" as practical, however, "Routine" and "Fracture Critical" inspections shall not exceed their prescribed twenty-four month intervals.

Procedure: To a higher degree of time spent for observation and access, all procedures outlined for "Routine Inspections" and "Fracture Critical Inspections" shall be followed, with detailed notes, sketches and ample condition photographs recorded during In-depth Inspections. An Inspector is "reasonably certain" if unaided visual inspection reveals no cause for further investigation. The distance an Inspector must be from a particular inspection item depends on several factors such as:

1. Type of Bridge
2. Structural material
3. Type of stress in member
4. Environment
5. Strength of Inspector's vision

For example, E or E' fatigue details on welded structural members require close visual inspection from "arm's length" or less. A welded steel compression member in the same bridge may require only a cursory examination to check for vehicular impact, misalignment or severe corrosion defects. A critical defect in a tension flange on a high strength steel member may be a crack of 1/4" length while long multiple cracks in the positive moment region of a reinforced concrete deck girder may be meaningless. The Inspector must familiarize himself with the structure he or she is preparing to inspect in order to recognize those areas requiring special attention.

Report: To an even greater extent than is necessary for the "Initial Inspection", the activities, procedures and findings of an "In-depth Inspection" must be well documented. All of the inspection data must be assembled into an electronic "Bridge Inspection Report". See the section titled "Outline of Required Report Sections" for the order of material in the electronic Bridge Inspection Report. In-depth inspection date and "performed by" fields shall be updated upon completion.

Post-Earthquake Inspection

Purpose: The purpose of this plan is to establish policy and procedures for emergency bridge inspection(s) following an earthquake.

Background: Following an earthquake, sound transportation infrastructure is required to support emergency response efforts and the delivery of life-safety and relief supplies. The Commonwealth of Kentucky's Emergency Response Plan identifies a number of bridges as Critical Infrastructure Assets[1] that need evaluation as quickly as possible following an earthquake.

Policy: The Kentucky Transportation Cabinet will perform inspections of affected bridges or bridges deemed critical infrastructure assets as soon as possible after a reported earthquake.

Procedures:
For Single-structure events:
Upon notification, the Transportation Cabinet shall ensure that a Certified Bridge Inspection Team is dispatched to the affected structure within a timely manner.

Earthquakes: This section has been prepared to address the probability of an earthquake in the New Madrid Seismic Zone affecting a preponderance of bridge structures in KYTC Highway Districts 1 and 2.

<3.5 Magnitude – Inspection Team(s) will respond to bridges/structures that are reportedly damaged.

3.5– 5.5 Magnitude – Inspection teams from the affected Highway District AND adjoining districts should respond to the District Office within 30 minutes of notification. The District Bridge Engineer of the affected district, Chief Load Rating Engineer, Chief Bridge Inspection Engineer, Chief Bridge Inspector or their designated representative will assign inspections keeping the critical infrastructure assets in mind as priorities. Inspection teams should be prepared to remain in the affected area until relieved by other teams.

>5.5 Magnitude – In the event of an earthquake of magnitude, inspection teams will be relied upon to self-activate, insuring that they are equipped/provisioned to maintain operations for a minimum of three days without re-supply. Inspection teams from the following districts will be responsible for inspecting structures on the following routes:

District	Route
3	Interstate 24
4&7	Western KY Parkway
5	US 60 from US 31W West
6	US 62 from US 31W West
8	US 68 from Bowling Green West
9	Pennyrile Parkway (then Audubon)
10	Natcher Parkway (then Audubon)
11&12	Prepare to relieve other inspection teams
CO	Designated personnel respond to Wendell Ford NG Training Center and the Joint Reception Center at Bowling Green, other Engineering/Inspection personnel backfill deployed teams and relief teams.

Communications: When Inspection Teams deploy in response to an emergency, they should contact the Transportation Operations Center (TOC) (502.564.2080) via telephone, radio, or satellite phone/radio and report the following:

1. Team Members names and contact information
2. Route/Structure responding to
3. Change(s) in status (arriving, departing, structure status, special circumstances, etc)

The TOC will log the information, and forward via email to appropriate entities to insure that everyone remains accounted for, and that a clear operational picture is maintained. In a large scale event, the Division of Maintenance will respond to the TOC to assist with these duties (similar to Snow & Ice response)

Other Inspection Assets: Snooper Trucks and Inspection Platforms

Upon learning of an earthquake of significant magnitude, a designated Snooper Truck Operator AND a designated alternate operator shall respond with a Snooper Truck and a support vehicle to the District 4 Office to stand by for deployment to the affected area. A designated Inspection Platform Operator AND a designated alternate operator shall respond with an Inspection Platform and a support vehicle to the District 4 Office to stand by for deployment to the affected area, as well. Designated operators for the other two Snooper Trucks and Inspection Platforms shall make preparations to respond upon request, ideally within an hour of the request being made.

Supporting Agencies:

- Kentucky Emergency Management
- Kentucky National Guard (Air Transport, Security)
- Kentucky State Police (Security/possible ground transport)
- Kentucky Department of Fish and Wildlife Resources (Security/Marine transport)
- US Coast Guard (Marine transport)

Note: In-depth inspections will not be performed on all affected structures in a definable time – initial assessment damage inspections will be performed based on hierarchy of route, importance and design characteristics of bridges (i.e. simple multi-spans without horizontal shear protection at substructure units or retrofits on emergency routes would be 1st. As more staff arrives, inspections on continous structures will be performed and then lower route structures, flagging with color coded cards/ spray paint reporting assessment findings. Thorough inspections and in-depth inspections for design of strengthening measures or for a better look at bridges that have been flagged for moderate concern could proceed after we get down to non-emergency routes. The almost certainty of aftershocks would have all available staff performing assessments in cycles and would not allow the luxury of "thorough" inspections for days.

Supporting Documents: "Kentucky Transportation Center: Post Earthquake Investigation Field Manual for the State of Kentucky", see **Appendix A**:

> The rapid assessment of a bridge structure's safety and functionality is an essential component to restoring vital lifeline routes after a major earthquake. Appropriate posting categories are used to assure the safety of the traveling public. The objective of this manual is to provide a rapid and efficient method of inspecting bridge structures after an earthquake. The primary users of this manual are intended to be the initial Kentucky Transportation Cabinet personnel who will initially reach the bridge sites. It is recognized that such first-line personnel will possess a variety of backgrounds and, therefore, a systematic method of evaluating the damage is necessary. This manual represents a rapid and efficient method of inspecting damaged bridge structures in a uniform manner. Evaluation forms are intended to be filled out electronically, whereby, the resulting posting will be determined through an internal program developed from the expert opinions of the authors. Appropriate posting actions and recommendations are then produced from the inspection results on the evaluation forms. The information gathered on these forms will also be used to prioritize the follow-up inspections by trained bridge engineers and plan repair efforts.
> http://uknowledge.uky.edu/cgi/viewcontent.cgi?article=1129&context=ktc_researchreports

Chart 1 – Tier 1 Critical Infrastructure points (from KYEM)

Description	County
I-24 Bridge (Ohio River)	McCracken
Henderson CSX Rail Bridge (Ohio River)	Henderson
US Hwy 68/ 80 Bridges over KY Lake	Marshall
US Hwy 68/ 80 Bridges over Lake Barkley	Trigg
US 60 Bridge at Wickliffe (Ohio River)	Ballard
US Hwy 41 (Ohio River Twin Bridges)	Henderson
US 231 Bridge (Ohio River)	Daviess
KY 2155/IN 161 (Ohio River)	Daviess
IN 237 / KY 69 (Ohio River)	Hancock
1-24 Bridge (Tennessee River)	Lyon/Marshall
US 60 Bridge (Tennessee River)	McCracken
Western KY Parkway Bridge over Green River	Ohio/Muhlenberg
US 51/ US 60/ US 62 Cairo Ohio River Bridge	Ballard
Cairo Rail Bridge	Ballard
Metropolis Rail Bridge	McCracken
US 45 Bridge (Ohio River)	McCracken
KY 56 Shawneetown Bridge (Ohio River)	Union
KY 81 Green River Bridge at Calhoun	McLean
Hwy 431 Green River Bridge at Livermore	McLean
US 60 Green River Bridge	Henderson
US 62 Green River Bridge	Ohio/Muhlenberg
Dorena-Hickman Ferry	Fulton

Chart 2 – Required/Recommended Equipment and Supplies

Personal Gear: Inspection Team members will need to be self-sufficient to the point that they can perform their duties for a minimum of three days without requiring re-supply. This will require team members to be responsible for their own food/water/clothing and personal gear for the period with overnight bag to include but not limited to:

- Change of clothes for up to 3 days
- Food
- Water (minimum of 1 gallon/day)
- Toiletries (personal hygiene items, extra glasses/contact lenses, medications)
- First Aid Kit
- Batteries/charging cords for phones, laptops, tablets, flashlights, radios

Rope access/climbing gear

Reflective Apparel

Spray Paint:

Green	Post BRIDGE OPEN signs
Blue	Post TRAVEL WITH CAUTION signs *
Yellow	Post REDUCED SPEED LIMIT signs **
Orange	Post BRIDGE CLOSED EMERGENCY VEHICLES ONLY AT REDUCED SPEEDS signs **
Red	Post BRIDGE CLOSED signs **

* Requires Maintenance evaluation

** Requires Structural Engineer evaluation

Reference materials

Camera

Notebooks/pens/pencils/markers

Special Considerations regarding vehicles: Disasters often cause disruptions to normal infrastructure. Refuel whenever possible, and keep extra motor oil and coolant in the vehicle, if at all possible.

Critical Bridge Maintenance Needs Program

The Division of Maintenance Bridge Branch has established a Critical Bridge Maintenance Needs Program (CBMNP), which defines uniform procedures to be followed by all districts. These procedures deal with identifying and documenting the need, notifying the bridge owner, documenting completed repairs, and maintaining a computer inventory for all actions taken.

A Critical Bridge Maintenance Need is any localized condition which imminently or immediately threatens the structural integrity of a structure to the extent that load restrictions or closure is warranted; or it is any condition which threatens motorist safety.

Critical problems demand immediate attention to prevent a reduction of the level of service provided by the bridge. Such problems cannot wait any period of time without action being taken.

This is not a bridge replacement program; there are many bridges with reduced load postings due to overall structural deterioration, which can be operated at their current posting without threatening the structure or traffic. These structures do not have critical needs and should be considered for replacement under the Federal Bridge Replacement Program.

The following provides guidelines for operating the Program, which are discussions of how the program works, the electronic/computer inventory, and guidance in determining if a problem is critical.

The Critical Bridge Maintenance Needs Procedure: When a critical bridge problem is found, the bridge inspector initiates form TC 71-5, "**C**ritical **B**ridge **M**aintenance **N**eeds **I**nspection **R**eport. This is done for both state and non-state maintained bridges. The bridge identification, the date, and the inspector's name are entered in the header area of the CBMNI report. Then the appropriate critical problem type code is circled. Multiple codes are allowed, if more than one type of critical problem exists. If the problem is not described by codes 1 through 9, code 99 is used for "other". If the "other" code is selected, the problem shall be described briefly. An additional comment area is provided for other information pertinent to the problem. The inspector makes no further comments on the CBMNIR. A critical bridge problem found during inspection shall be described thoroughly in the NBIS inspection report; The inspector submits the CBMNIR and the inspection report to the District Bridge Engineer (DBE) for review, as soon as possible. If the DBE agrees that the problem is critical, he/she completes the form by coding the recommended maintenance action and signing it. Otherwise, the CBMNIR is returned to the inspector with notes explaining why the problem isn't critical. If the DBE is unavailable, the inspector will go to the TEBM for engineer support or contact the Bridge Branch for concurrence. The DBE shall send a scanned electronic copy of the CBMNIR, for state and non-state maintained bridges, to the Bridge Branch CBMN contact person (Josh Rogers) immediately.

State Maintained Bridges:

If the bridge is state maintained, the DBE shall also phone the contact person immediately. The DBE shall maintain a holding file of CBMNIR for state maintained bridges, pending completion of repairs. The DBE shall also maintain an electronic/computer inventory of critical bridge problems found on state bridges.

Non State maintained Bridges: Kentucky has many non-state-maintained bridges, which may be owned by entities such as counties, cities and railroads. If a critical problem is found in one of these bridges, **immediate contact shall be made** with the appropriate official representing ownership of the bridge, such as a County Judge/Executive or Mayor.
A certified letter documenting this contact shall be sent to the official not later than the next working day after the contact is made. The letter shall describe the problem, state that the problem should be addressed or the bridge closed, and request that the official notify the Department within 3 days of what action has been taken. **Exhibit #9106** is a sample of such a letter to a County Judge/Executive. Copies of both the CMNIR and bridge inspection report shall be attached to this letter. A copy of the letter, the CMNIR and the bridge inspection report are filed in the individual bridge file. The CBMNIR should also be uploaded into BrM in the media tab. The DBE shall inform the Bridge Branch that the jurisdiction is not in compliance if the CBMNIR recommends posting and the jurisdiction fails to post the structure. Since the Department has no maintenance responsibilities for these bridges, no further action can be taken.

Recommended Maintenance Action: All recommended maintenance action shall be initiated within **three days** of identification of the problem.
All bridge closures shall follow the procedures provided in the Division of Maintenance Guidance Manual.
If monitoring is the recommended maintenance action, a monitoring frequency shall be determined and recorded in the comment area of the CBMNIR and on the current BrM inspection report for item #92c; all appropriate changes to #92c shall reflect that a critical feature requires special inspection. Each time the situation is monitored; a special inspection shall be performed and uploaded with completion date to reflect the date of monitoring. This procedure is continued until the problem is determined not to be critical or a repair is made.
The long term repair of a critical problem may take some time to accomplish, but a temporary repair may arrest the critical situation. In these cases, the problem is coded as corrected and a note is placed in the comments area stating that further repair is needed.
Repairs scheduled for State Forces should be handled through the use of KYTC Projects and Work Candidates in BrM. The DBE shall complete the work order and stamp it “CRITICAL BRIDGE REPAIR”. The work order is then submitted to the District TEBM for Operations, who shall distribute them to the appropriate crew. Upon completion of the repair, a copy of the work order shall be returned to the DBE.
Contract repairs must be requested through the Bridge Branch CBMNIR contact person. Initial contact regarding contract repairs may be made by telephone, but a memo requesting and justifying why the repair is required.
When the recommended maintenance action is completed, the completion date is entered on the CBMNIR and a copy of the report is again sent to the Bridge Branch contact. Then, both the CBMNIR and the completed work order (if applicable), are permanently filed in the individual bridge file. Also, perform a repair/special inspection with addition of notes and photographs to adequately describe the repair method and to reflect the completion date.

The Electronic (Computer) Inventory: The District Bridge Section shall maintain a Critical Bridge Maintenance Needs Computer Inventory for state maintained bridges only. All Critical needs should be entered into the CBMNI within a week of their discovery.

The completion date for a critical bridge problem repair shall be entered into the inventory upon receipt of notification that the problem is repaired. If a problem is being monitored, the completion date is the last date of monitoring and changes each time monitoring occurs.
The CBMNI shall be maintained on an annual basis. At the beginning of each calendar year, all items still deemed critical are carried forward into a new file. The last year's file is then stored for archive purposes. The CBMNI file shall be named CBMNyrdi. The "yr" is the last two digits of the year and the "di" is the two digit district number, i.e. CBMN9101 is the 1991 file for District 1.

Guidelines for Determining Critical Needs: The objective of the Critical Bridge maintenance needs Program is to identify and repair critical bridge problems. These are problems which are an imminent or immediate threat to the structure or present serious traffic hazards. They demand immediate attention. If the problem can wait for an extended period of time without action being taken, it is doubtful that it is critical.
There should be a direct relationship between a critical problem and the NBIS inspection report rating for corresponding items. Corresponding NBI Inspection Report items must be rated a "3" or less OR; Element level condition rating or Defects assigned to lowest condition rating for codes 1, 2, 4 and 6; and NBI rating of 4 or less OR; Element level defects in condition state 4 for codes 3 and 5

Codes: The following provides guidance for determining whether a maintenance need is critical. The CMNI report item codes are categories for classifying critical bridge problems and do not fully define a problem as critical. Often the DBE must use judgment in determining if a problem is critical.

Code 1: Cracks, severe section loss or other defects in load carrying members which impair its ability to carry load:

- Any crack in tension areas of load carrying members of steel bridges is considered a critical problem. Cracks in non-tension areas, severe section loss or other major defects in load carrying steel members are critical, if they are severe enough to reduce the load carrying ability of the member.
- Generally, cracking in rigid concrete deck girder bridges does not constitute a critical problem. However, cracking in Pre-stressed concrete members may be critical, if there is a noticeable separation to the crack.

Code 2: Loss of load bearing capability due to loss of bearing support, severe misalignment of bearing devices, or settlement of substructure units:

- One must consider "what is the worst thing that would happen if the problem goes untreated". If collapsing of a span or, if the bridge elevation would change enough to create a traffic hazard, the problem is critical.

Code 3: Scour or undermining of substructure foundations:

- It is critical if there is significant undermining of a spread footer or if the next period of high water could result in significant damage or loss of the substructure unit. If a scour problem is critical, then it is too serious for monitoring to be the course of action. Several factors may effect this determination, such as the cohesiveness of the soil or how the substructure unit is founded. A substructure unit founded on rock is less likely to be critical than one founded on piles.

Code 4: Impact damage to structural members:

- This is damage due to a vehicle or other object striking a member. Impact damage to primary load carrying members is critical if it impairs the member's ability to carry load.

Code 5: Severe drift accumulation:

- Drift accumulation is critical if it is believed that flooding could bring enough weight and force to bear on the substructure to threaten it, or it will constrict the waterway and/or contribute to accelerated scour during flooding.

Code 6: Severe misalignment of structural members:

- Misalignment is critical if it presents a real threat of the structure falling. Misalignment in compression members may be very critical. The degree of misalignment should be quantitatively measured for reporting and follow-up monitoring, i.e. the lean of a truss or displacement of bent members. If the misalignment has existed for quite some time, without change, it is not critical. If there is doubt about whether this is a critical problem it should be monitored first and if change is detected then it is critical.

Code 7: Severe impact due to differences in the level of the bridge deck and approach pavement:

- If the difference in the deck and approach is enough that the backwall will soon be damaged the situation is critical.

Code 8: Severe deck drainage deficiencies:

- Deck drainage deficiencies are considered critical if drains are clogged, such that water is retained in the deck and hydroplaning is possible.

Code 9: Loose expansion devices:

- Loose expansion devices are considered critical because they may pop out at any time and be a threat to motorist. If the device can be tightened in a somewhat permanent manner, code the problem as being repaired.

Code 99: Other Deficiencies:

- Any other maintenance need deemed to be critical according to the definition of the Critical Bridge Maintenance Needs is to be coded 99. If code 99 is used, the problem must be described on the field sheet and in the comment area of the electronic/computer record.

Critical Findings Requiring Immediate Notice: The specific critical findings listed below require immediate contact via telephone to the Chief Bridge Inspection Engineer/NBIS Program Manager or the Chief Bridge Inspector. After contact, complete the usual CBMNI report process to be submitted to Central Office via email. FHWA requires notice of these specific critical findings within 24 hours.

- Interstate Bridge Closures
- Accidents on a bridge involving a school bus
- Counties not closing structures in a timely matter
- Anything that could draw "National Media Attention"

QC/QA Review for KY NBIS Inspection Program

Definitions:
- Quality Control (QC) is the enforcement of procedures that are intended to maintain the quality of bridge inspection, reporting and evaluation.
- Quality Assurance (QA) involves the verification of the level of quality of the bridge inspection, appraisal and maintenance program.

Procedures:

Revised National Bridge Inspections Standards (NBIS) published in the Federal Register December 14, 2004 requires each State/Federal agency to implement a Quality Control/Quality Assurance procedure for Bridge Inspection programs by January 13, 2006.

I: Purpose
In order to insure that Kentucky's bridges are being inspected for safety, through a thorough and consistent process by qualified inspectors and inspection practices, it is necessary to implement a QC/QA process. Also, information received from NBIS field inspection reports weighs heavily on prioritization of repairs and replacement project decisions. Sound, uniform condition assessments and ratings in these reports are necessary.
With Kentucky's migration into BrM inspections, the QC/QA program will also address questions of expectations regarding condition states, and inspection reporting in a more timely and consistent manner.

II: Objectives
1. Generate greater consistency of data collected and uniformity of practice across districts
2. Ensure all inspection personnel are properly trained and operate within limits of qualification and training requirements set forth by NBIS
3. Improve communication between Inspectors, District Bridge Engineers and Central Office Management
4. Continued adherence to reporting critical inspection findings as set forth in Kentucky's Critical Maintenance Needs Inventory (CMNI) guidelines
5. Improve reporting procedures of needed maintenance activities found during inspections
6. Improved tracking of bridge conditions over time

III: Quality Control
Training:
- All inspection personnel shall meet the minimum experience and training requirements under NBIS related to inspection responsibilities given them.
- Various NHI courses will be periodically sponsored – attendance will be required for initial training and refresher purposes.
- In-house fall protection and rope access training will be provided – annual attendance in rope access training required for purchase/use of specialized gear.

District Review:

- All inspection procedure shall be overseen by at least one qualified team leader. Notes from inspection entered into the report shall be reviewed by the team leader for accuracy and submitted to the District Bridge Engineer.
- The District Bridge Engineer will review the inspection report and discuss needs or concerns (in the case of the DBE being the Team Leader for inspection the report will be submitted to a senior Team Leader or program manager for review).
- Any unresolved discrepancies during district office review of the inspection report should have secondary field review by both the inspector and reviewer.
- Upon acceptance at district level all reports shall be submitted to Central office for final review with results submitted to FHWA.

IV: Quality Assurance

Central Office review:

- Consistently monitor that inspections of all types (routine, sub-standard, fracture critical, underwater, etc.) are performed by prescribed due dates
- Assure timely follow up to Critical Needs reported, by appropriate personnel/division
- Selection of candidate bridges for independent QA inspection
- Central office will review a random sample of inspections in each district based on a parameter driven search of inspector, district, and range of dates on the report and a follow up on posting deficiencies. These individually reviewed reports will be marked as “Reviewed by Central Office” with the reviewer’s credentials. After the review, if central office is convinced the district is properly performing and completing the bridge inspections then the remainder of the district inspections in that parameter search will be batch approved. The batch approved inspections will have a disclaimer attached to them indicating they were part of the batch approval.

Review in District Office (Office and Field):

- Each District Bridge Engineer will be required to maintain individual records on each person involved with bridge inspection in the district. Records will include inspection experience, training pertinent to bridge inspection with certificates and/or dates of courses where available and responsibilities in bridge inspection of employee—files will be reviewed by Program Manager annually.
- Independent field inspections will be performed on a minimum of five (5) bridges selected from each district within each 24 month inspection cycle. Bridges will be randomly selected to represent a cross section of structures in the district, by type, size, material used in construction, configuration, condition and team leaders responsible for inspections. Independent QA inspections will be performed by the Chief Bridge Inspector or the Chief Bridge Engineer/Program Manager and should include, where possible, representative inspectors from other districts and personnel from different disciplines associated with bridge maintenance activities (e.g. analysis engineer, bridge coating coordinators, etc.).
- Check to ensure Critical Maintenance Needs are being recognized during routine inspections and reported.
- Random review of district procedures for documenting inspection findings through notes and pictures
- Electronic bridge reports will be randomly inspected for maintenance needs reporting procedure in BrM.

V: QA Review findings

At the conclusion to each district's QC/QA office and field reviews, findings will be reported to the district:

- All district inspection personnel and all participating members of the independent field inspection team should be present.
- The review team's report will be compared to last dated report in file. Discrepancies will be openly discussed and explained.

VI: Disqualification

Reasons for disqualification may include, but are not limited to:

- Lack of proper follow-up or recognition of critical needs, such as broken load carrying members, critical scour at foundations, impact damage which could adversely affect load carrying members, etc.
- Failure to correct findings from Quality control or Quality Assurance reviews.
- Recurring miscoded inventory or inspection items.
- Recurring miscoded critical elemental items such as structural elements or Defects
- Failure to attend continuing education classes as required

Any inspection Team Member that has been disqualified will be required, as a minimum, to retake the NHI training course "Safety Inspection of In-service Bridges" and receive a passing score on the exam given at the end of the course.

400 – Load Rating

Load Rating Program Overview

NBIS requires public agencies to load rate **all** bridge-length structures on **all** public roadways for load capacity. Load rating calculations compare the strength of the structure with the loads applied to it to determine its safe load capacity. Engineering expertise is required in determining the rating value and in making posting, closing or permit decisions. Load ratings may be done by mathematical calculations or, in some specific instances, engineering judgment. The Manual for Bridge Evaluation, Current Edition, outlines acceptable procedures for both methods.

The Kentucky Department of Highways, Division of Maintenance, Bridge Preservation Branch uses the computer programs LARS (Load Analysis and Rating System) and Complex Truss to mathematically analyze structures. The computer spreadsheet “SimpSpan.xlsx” is available to the Districts for preliminary simple-span steel and timber beam analysis. Guidelines for hand analysis are included in the following sections.

Quality Control/Quality Assurance: QC/QA is provided through the review process described herein. The Chief Analysis Engineer is responsible for performing detailed checks on the calculations. He/She also reviews and concurs in the ratings, Summaries of Postings and Closings by the bridge evaluator.

Any questions regarding load ratings should be directed to Central Office Maintenance:

- David Steele, P.E., Branch Manager
- Anne Lynch Irish, P.E., Chief Load Rating Engineer
- Dora Alexander, P.E., Load Rating Analysis Staff
- Michael Edwards, E.I.T., Load Rating Analysis Staff

Definitions

Bridge Condition Evaluation: The process of determining the overall condition and load capacity of a bridge, based on the inventory and inspection data

Inventory Rating: The load that can safely use the bridge for an indefinite period of time

Operating Rating: The maximum permissible live load that can safely be placed on the bridge

"H" Loading: The standard AASHTO two axle truck loading

"HS" Loading: The standard AASHTO three axle truck loading

"HL-93" Loading: The standard AASHTO three axle truck loading with uniform lane load

Sufficiency Rating: an overall measure of a bridge's condition, used to determine eligibility for federal funds. Ratings are on a scale of 1 to 100, with 100 considered as an entirely sufficient bridge, usually new; an entirely deficient bridge would receive a rating of 1.

Functionally Obsolete: One or both of the following apply:

1. appraisal rating of 3 or less for one or more of the following appraisal items:
   - Item 68 (deck geometry)
   - Item 69 (under clearances)
   - Item 72 (approach roadway alignment)
2. appraisal ratings of 3 or less for one or both of the following appraisal items:
   - Item 67 (structural condition)
   - Item 71 (waterway adequacy)

Structurally Deficient: One or both of the following apply:

1. condition rating of 4 or less for one or more of the following condition rating items:
   - Item 58 (deck condition)
   - Item 59 (superstructure condition)
   - Item 60 (substructure condition)
   - Item 62 (culvert or retaining wall condition)
2. appraisal rating of 2 or less for one or both of the following appraisal rating items:
   - Item 67 (structural condition)
   - Item 71 (waterway adequacy)

Any bridge classified as structurally deficient is excluded from the functionally obsolete category.

Substandard: A bridge is substandard if it meets any of the following three criteria:

1. Weight – posted for load less than the legal limit of the roadway classification.
   a. A bridge posted for Extended Weights below legal EW limits IS NOT substandard.
2. Vertical – clearance < 14'-0" for a through-truss.
3. Horizontal – roadway width <= 18'-0" for a through-truss, through-girder, or pony truss.

Any bridge substandard for Weight and any truss bridge substandard for Vertical or Horizontal clearance is put on a 12-month inspection cycle. See the Maintenance Guidance Manual MAIN-805, "Substandard Bridge Classification."

Note that the presence of a posting sign does not necessarily mean the bridge is substandard. Bridges posted higher than the legal limit are not substandard by definition, but these bridges may be set to an increased inspection frequency at the discretion of the District Structure Section or Central Office Bridge Preservation Branch.

Field Data Needed for a Load Rating

When an inspector has a bridge which needs a load rating, he or she shall contact a load rating engineer in the Central Office (email is the preferred method). The minimum information needed:

1. 10-character Bridge ID# – preferably at the start of the email subject line
2. Description of need for load rating – new structure, deterioration, proposed overlay, etc.
3. Measurements – if no plans; see Bridge Information Sheets below
4. Photos

Measurements: To load rate a bridge, an engineer needs measurements of the load-carrying components of the bridge. Design plans are the obvious and ideal source of this information for bridges without significant deterioration. Field measurements are needed for any bridge without design plans **and** for any component with significant deterioration.

As the inspector plans and performs the bridge inspection, he or she should be aware of the availability of plans for the bridge. An inspector who is already on-site can get needed measurements much more efficiently than can an engineer travelling from Central Office.

Bridge Information Sheets: Central Office has developed these to use to record needed field data. See **Exhibits # 9405-9407**. There is no such thing as Too Much Information on these sheets. The inspector should consider "will this increase the load on the structure?" and "will this reduce the capacity of the structure?" when determining what information to include.

Section Loss: Always report REMAINING SECTION. 100% section loss means the beam is completely severed. 100% section loss on the flange means the flange is completely severed. If that's the case, then report that. What's more likely is a PART of the flange is severed but some is still intact. For example:

- "Span 1 Beam 3, for a 12" section at 4' from abutment 1, remaining bottom flange measures 4"x3/16"
- NOT "75% section loss on bottom flange" – this is not accurate enough to analyze.

Photos: As discussed in Chapter 300 (Inspection, Reports, Photographs), photos are critical for the load rating engineer to understand what the inspector is seeing in the field. At a minimum, load raters need these views:

1. The underside of the bridge showing the beam arrangement
2. The profile of the bridge showing the span arrangement
3. The topside of the bridge showing the barrier arrangement
4. Additional photos to describe any deterioration, including a close-up of the localized area and a wider view showing the location of the defect.

Load Rating Procedures

Initiation: The following circumstances can trigger the load rating of a bridge:

- Newly-inventoried structure without a load rating
- Damage to or deterioration of structural components
- Changes in configuration (i.e. widening of bridge, bridges made continuous, etc.)
- Changes in dead loads (i.e. overlay, barrier changes, utility attachments, etc.)
- Changes in live loads (upgraded roadway classification, overweight vehicles, etc.)
- Changes in rating or posting policy

Analysis: After reviewing the bridge file, including the inspection report, photographs and plans, the load rating engineer makes engineering judgments and/or capacity calculations using manual and/or automated (LARS, Complex Truss, etc.) rating procedures, and files the calculations in the electronic bridge report. This includes updating BrM and the permanent data file.

Rating Method:
FHWA dictates the rating method to be used to calculate Inventory and Operating Ratings:
LRFR is preferred, LFR is allowed, and ASR is allowed only for timber.
KYTC dictates the rating method to be used to calculate Posting Ratings:
Use the rating method which matches the design method.
For example:

<table>
<tr><th colspan="4">Rating Method to use (* is optional)</th></tr>
<tr><th rowspan="2">Material</th><th colspan="3">Design Method</th></tr>
<tr><th>ASD or Unknown</th><th>LFD</th><th>LRFD</th></tr>
<tr><td>Timber</td><td>ASR* or LRFR for I/O
ASR for T1-4 & SU4-SU7</td><td>ASR* or LRFR for I/O
ASR for T1-4 & SU4-SU7</td><td rowspan="2">LRFR for all ratings</td></tr>
<tr><td>Other than Timber</td><td>LFR* or LRFR for I/O
ASR for T1-4 & SU4-SU7</td><td>LFR* or LRFR for I/O
LFR for T1-4 & SU4-SU7</td></tr>
</table>

Allowable Stress Rating may utilize 75% of yield strength (Fy) for rating but only 69% for posting.

Overlays: Central Office Load Rating staff should be consulted ANY time an overlay is planned to be added to a bridge deck. Overlays add weight which will reduce the capacity for live load and may lead to requiring the bridge be posted. Limit the total asphalt overlay thickness to 4" maximum.

<u>Concrete Overlay</u>: Assume when the overlay was applied, ¼" of existing deck was removed (milled off) before the new overlay was added. For composite decks, assume ½" of the newly overlaid deck has worn off (wearing surface) for strength, but include the ½" as dead load. Latex concrete overlays are usually 1.5" and low slump or PCC overlays are usually 2" thick. Do not include Future Wearing Surface (FWS) when concrete overlay is present.

Analysis Vehicles:

- AASHTO HS20 or HL-93 loading is used for Inventory and Operating ratings.
- Kentucky Legal Loads are Truck Types 1 through 4, as defined in 603 KAR 5:066 Section 1 (2).
- Single Unit Vehicles SU4-SU7 are required to be rated per FHWA Memorandum dated November 15, 2013 and MBE 6B.7.2.
- Annual Permit vehicles must also be rated, and these configurations are in development.

See **Exhibit #9402** for these vehicles' axle weights and spacings.

Rating Type	Vehicle Name	# Axles	Gross Wt (lbs)	Gross Wt (tons)
Inventory & Operating	HS20	3	72,000	36.00
	HL93	HS20 truck with 640 plf lane load		
Posting	Type 1	2	40,000	20.00
	Type 2	3	56,700	28.35
	Type 3	4	73,500	36.75
	Type 4	5	80,000	40.00
	SU4	4	54,000	27.00
	SU5	5	62,000	31.00
	SU6	6	69,500	34.75
	SU7	7	77,500	38.75
	Annual Permit	in development		

Trucking Classification of Highways: The following are weight limits for KY legal loads on the various trucking weight classification routes, as defined in 603 KAR 5:066 and KRS 177.9771:

WEIGHT LIMITS (tons)					
Truck Type	Roadway Classification				
	County	A	AA	AAA	Extended Weight Coal Haul
Type 1	18	20	20	20	20
Type 2	18	22	27	27	45
Type 3	18	22	31	34	50
Type 4	18	22	31	40	60

Maps which delineate trucking classifications A, AA, and AAA are available from the Division of Planning at http://transportation.ky.gov/Planning/Pages/Truck-Weight-Classification.aspx. These classifications are frequently changed by Official Order. Please contact the Division of Planning at (502) 564-7183 for assistance.

Various laws (see KRS 189 and 603 KAR 5) have been enacted by the Kentucky legislature which allow up to 88,000 lbs (44 tons) on any type vehicle and on any state roadway classification when hauling certain cargo. The above weight limit chart will be used when assigning legal weights by engineering judgment(**), but calculated ratings will be posted up to this higher threshold (see the following section on "Posting & Closure").

** Legal Weights posting for Class A shall be 22 tons gross, due to the similarities of tonnages. Consider the effect of the 15-mile rule (HB-124, KRS 189.222.1f) when assigning legal weights. Legal Weights posting for precast segmental concrete structures commonly known as "ConSpans" which are designed HS25 or greater and stamped by a KY PE shall be for AAA limits regardless of the roadway classification of the route.

Material Weight for Analysis:

Concrete	150 pcf
Wood	60 pcf
Steel	490 pcf
Asphalt	150 psf
Soil fill	120 pcf
Dense Graded Aggregate (DGA)	120 pcf
Metal Plank and 3" Asphalt	41.3 psf
Future Wearing Surface	15 psf

Material Strength for Analysis:

Steel	Prior to 1905	Fy = 26,000 psi
	1905 to 1936	Fy = 30,000 psi
	1937 to 1962	Fy = 33,000 psi
	1963 to now	Fy = 36,000 psi
	New steel	Fy = 50,000 psi
Timber	Sound wood	Fa = 1,600 psi
	Deteriorated wood	Fa = 1,100 psi

Posting & Closure

A structure is recommended posted when its load rating (at 75% Fy) falls below a certain threshold for any posting truck. For state-maintained bridges that threshold is 44 tons, and for non-state-maintained bridges that threshold is 40 tons. After it is determined which truck types are to be posted, the actual posting capacity is calculated by analyzing the structure at 69% Fy using the trucks in question.

Gross Posting: If the load rating (at 75% Fy for ASR) of a Type 1 truck falls at or below the gross posting threshold (18 tons state-owned or 40 tons non-state-owned), then the bridge is gross-posted for all truck types. The posting capacity is the capacity of the Type 1 truck (at 69% Fy for ASR). The posting sign (MUTCD Type R12-1) will read "Weight Limit __ Tons" and will not show the silhouetted truck symbols as required for posting particular truck types, nor will the Single Unit Vehicle posting sign be used.

If a structure's deterioration or damage is not quantifiable, posting is based on engineering judgment and condition ratings as follows:

- If the condition rating of the Deck, Superstructure, Substructure, and/or Culvert equals **4-Poor**, the structure may be posted at half of the roadway weight limit.
- If the condition rating of the Superstructure and/or Substructure equals **3-Serious**, the structure shall be posted at 3 tons.
- If the condition rating of the Culvert equals **3-Serious**, the structure may be posted at 3 tons, taking into consideration the fill height above the culvert.
- If the condition rating of the Deck, Superstructure, Substructure, and/or Culvert equals **2-Critical**, the structure shall be posted at 3 tons ONLY IF the structure is closely monitored. Without close monitoring, the structure shall be closed.
- If the condition rating of the Deck, Superstructure, Substructure, and/or Culvert is less than 2, the structure shall be closed.

A structure is recommended closed when its load rating falls below 3 tons. No posting will be allowed less than 3 tons.

Non-Gross Posting: For all state bridges and any non-state bridge with an Extended Weight posting, if any KY Truck Type needs to be posted with a silhouette-type sign, then post tonnages for all 4 truck types using all 4 silhouettes.

Signs: **Exhibit #9403** shows the standard posting sign designs used by KYTC. For all roadways, except Extended Weight coal routes, the basic sign types are described in the Manual on Uniform Traffic Control Devices, Section 2B.49. The Extended Weight Coal Haul posting sign is a special Kentucky sign.

Place posting signs on the right shoulder of both approaches to the structure, approximately 10 feet from the end of the structure. In addition, to reduce costly delay and backtracking, it is recommended that a weight limit sign with an advisory message be placed at approach road intersections or other points where the affected vehicle can detour or turn around. Consult with the District's Traffic Section for placement of signs.

The KY Type 3 truck and the AASHTO SU4 truck have virtually the same silhouette, therefore post for both of these trucks at the controlling tonnage using the KY Type 3 silhouette.

Annual Permits will be restricted if any of the rating configurations rate below a rating factor or 1.0. These vehicles are too variable in axle configuration to effectively post for various weights.

Online Posting: The cabinet will develop and maintain an online list available to the public with the following information: bridge ID, county, route, milepoint, crossing, and posting tonnages.

Notifications: The load rating engineer shall immediately notify (by email and/or phone) the District Bridge Engineer (DBE) about any structure which requires posting or closure and shall subsequently send the written official memo by regular mail to the Chief District Engineer. See **Exhibits #9101-9102** for sample posting and closure memos to the District.

Posting removal and/or reopening of closed bridges requires the concurrence of Central Office load rating staff. If repairs are made to increase the load carrying capacity and/or to remedy the deficiency which caused the posting or closure, District shall request of Central Office a revised load rating and posting recommendation.

District responsibilities for the posting/closure of **State-Owned structures**:

Notification: If school is in session and only for bridges with recommended capacities below 18 tons, the DBE shall immediately notify the affected School Superintendent(s) by phone of the new weight limits or closure, followed with a certified letter within 24 hours to confirm what was discussed, and a copy of said letter forwarded to Central Office Maintenance. The District Public Information Officer *may* need to notify the following: Post Office, Fire Department, EMS, and/or Public Transportation.

Installation: Request district traffic to install the posting signs or closure barricades. The request should be specific as to sign type, message and bridge location. Allowable time fames (from the date of the recommendation) within which action must be taken:

- Closures: 14 days
- Substandard Postings: 30 days
- Non-Substandard Postings: 60 days

Verification: District bridge inspection staff shall perform a "Special – Posted Bridge" Inspection (if posted or closed) or "Repair Inspection" (if repaired in lieu of posting or closing) within 7 days of the end of the allowable time frame noted above (posting or closure) to verify compliance (see Chapter 300 – Inspection), to include the following:

- Photograph the face of each sign (or barricade) to clearly show the posting value(s) or lack thereof.
- Photograph both approaches to the bridge, even if the recommendation was only to replace a missing sign at a single approach.

For **Non-State-Owned structures**, see the following section.

Posting Compliance for Non-State-Owned Structures

For any County or City bridge owner to be eligible for a federal bridge replacement project, it must be certified to be in compliance with bridge load posting requirements. Compliance is determined by the presence and proper placement of weight limit posting signs and/or barricades where recommended. All structures maintained by the bridge owner with recommended weight limits of 3 to 39 tons, inclusive, must be load posted. All structures recommended closed must be physically barricaded to traffic. All posting signs and closure barricades must meet MUTCD requirements.

Procedure: The procedure below describes the annual certification process for all structures owned by a county, city or other owner. When an **individual** bridge is determined to need posting or closure in the middle of the certification year, the same basic procedure applies: Notify then Verify.

Notification: Upon completion of the inspection of all required bridges for that year in a particular county or city, the DBE shall send a letter by certified mail with copies of the inspection reports to the owner (County Judge Executive or Mayor). This letter shall contain information about the posting limits for bridges in that county or city, any recommended maintenance actions, and a paragraph outlining the process to be followed in regards to bridge posting for the agency to be certified for federal funds. Forward a copy of this letter by certified mail to the local school superintendent(s) for bridges with recommended capacities below 18 tons. See **Exhibit # 9105** for a sample letter.

Allowable Time Frames: To remain compliant, the owner has the following amount of time (from the date of the recommendation) to post or close structures as recommended:

- Closures: 14 days
- Substandard Postings: 30 days
- Non-Substandard Postings: 60 days

Certification: Once the owner has posted and/or closed the required structures, the District *may* ask the owner to return a "Statement of Compliance" Form ("SOC", see **Exhibit #9108** pages 1 and 2) to certify that it has complied. If an owner has no structures which require posting or closure, the owner may use the page of the Exhibit which notes such. The Districts may use these SOCs to track compliance, but Central Office (CO) no longer requires the District to submit the SOC to CO.

Verification: District bridge inspection staff shall perform a "Special – Posted Bridge" Inspection (if posted or closed) or "Repair Inspection" (if repaired in lieu of posting or closing) within 7 days of the end of the allowable time frame noted above (posting or closure) to verify compliance (see Chapter 300 – Inspection), to include the following:

- Photograph the face of each sign (or barricade) to clearly show the posting value(s) or lack thereof.
- Photograph both approaches to the bridge, even if the recommendation was only to replace a missing sign at a single approach.

Failure to Comply with Postings: If the owner does not comply with the posting requirements within the allowable time frame, the owner is deemed out of compliance and loses eligibility for Federal funding of projects.

- If after the allowable time frames noted above the bridge has not been posted properly, the District shall send a second letter by certified mail re-stating that the bridge must be posted for the recommended weight limits. The bridge owner is now out of compliance, and the Chief District Engineer shall contact the bridge owner.
- If the structure has not be properly posted within three days of contact from the Chief District Engineer, the District shall alert Central Office (NBIS Program Manager and the TEBM for Bridge Preservation) that the bridge is past due to be posted for weight limits.
- Central Office will then contact the Division of Legal Services about the matter and request they prepare and mail out a Legal Services letter to either or both the County Judge Executive and the County Attorney or the mayor.

Failure to Comply with Closures: If the owner does not comply with the closing requirements within 14 days of first notice, the owner is deemed out of compliance and loses eligibility for Federal funding of projects.

- After 14 days of first notice, the District shall send a second letter by certified mail re-stating that the bridge must be closed and the Chief District Engineer shall contact the bridge owner and advise the bridge owner to close the structure immediately.
- If structure is not closed within 48 hours of contact from the Chief District Engineer, the District shall alert Central Office (NBIS Program Manager and the TEBM for Bridge Preservation) that the bridge is past due to be closed.
- Central Office will then contact the Division of Legal Services about the matter and request they prepare and mail out a Legal Services letter to either or both the County Judge Executive and the County Attorney or the mayor.

Return to Compliance: Once an agency is placed out of compliance, the agency must make the repairs, close or post its bridges as required to return to compliance and must advise the DBE of such. Upon verification of compliance (as described above), the agency is again placed in compliance.

Repairs Made to Weight Posted or Closed Bridges: If the owner chooses to repair rather than post or close, and the owner requests the state to remove the recommendation to post or close, a “Repair Inspection” must be performed by district bridge inspection staff. If the district agrees with the request, the DBE shall forward the matter to Central Office for consideration and an updated load rating.

Overweight and Permit Loads

Over-Weight/Over-Dimensional (OW/OD) loads are evaluated to balance competing goals:

Economic development – allowing the transportation of such cargo as cannot be reasonably dismantled or conveniently transported otherwise

Public safety and bridge preservation – no overstress to the bridges along the requested route.

Required Data: route, vehicle dimensions, axle weights, axle spacings, wheel spacings along the axle.

Types of OW/OD checks:

Construction Loads – construction vehicles hauling over a bridge for a limited time period.

Superload Permits – The Division of Motor Carriers' OW/OD Branch screens the permit for roadway restrictions, and then sends the permit to the load rating engineer to check the bridges on the route for weight capacity and vertical and horizontal clearance.

Industrial Haul Permits – The district where the IHP originates checks all routes for restrictions. These could be horizontal and vertical clearances or posted weight limits for bridges. If any bridge on the route does not have a load rating, the district can ask for an updated load analysis. However, it is the policy of the Transportation Cabinet not to inspect or document the requested industrial haul route and to only reevaluate bridges specifically identified by the applicant. It is assumed that the applicant will not exceed the legal weight limit of the bridge, as defined by the legal weight class of the road. For more information see the Maintenance Guidance Manual Chapter 906.

Extended Weight Coal Haul Routes – The district where the extended weight coal haul route request originates shall contact the Division of Maintenance, Bridge Preservation Branch, Load Rating Section to determine the maximum capacities of the bridges located on the routes listed on the Certified Transportation Plan. All bridges capacities will be calculated and that information will be sent back to the district for completion of the request. For more information see the Maintenance Guidance Manual Chapter 905.

Possible **Restrictions** for Superloads or Construction Loads:

- No stopping or parking on the bridge
- Reduced speed (which reduces impact)
- Exclusivity – no other vehicles on bridge when load crosses
- Crabbing – extend axles to spread the load transversely
- Avoidance – exit off then back on to avoid a bridge

Analysis of Simple Stringer Spans - General Procedure and Rating Formulas

1. **Date and Analyzer's Name**
2. **Identify Structure**
3. Sketch **Cross Section** of Span

4. **List**:
   a. Date Year built (if salvage steel used, say so)
   b. Span length (center to center of bearing)
   c. Stringers (size, number and spacing)
   d. Deck (material and thickness)
   e. Asphalt covering (thickness)
   f. Curb to curb spacing (two lane if 16' or more)

5. Choose **Yield Strength** (Fy) of Stringer Material
   See the preceding section, "Load Rating Procedures, for standard values.

6. Calculate **Dead Load**/Ft. of Stringer
   Include the barriers, future wearing surface, utilities, overlay, deck, lateral bracing and stringer.

7. Calculated **Dead Load Moment** on One Stringer
   DLM = Dead Load Moment = W * L^2 / 8
   W = Distributed Dead Load
   L = Span Length, center-to-center of bearing

8. Calculate **Distribution Factor**
   Calculate the distribution factor based on the Stringer spacing, S, measured in feet:

Floor Type	**One Lane** <= 18 ft	**Two Lane** > 18 ft
Wood Plank	S / 4.0	S / 3.75
Wood Strips on Edge (4" tall)	S / 4.5	S / 4.0
Wood Strips on Edge (6" tall)	S / 5.0	S / 4.25
Metal Plank/Asphalt	S / 5.5	S / 4.5
Concrete on Timber Beams	S / 6.0	S / 5.0
Concrete on Steel Beams	S / 7.0	S / 5.5

9. Calculate **Impact** Factor
   I = Impact Factor (dimensionless) = 50 / (125 + L) <= 0.30
   L = Span Length, center to center of bearing (feet)
   For spans under 41'-8" in length, use I = 0.30
   No impact is added to timber stringers

10. Calculate **Live Load Moment**/Ton of Truck
LLM = Live Load Moment (lbs-in/ton)
L= Span length, center to center of bearing (feet)

Type 1 Truck (H-Truck)

L<=28'	LLM = 200L * 12 * D.F. * (1+I)
L>28'	LLM = (250L - 1400) * 12 * D.F. * (1+I)

Type 2 Truck (Tandem Truck)

L<=24'	LLM = (215L - 860) * 12 * D.F. * (1+I)
L>24'	LLM = (250L - 1700) *12 * D.F. * (1+I)

Type 3 Truck (Tri-axle Truck)

L<=32'	LLM = (202.5L - 1080) * 12* D.F. * (1+I)
L>32'	LLM = (250L - 2600) * 12 * D.F. * (1+I)

Type 4 Truck (Five Axle Tractor-Trailer)

L<=24'	LLM = (110L - 440) * 12 * D.F. * (1+I)
24'<L<=32'	LLM = (140L - 1160) * 12 * D.F. * (1+I)
32'<L<=36'	LLM = (195L - 2940) * 12 * D.F. * (1+I)
L>36'	LLM = (250L - 4920) * 12 * D.F. * (1+I)

11. Select **Section Modulus**
Choose “S” in Axis X-X from a steel manual (List name and date of information source).
For timber beams, calculate Section Modulus S = b * d^2 / 6 where b=width and d=depth.

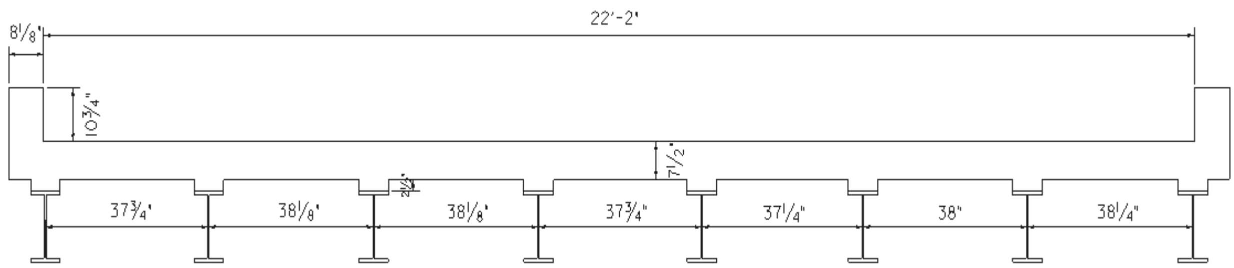
12. Calculate **Live Load Capacity**
LLC = Live Load Capacity = (S * Percentage * Fy – DLM) / LLM
S= Section Modulus
Percentage = 55% for inventory, 69% for posting, 75% for operating, 100% for timber
Fy = Yield Strength
DLM = Dead Load Moment
LLM = Live Load Moment

Analysis of Simple Stringer Spans - Sample Problem – Hand Calculations

1. June 18, 2008, Erin Van Zee

2. 035C00070N
Turkey Run Road (CR 1039) over Turkey Run Creek
1.68 miles North of JCT CR 1041
1- 23.5' Steel Beam Span

3.



4. Data: a- Built: 2006 with new painted beams
b- Span: 23.5' center-center bearing
c- Steel stringers: 8- W14x38
d- Deck: 7.5" of Concrete
e- No asphalt overlay
f- Curb to Curb: 22' 2"

5. Yield Strength: Fy = 36,000 psi

6. Dead Load:
Guardrail = 7.0 plf
Curb = 8.125 in * 10.75 in / 144 in^2/ft * 2 sides / 8 beams = 22.7 plf
Deck = 7.5 in * 38.125 in / 144 in^2/ft * 150 pcf = 297.9 plf
Fillet = 2.5 in * 6.875 in / 144 in^2/ft * 150 pcf = 17.9 plf
FWS = 15 psf * 3.17708 ft = 47.7 plf
Stringer = 38.0 plf
DL = 7+22.7+297.9+17.9+47.7+38 = 431.2 plf

7. Dead Load Moment: DLM = 431.2 plf * (23.5 ft)^2 * 12 in/ft / 8 = 357195.3 lbs-in

8. Distribution Factor: DF = S/5.5 = 3.17708/5.5 = 0.5776

9. Impact Factor: I = 50/(125+23.5) = 0.3367 > 0.30 therefore use 0.30

(continued on next page)

10. Live Load Moment/Ton of Truck:
    Type 1: LLM = (200.0 * 23.5 – 0) * 12 * 0.5776 * 1.3 = 42349.632 lbs-in/ton
    Type 2: LLM = (215.0 * 23.5 – 860) * 12 * 0.5776 * 1.3 = 37776.7728 lbs-in/ton
    Type 3: LLM = (202.5 * 23.5 – 1080) * 12 * 0.5776 * 1.3 = 33147.5976 lbs-in/ton
    Type 4: LLM = (110.0 * 23.5 – 440) * 12 * 0.5776 * 1.3 = 19327.6512 lbs-in/ton

11. Section Modulus: S = 54.6 in3

12. Live Load Capacity:

Type 1 Truck @ 55% Fy	LLC = (54.6*0.55*36000-357195)/42349.6 = 17.1 tons
@ 69% Fy	LLC = (54.6*0.69*36000-357195)/42349.6 = 23.6 tons
@ 75% Fy	LLC = (54.6*0.75*36000-357195)/42349.6 = 26.4 tons
Type 2 Truck @ 55% Fy	LLC = (54.6*0.55*36000-357195)/37776.8 = 19.2 tons
@ 69% Fy	LLC = (54.6*0.69*36000-357195)/37776.8 = 26.4 tons
@ 75% Fy	LLC = (54.6*0.75*36000-357195)/37776.8 = 29.6 tons
Type 3 Truck @ 55% Fy	LLC = (54.6*0.55*36000-357195)/33147.6 = 21.8 tons
@ 69% Fy	LLC = (54.6*0.69*36000-357195)/33147.6 = 30.1 tons
@ 75% Fy	LLC = (54.6*0.75*36000-357195)/33147.6 = 33.7 tons
Type 4 Truck @ 55% Fy	LLC = (54.6*0.55*36000-357195)/19327.7 = 37.5 tons
@ 69% Fy	LLC = (54.6*0.69*36000-357195)/19327.7 = 51.7 tons
@ 75% Fy	LLC = (54.6*0.75*36000-357195)/19327.7 = 57.8 tons

Inventory Rating = H17 (Type 1 @ 55% Fy)
Operating Rating = H26 (Type 1 @ 75% Fy)

SimpSpan has a steel beam rating worksheet, as shown on the following page.

Analysis of Simple Stringer Spans - Sample Problem – SimpSpan

Simple-Span Steel or Timber Beam Analysis

Erin Van Zee	
035C00070N	
September 9, 2008	

USER-PROVIDED INFO

SPAN LENGTH: (c/c bearing) (ft)……………	23.5	*
STRINGERS:		
Input dimensions in applicable sheet and choose section from dropdown	I shaped Beam	*
Number of beams……………………………	8	*
Stringer Spacing (ft)…………………………	3.17708333	*
Section Modulus (in^3)………………………	54.59945007	
Cross-Sectional Area (in^2)……………………	11.19972821	
Yield Strength (26, 30, 33, 36, or 50 ksi)…	36	*
CURB:		
2-Curb Weight on Bridge(lbs./ft.)…………………	381.16	*
DECK:		
Deck width (curb/curb) (ft)……………………	22.16666667	*
Number of Lanes (1 or 2)……………………	2	
C=Concrete, T=Timber, S=Steel…………	C	*
Deck thickness (in)………………………	7.5	*
Asphalt Overlay Thickness (in.)	0.0	*
		leave blank
		leave blank
		leave blank
15psf Future Wearing Surface (Y/N)………………	Y	*
Longitudinal Length Between Bracing on Compression Flange (ft) (0 if braced along entire length)	0	*
DISTRIBUTION FACTOR:	Calc. Factor	*
If lever rule is needed, insert calculated DF		*leave blank
ROAD CLASS: C, A, AA, AAA	C	*

RESULTS

Actual Capacity		
Truck Type	Capacity	
Type 1	26.4	tons
Type 2	29.6	tons
Type 3	33.7	tons
Type 4	57.8	tons

Posting Capacity		
Truck Type	Capacity	
Type 1	26	tons
Type 2	29	tons
Type 3	33	tons
Type 4	57	tons

Inventory Rating =	H 17
Operating Rating =	H 26

* = Required Field(See Notes Below)

CALCULATIONS

		Rating(ASD)
Deck Material………………………………	Concrete	
Deck Weight (psf)…………………………..	108.8	
Curb Weight (lbs./ft.)	47.6	
Stringer Weight (lbs/ft.)…………………………	38.1	
Uniform Dead Load (lbs/ft)…………………	431.3	
Dead Load Moment (kip-ft.)………………	29.771	
Distribution Factor………………………	0.578	
Impact Factor……………………………	0.30	
Live Load Moment(kip-ft)		
Type I Truck (2-Axle-Truck)…………………..	94.0	
Type II Truck (3-Axle Truck)………….	118.9	
Type III Truck (4-Axle Truck)………….	135.2	
Type IV Truck (5-Axle Tractor-Trailer)…	85.8	
Yield Strength of Steel (ksi)……………	36.0	
Live Load Capacities (TONS):		Rating(ASD)
Type I Truck @ 55% Yield Strength…..	17.1	0.855
Type I Truck @ 69% Yield Strength..	23.6	1.179
Type I Truck @ 75% Yield Strength…..	26.4	1.319
Type II Truck @ 55% Yield Strength……	19.2	0.676
Type II Truck @ 69% Yield Strength……	26.4	0.933
Type II Truck @ 75% Yield Strength……	29.6	1.043
Type III Truck @ 55% Yield Strength…..	21.8	0.594
Type III Truck @ 69% Yield Strength…..	30.1	0.820
Type III Truck @ 75% Yield Strength…..	33.7	0.917
Type IV Truck @ 55% Yield Strength…..	37.4	0.936
Type IV Truck @ 69% Yield Strength….	51.7	1.292
Type IV Truck @ 75% Yield Strength….	57.8	1.445

Analysis of Timber Plank Decks – General Procedure and Rating Formulas

Shown in the following section is an analytical procedure for calculating the load capacity of transverse timber plank flooring laid flat. This procedure is extremely conservative due to wide fluctuations in the stress range of various grades and types of timber. Although a timber deck failure would not be catastrophic, the Engineer should use this procedure in conjunction with engineering judgment when establishing load capacity for a timber plank deck. Heavy emphasis should be placed on such factors as condition, performance history, location of active wheel paths and the presence or absence of runners.

The use of runners to distribute the wheel loads to stringers is strongly encouraged and will, as a rule of thumb, double the floor capacity.

Cantilevers of timber plank flooring without runners or hub rails are considered to have no load carrying capability. To avoid closing such a structure, hub rails or runners must be in place to guide traffic away from the cantilever sections.

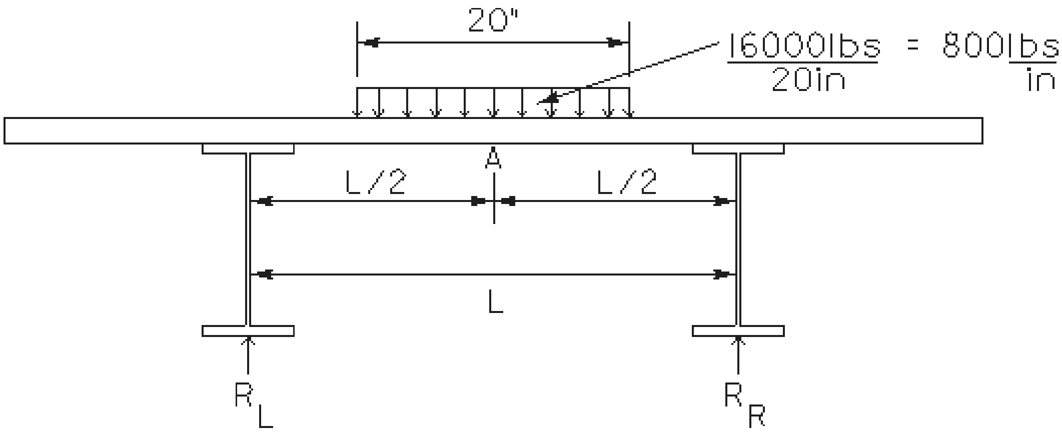
The following analysis methods are based upon these assumptions:

- The wheel load applied is that of a Type I Truck. This truck has the maximum axle load.
- Because of the use of dual wheels, the wheel load is evenly distributed over a transverse width of 20 inches and a longitudinal length of one plank width.
- For floors continuous over three or more stringers, the simple beam moments are reduced by 20% to account for continuity (AASHTO 3.25.4).
- Impact is not applied.
- The floor span shall be considered as the center to center spacing of stringers. (This can be reduced some through application of AASHTO Standard Specifications for Highway Bridges, Article 3.25.1.2.)
- The dead load of the timber plank is negligible.

The load will be applied to the flooring in one of the following cases:

Case 1: Load applied at middle of the span.
Case 2: Load applied at any point in the span and the 20" length of the wheel load falls outside the width of the beam flange.
Case 3: Load applied partially or fully over beam.

Case I: Load applied at middle of the span.



Bearing Span: L, where L is the clear distance between stingers plus one-half the width of one stringer, but shall not exceed the clear span plus the floor thickness

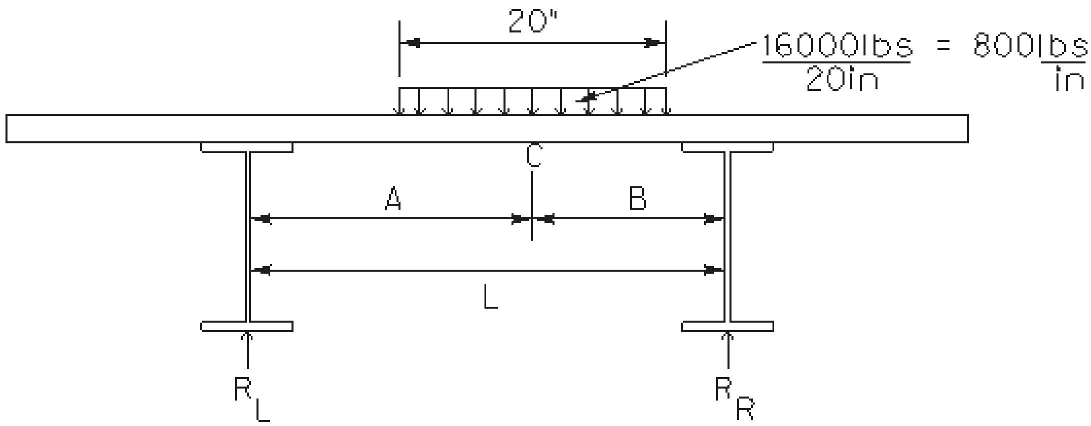
<u>L greater than 20”</u>

Reaction:	RL = RR (lbs)	= 0.5*16000 lbs = 8000 lbs
Moment:	MA (lbs-in)	= 0.8*(8000 lbs * (L/2-10) + 0.5 * 10 * 8000
		= (4000 * L - 40000) = 4000 * (L - 10)
Capacity:	LLC (tons)	= fa * S * 20 tons / (0.8*(4000*(L-10)))
		= 0.00625 * fa * S / (L - 10)

<u>L less than or equal to 20”</u>

Reaction:	RL = RR	(lbs) = 800 * L / 2
Moment:	MA (lbs-in)	= 0.5 * L / 2 * 800 * L / 2
		= 100 * L^2
Capacity:	LLC (tons)	= fa * S * 20 tons / (0.8*100*L^2)
		= 0.25 * fa * S / L^2

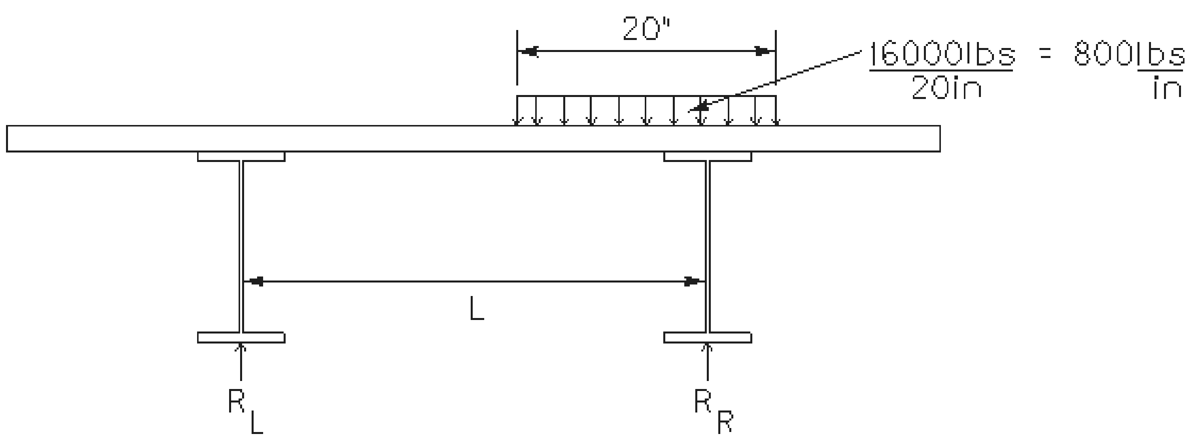
Case II: Load applied at any point in the span and the 20" length of the wheel load falls outside the width of the beam flange.



Bearing Span: L, where L is the clear distance between stingers plus one-half the width of one stringer, but shall not exceed the clear span plus the floor thickness

Reaction:	RL (lbs)	= 16000 * B / L
Moment:	MC (lbs-in)	= 16000 * B / L * (A - 10) + 0.5 * 10 * 16000 * B / L
		= 16000 * B / L * (A – 5)
Capacity:	LLC (tons)	= fa*S*20tons/(0.8*(16000*B/L*(A-5)
		= 0.0015625*fa*S/(B/L*A-5)

Case III: Load applied partially or fully over beam.



Since the beam web and flanges directly support the wheel load, the case will not generally control the deck rating. However, if analysis is required, a modified version of Case II can be utilized for analysis.

Consider the floor to support only the portion of the 20" wheel width that falls outside the limits of the top flange of the beam. The formula as derived for case II must be modified to account for the reduced load. Contact Central Office if assistance is required.

Analysis of Timber Plank Decks – Procedure for Planks Laid Flat and No Runners

Step 1: Sketch a cross-section of the structure showing:

a. Beam spacing (number stringers L-R)
b. Curb to curb width
c. Cross-section of timber plank showing dimensions and condition of the wood.

Step 2: Calculate section modulus for timber plank (if planks are not of uniform width or thickness use the plank having the smallest section modulus).

b = width of plank (inches)
d = thickness of plank (inches)
S = section modulus (in^3) = b * d^2 / 6

Step 3: Select the largest center to center beam spacing where a wheel load can be applied between the stringers. (Use 6 feet spacing between wheels on an axle.)

L = bearing span (AASHTO 3.25.1.2) based on maximum center to center beam spacing in inches
fa = maximum allowable stress for timber
= 1100 psi (deteriorated wood)
= 1600 psi (sound wood)
If the bearing span is greater than 20”: LLC (tons) = 0.00625 * fa * S / (L – 10)
If the bearing span is 20” or less: LLC (tons) = 0.25 * fa * S / L^2

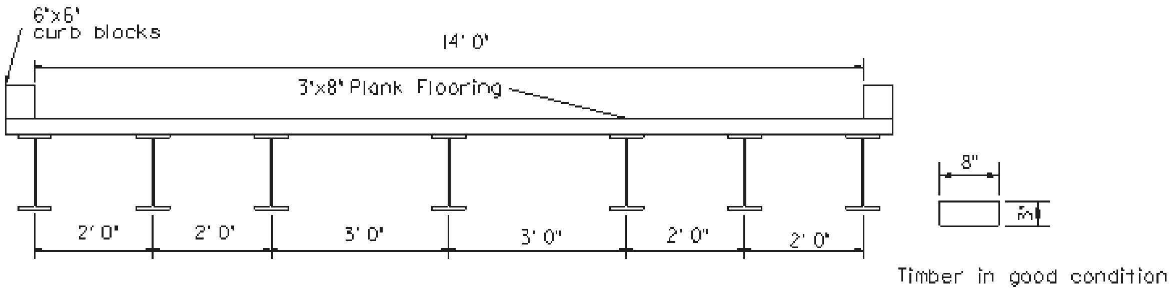
Step 4: If a condition exists, because of a very narrow roadway (less than 12 feet), where a wheel load cannot be placed midway between stringers and the spacing of these stringers is greater than that of those adjacent:

a. Place the wheel load as near as physically possible to the center of the span between the stringers.
b. LLC (tons) = 0.0015625 * fa * S / (B / L * (A – 5))

Step 5: Use the smaller of the rating as determined in Steps 3 and 4.

Analysis of Timber Plank Decks – Sample Problem – Hand Calculations

Step 1:



Step 2: Section Modulus:

b= 8”

d= 3”

S = 8 * 3^2 / 6 = 12 in^3

Step 3: Curb to Curb ≥ 12’, therefore L = 36”

Timber in good condition, therefore fa = 1600psi

Bearing span > 20”, therefore LLC = 0.00625 * 1600 * 12 / (36-10) =4.6 tons

Step 4: Step 4 does not apply because roadway is 12’ or greater.

Step 5: Rating is 4 tons (round down to nearest whole number).

Analysis of Timber Plank Decks – Sample Problem – SimpSpan

Timber Plank Deck Rating

Analyst's Name	enter name here
Date	enter date here
Structure ID	Bridge ID

INPUT:

Beam Spacing (in.)	39	Note: Cantilevered Timber is assumed to have no capacity.
Beam Flange Width (in.)	6	
Timber Description		
Plank Thickness	3	**Plank Thickness** is typically 3".
Plank Width	8	**Plank Width** is typically 8".
Bending Strength (ksi)	1.6	**Bending Strength** (ksi) is assumed by KY DOH to be 1.6ksi
Number of Beams	7	for sound timber or 1.1 ksi for some deterioration.

OUTPUT:

Section Modulus (in.^3)	12.00	
Moment Capacity (kip-in)	19.20	
Clear Span (in.)	33.00	
Bearing Span (in.)	36.00	AASHTO 3.25.1.2
LL Moment (kip-in)	104.00	The maximum possible wheel load is 16kips (type 1 truck).
		Dead Load Moment is assumed to be negligible.
Rating	0.23	
Rating *20 tons	4.62	tons

This analysis is very conservative, if there are questions contact central office

BrM Fields with Permissions/Responsibilities for Load Raters

Structure Notes: Identify the controlling member (each with deterioration level and critical point) for each rating vehicle, and list any posting or closure memos issued. Because Structure Notes are not tied to any date or person, begin the note with the date, and end the note with the load rater's initials. For example:

> 07/16/14 The load rating is controlled by an interior beam with one exposed/broken strand for all load cases, at midspan for Trucks 1-4 and annual permits, at Pier 1 for SU4-SU7, and at either abutment for Inventory and Operating – ALI.
> 07/16/14 Posting memo for 11 tons due to the load rating of the steel beams – ALI.

Load Rating Review Recommended: this field is not used

Rating Date: Enter mm/dd/yyyy. BrM is fickle, so use slants (/) instead of dashes (-).

Initials: Enter the load rater's initials (3 character limit)

Design Load (Item 31): Design load may be determined from the design plans or from any information stamped on the bridge itself. The inspector should note any such identifying marks in the initial inspection report (include a photo) and update the "Design Load" field if possible. The coding guide has been expanded since it was printed in 1995. FHWA memorandum dated February 2, 2011 added 5 codes (0, 9, A, B, C) to the original 8:

Code	Metric Description	English Description
0	Unknown	Unknown
1	M 9	H 10
2	M 13.5	H 15
3	MS 13.5	HS 15
4	M 18	H 20
5	MS 18	HS 20
6	MS 18 + Mod	HS 20 + Mod
7	Pedestrian	Pedestrian
8	Railroad	Railroad
9	MS 22.5 or greater	HS 25 or greater
A	HL 93	HL 93
B	Greater than HL 93	Greater than HL 93
C	Other	Other

Posting (Item 70): While load raters do have access to change this field, the value is calculated internally by BrM by comparing Operating Rating (Item 64) in tons to the legal limit of the roadway (18, 22, 31, or 40 tons) based on Highway Classification.

<u>Operating Type (Item 63) and Inventory Type (Item 65</u>): The coding guide has been expanded by several memoranda since it was printed in 1995. These rating methods will usually match each other, except in the case where one is controlled by a timber rating done in Allowable Stress and the other is controlled by a different non-timber member.

Code	Rating Method	Units	Source
0	Engineering Judgment	Tons	02/02/2011 FHWA Memo
1	LFR using HS20	Tons	1995 Coding Guide
2	ASR using HS20	Tons	
3	LRFR using HL93	Tons	
4	Load Testing	Tons	
5	No rating	Tons	
6	LFR using HS20	Rating Factor	03/22/2004 FHWA Memo
7	ASR using HS20	Rating Factor	
8	LRFR using HL93	Rating Factor	
A	Assigned by LFD	Tons	11/15/2011 FHWA Memo
B	Assigned by ASD	Tons	
C	Assigned by LRFD	Tons	
D	Assigned by LFD using HS20	Rating Factor	
E	Assigned by ASD using HS20	Rating Factor	
F	Assigned by LRFD using HL93	Rating Factor	

<u>Operating Rating (Item 64) and Inventory Rating (Item 66</u>):
<u>Maximum</u> allowable values for both:

- For a culvert with enough fill to disregard the effects of Live Load, enter 110.10 English tons (99.9 metric tons).
- For a calculated rating higher than 110.01 English tons (99.9 metric tons), enter 110.01 English tons (99.8 metric tons).
- The maximum rating factor allowed is 3.0 according to UPACS error checking.

<u>Minimum</u> allowable values, when bridge is NOT recommended closed: 3 English tons (2.7 metric tons)
<u>Minimum</u> allowable values in English tons, when bridge IS recommended closed:

- For Inventory Rating, enter 0.1 instead of 0.0 to help BrM correctly calculate the Sufficiency Rating.
- For Operating Rating, enter 0.2 instead of 0.0 to make Operating greater than Inventory.

<u>Assigned tonnages using codes A-C</u>: Per a 1998 memorandum by M. Myint Lwin (then at Washington DOT), assigned ratings may be determined based on Design Load, with Inventory Rating equal to Gross Vehicle Weight, Operating Rating equal to 5/3 times Inventory Rating, and HL93 considered equivalent to HS25. A later memo from FHWA dated September 29, 2011 requires the Design Load to be HL93 or HS20 or greater to use this rule.
<u>Assigned tonnages, rounding issue</u>: Add 0.1 English tons to prevent the metric/English conversion/rounding from returning a value lower than intended. For example, code 18.1

instead of 18.0, because BrM will convert 18.0 English to 16.33 metric, round that to 16.3 metric, convert it back to 17.97 English, and then return an error because it's now lower than legal on that county route.

Temporary Bridge and/or Shoring: The coding guide requires Items 64 and 66 to be coded 0 tons if Item 103 is coded T. UPACS also requires Item 66 to be 0 if Item 41=E. If Item 41=D then code the capacity of the original structure without the shoring.

Rating Factors: We haven't started using these much yet, so we're not sure how BrM handles calculations with these Items if the values are rating factors instead of tonnages. Fields which use these 2 items for calculations include Sufficiency Rating, Posting Item 70, Structural Evaluation Item 67, and possibly Health Index. Enter the rating factor to the hundredth (x.xx). See the March 22, 2004 memorandum by M. Myint Lwin of FHWA for guidance.

Truck Weights Types 1 through 4: Enter the capacity of each truck, whether calculated or assigned. Use whole number tonnages only, rounded down.

Truck Weights SU4 through SU7: proposed to be added in the next version of BrM. Enter the capacity of each truck, whether calculated or assigned. Use whole number tonnages only, rounded down.

Truck Weights Ext. Wt.: this field is not used

Analysis Type: 13 codes are available and have been used over time. New load ratings should be coded either 1, 4, 10 or 11. Existing BARS and SimpSpan (2, 3, 5 and 6) analyses should be updated with LARS. Analyses by District, Maint, Design, Other and None (7, 8, 9, 12 and 13) should be updated by calculation and/or engineering judgment. Ratings by Consultants should use code 11. Codes 2, 3, 5, 6, 7, 8, 9, 12, 13 should not be used in the future.

Code	Description
1	LARS
2	BARS
3	SimpSpan
4	LARS+EJ
5	BARS+EJ
6	SimpSpan+EJ
7	District
8	Maint
9	Design
10	KYTC EJ
11	Consultant
12	Other
13	None

Date Posted Request: currently missing from BrM, but when available, enter the date of the current posting memo as mm/dd/yyyy. If posting is recommended to be removed, enter "01/01/1901" as the date. BrM is fickle, so use slants (/) instead of dashes (-).

Posting Reason: Use the appropriate code from the list below:

Code	Description	Comment
1	LoadRat-Beam	Posted due to superstructure calculations
2	LoadRat-Truss	
3	LoadRat-Deck	
4	LoadRat-Other	
5	FieldRec-Beam	Posted due to superstructure by engineering judgment
6	FieldRec-Truss	
7	FieldRec-Deck	
8	FieldRec-Other	
9	Substructure	Posted due to substructure, with or without superstructure calculations
10	KRS-15Mile	KRS 189.222 allows AAA loads on lesser routes within 15 miles of an interstate or parkway exit. Current policy posts everything less than 40 tons, so this code is no longer used.
11	Coal Haul	Posted for Extended Weight Coal Haul

NTN Weights: this field is not used

Bridge Plans, Drawing No. 1 thru 4: Enter the drawing number of the plans for the bridge, or "See Media Tab" (on three lines) if unnumbered plans have been uploaded to BrM. (Inspectors also have access to this field and will populate it if possible.) (5 character limit per line)

BrM Fields for Particular Situations

New Bridge: When entering data for a newly inventoried bridge which has not yet been load rated, enter values as shown:

<table>
<tr><td>Rating Date</td><td colspan="3">01/01/1901</td></tr>
<tr><td>Initials</td><td colspan="3">-1</td></tr>
<tr><td>Design Load (Item 31)</td><td colspan="3">As applicable</td></tr>
<tr><td>Posting (Item 70)</td><td colspan="3">5 Equal To or Above Legal Loads</td></tr>
<tr><td>Operating Type (Item 63)
Inventory Type (Item 65)</td><td>5
No Rating</td><td>A-F Assigned
Rating</td><td rowspan="2">As applicable</td></tr>
<tr><td>Operating Rating (Item 64)
Inventory Rating (Item 66)</td><td>Roadway
Limits</td><td>Tons or R.F. per
Design Load</td></tr>
<tr><td>Analysis Type</td><td colspan="3">13 None</td></tr>
<tr><td>Posting Reason</td><td colspan="3">N/A</td></tr>
<tr><td>Truck Weights Types 1-4 and SU4-SU7</td><td colspan="3">-1</td></tr>
</table>

Gross Posting: If a bridge is recommended gross posted, enter the same tonnage for all truck type capacities, and enter either the calculated tonnage or the assigned tonnage for Inventory and Operating Rating.

Extended Weights: A bridge shall NOT be posted for KY trucks for both legal weights AND for extended weights. The posted load limits for legal weights will always be less than extended weights and will control.

Closed Bridge: Enter 0 for all truck capacities, enter 0.02 for Operating Rating, and enter 0.01 for Inventory Rating.

Temporary Bridge and/or Shoring: Item 103 is Temporary Structure Designation – see the coding guide for procedures. The coding guide also requires Items 64 and 66 to be coded 0 tons if Item 103 is coded T. Items 58 thru 62 ignore the presence of temporary members. Item 41 has codes D and E. Item 70 may take advantage of the capacity of a temporary structure.

Non-Highway Overpasses: Design Load (Item 31) will be 7 for Pedestrian, 8 for Railroad, and C-Other for Tunnel. Code these other values as shown:

Rating Date	01/01/1901
Initials	N/A
Posting (Item 70)	5 Equal To or Above Legal Loads
Operating and Inventory Type (Items 63 and 65)	5 No Rating
Operating and Inventory Tons (Items 64 and 66)	-1
Analysis Type	None
Posting Reason	N/A
Truck Weights Types 1-4 and SU4-SU7	-1

BrM Load Rating fields with Permissions for Others

Open/Closed/Posted Item 41: if an inspection changes this Item, that inspection must be marked NBI also – see Chapter 300 for clarification.

Code	Description	Comment
A	Open, no restriction	Has NO posting signs
B	Posting Recommended	LACKS one or both posting signs, or has missing or improper barricade(s)
D	Open, temporarily shored	
E	Open, temporary structure	Do not use if the temporary bridge is posted
G	New-Not Yet Open	
K	Closed to All Traffic	Has MUTCD-compliant barricades across BOTH ends
P	Posted for load	Has BOTH posting signs (or one, if bridge is one-way)
R	Posted for Non-Load	

For a non-state-owned bridge with posting signs but no posting recommendation from KYTC: the district needs to contact the bridge owner to determine their intent. If the bridge has 2 signs, Item 41 may be marked P; but if the bridge has only 1 sign, it is not properly posted so Item 41 should be B.

Date Field Posted: currently missing from BrM. Enter mm/dd/yyyy. BrM is fickle, so use slants (/) instead of dashes (-).

Field Postings Type 1 through 4: Enter the tonnage for each truck if shown on the posting sign, enter 0 if closed, or enter -1 if no tonnage shown.

Field Postings SU4 through SU7: proposed to be added in the next version of BrM. Enter the tonnage for each truck if shown on the posting sign, enter 0 if closed, or enter -1 if no tonnage shown.

Field Postings Gross: Enter the tonnage if shown on the posting sign, enter 0 if closed, or enter -1 if no tonnage shown.

Field Postings Ext. Wt.: Enter a code of “2” if the field postings are for coal only. Otherwise leave blank.

Signs Posted Cardinal and Non-Cardinal: Enter yes or no as applicable. Use the “Signs Posted” fields only to indicate the presence of weight-restrictive signs. Signs for horizontal or vertical clearance should be noted in the inspection notes but should not be considered a “posting sign” for these fields.

500 – Scour

Scour Evaluation

Target Audience: Scour Engineer

Purpose: The following procedures should be used to properly code "**Item 113: Scour Critical Bridges"** field under the **KYTC Tab, Scour Task** in BrM for the National Bridge Inventory. Use a single-digit code as indicated in the Coding Guide to identify the current status of the bridge regarding its vulnerability to scour.

Procedures: The Scour Engineer is the responsible party for coding **Item 113** in BrM. **Item 113** shall be updated according to the following procedures. The type of evaluation performed shall also be documented on the **KYTC Tab, Scour Task** in BrM under the "**Scour Analysis/Assessment**" field. A note indicating when and why **Item 113** was assigned/updated shall be documented in the "**Scour Notes**" field on the **KYTC Tab, Scour Task** in BrM**.** All supporting documents shall be uploaded to the I**nspection Tab, Media Task** under the Bridge Context in BrM for each bridge.

<u>Item 113: Scour Critical Bridge Rating Code Description</u>

N Bridge not over waterway

U Bridge with "unknown" foundation that has not been evaluated for scour. Until risk can be determined, a plan of action should be developed and implemented to reduce the risk to users from a bridge failure during and immediately after a flood event (see HEC 23).

T Bridge over "tidal" waters that has not been evaluated for scour, but considered low risk. Bridge will be monitored with regular inspection cycle and with appropriate underwater inspections until an evaluation is performed ("Unknown" foundations in "tidal" waters should be coded U.)

9 Bridge foundations (including piles) on dry land well above flood water elevations.

8 Bridge foundations determined to be stable for the assessed or calculated scour condition. Scour is determined to be above top of footing (Example A) by assessment (i.e., bridge foundations are on rock formations that been determined to resist scour within the service life of the bridge), by calculations or by installation of properly designed countermeasures (see HEC 23).

7 Countermeasures have been installed to mitigate an existing problem with scour and to reduce the risk of bridge failure during a flood even. Instructions containted in a plan of action have been implemented to reduce the risk to users from a bridge failure during or immediately after a flood event.

6 Scour calculation/evaluation has not been made. (Use only to describe case where bridge has not yet been evaluated for scour potential.)

5 Bridge foundations determined to be stable for assessed or calculated scour condition. Scour is determined to be within the limits of footing or piles (Example B) by assessment (i.e., bridge foundations are on rock formations that have been determined to resist scour within the

service life of the bridge), by calculations or by installation of properly designed countermeasures (see HEC 23).

4 Bridge foundations determined to be stable for assessed or calculated scour conditions; field review indicates action is required to protect exposed foundations (see HEC 23).

3 Bridge is scour critical; bridge foundations determined to be unstable for assessed or calculated scour conditions:

- Scour within limits of footing or piles (Example B)
- Scour below spread-footing base or pile times (Example C)

2 Bridge is scour critical; field review indicates that extensive scour has occurred at bridge foundations, with are determined to be unstable by:

- a comparison of calculated scour andobserved scour during the bridge inspection, or
- an engineering evaluation of the observed scour condition reported by the bridge inspection in Item 60.

1 Bridge is scour critical; field review indicates that failure of piers/abutments is imminent. Bridge is closed to traffic. Failure is imminent based on:

- a comparison of calculated and observed scour during the bridge inspection, or
- an engineering evaluation of the observed scour condition reported by the bridge inspector in Item 60.

0 Bridge is scour critical. Bridge has failed and is closed to traffic.

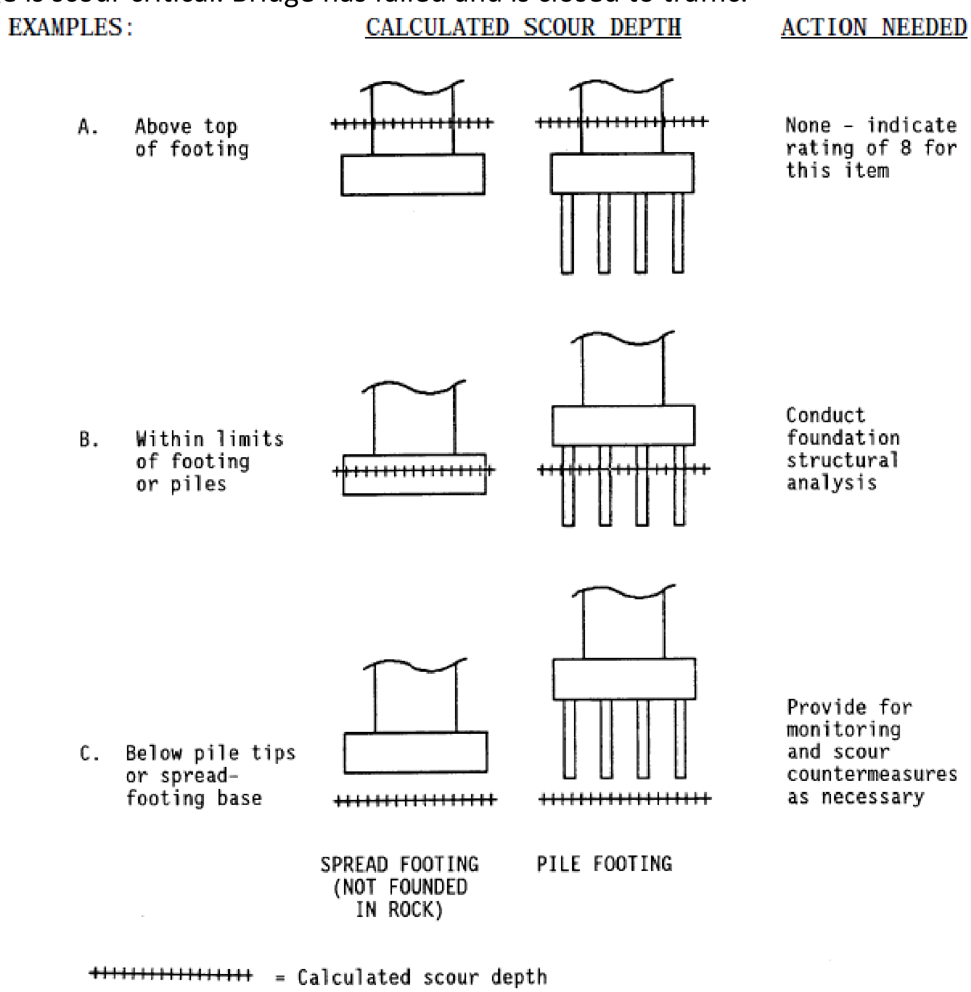


Figure 1: Example of Calculated Scour Depths and Foundations

Note: Whenever a rating factor of 2 or below is determined for Item 113, the rating factor for Item 60-Substructure and other affected items (i.e., load ratings, superstructure rating) should be revised to be consistent with the severity of observed scour and resultant damage to the bridge. A plan of action should be developed for each scour critical bridge (see FHWA Technical Advisory T 5140.23, HEC 18 and HEC 23). A scour critical bridge is one with abutment or pier foundation rated as unstable due to (1) observed scour at the bridge site (rating factor of 2, 1, or 0) or (2) a scour potential as determined from a scour evaluation study (rating factor of 3). It is assumed that the coding of this item has been based on an engineering evaluation, which includes consultation of the NBIS field inspection findings.

Note: New inventories added to BrM automatically default to “6- Scour calculation/evaluation has not been made”.

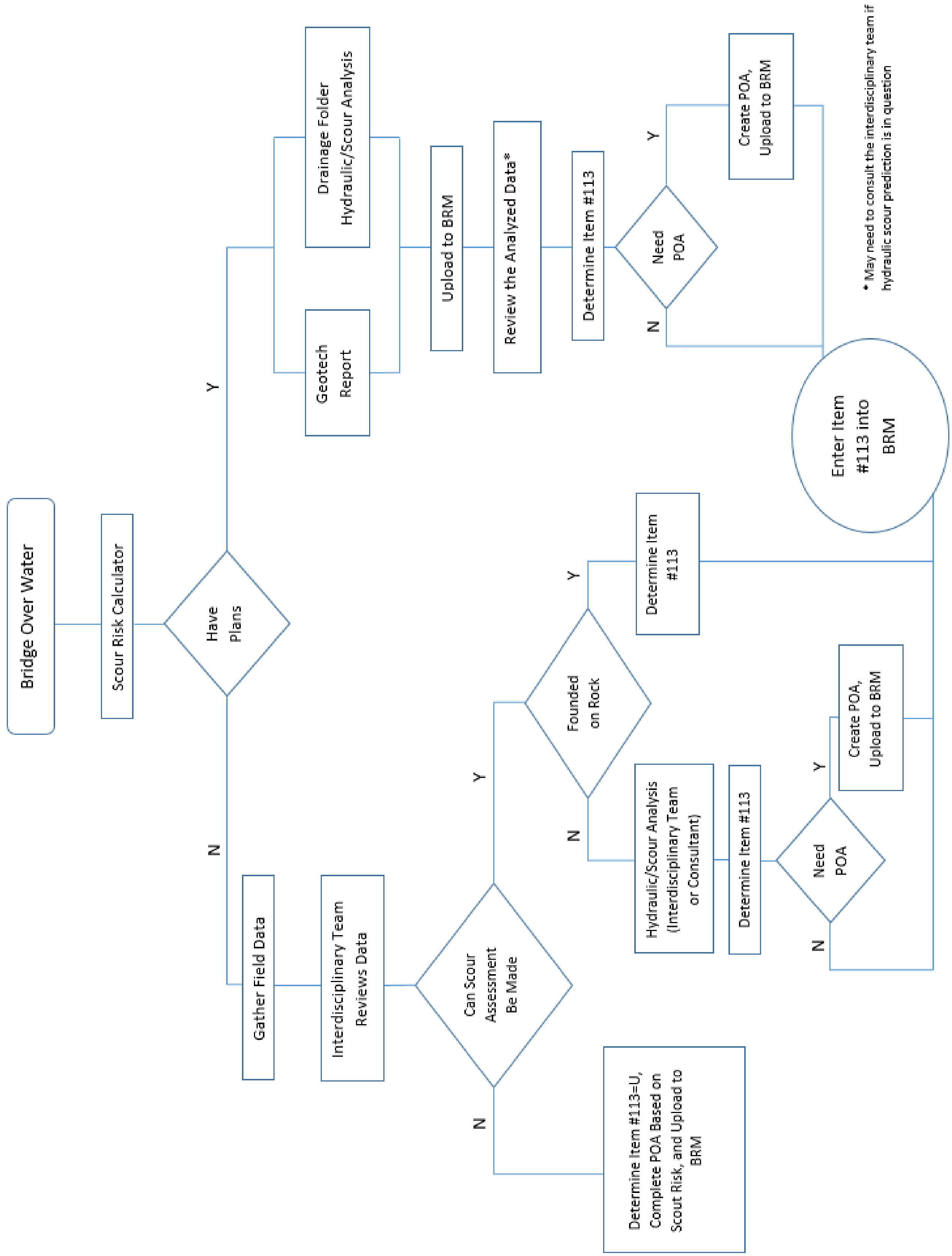


Figure 2: Flow Chart for Item 113 Determination

<u>Scour Analysis/Assessment</u>

Use the following guidelines to accurately code the type of evaluation performed under the "**Scour Analysis/Assessment**" on the **KYTC Tab, Scour Task** in BrM**.**

Needs Assessment/Analysis	Used to indicate that a structure has not been evaluated by the Scour Engineer. New inventories are automatically given this designation in BrM.
Analysis Performed	Used to indicate that a structure has had a detailed engineering analysis such as detailed in Hydraulic Engineering Circular 18 "Evaluation Scour at Bridges" or a full hydraulic analysis. (More detail below)
Assessment Performed	Used to indicate that a structure has had an engineering evaluation for scour but not a detailed engineering analysis as detailed in Hydraulic Engineering Circular 18 "Evaluating Scour at Bridges". (More detail below)
Not Required	Used to indicate that a structure is not over water and therefore does not require a scour evaluation.
Completed by Ogden	Used to indicate that the structure was included in the scour assessment that Ogden completed in the mid-90s and early 2000s. The Item 113 ratings for these structures were the assigned ratings from Ogden. Also, the "**Scour Risk**" was also calculated and assigned for these structures.

<u>Analysis Performed Details</u>

The scour evaluation should be coded as "**Analysis Performed**" when the structure has had an hydraulic analysis with calculated scour depths for substructures in soil (foundations on end bearing piles, friction piles, drilled shafts, etc.) or geotechnical evaluation of scouring of bedrock (foundations on spread footings founded on rock). New bridges designed by the Division of Structural Design or any consultants hired by the Cabinet for bridge replacements will be included in this type of scour evaulation. If the structure is more than one span, the scour analysis will be found in the drainage folder. The scour analysis will indicate the local and contraction scour depths for abutments and piers. If the structure is a single span, use the guidance given in the geotechnical report for the scour evaluation. Upload the hydraulic section of the drainage folder and/or the geotechnical report into the I**nspection Tab, Media Task** under the Bridge Context in BrM. Using the pile tip and/or drilled shaft elevations on the plans and/or as-built plans, examine the calculated scour depths for substructures founded on soil and determine the correct coding for **Item 113**. Using the bottom of footing elevations on the plans and/or as-built plans, examine the geotechnical report required embedded and determine the correct coding for **Item 113**.

The scour evaluation should be also be coded as "**Analysis Performed**" if a special hydraulic and/or scour analysis was completed after the structure had been in service and exhibited scour related problems. Upload the completed hydraulic and/or scour analysis into the **Inspection Tab, Media Task** under the Bridge Context in BrM. Code **Item 113** accordingly to the assessment's recommendation.

Assessment Performed Details

The scour evaluation should be coded as "**Assessment Performed**" when the structure has had an engineering evaluation in the field or during the inspection cycle. These situations will include when **Item 113** is decreased to a **4, 2**, **1** or **0** based on a field review or when scour countermeasures have been successfully installed and **Item 113** can be coded a **5**, **7** or **8** based on the design of the countermeasures. In both cases, documentation shall be completed and uploaded in the I**nspection Tab, Media Task** under the Bridge Context in BrM showing before and after conditions documenting the change in **Item 113**.

The scour evaluation should also be coded as "**Assessment Performed**" when the structure's substructure units are founded on rock and an engineering scour evaluation has been completed based on the lithology of the rock. Using documented geotechnical reports in the area, Division of Structural Design Geotechnical Branch Guidance Manual, Kentucky Geological Survey, Kentucky Transportation Center Research Report KTC-99-57/SPR 157-94 Correlation of Rock Quality Designation and Rock Scour Around Bridge Piers and Abutments Founded on Rock and any other pertinent information, **Item 113** can be coded a **5** or **8** after gathered geotechnical information is assessed and field review confirms any scour related issues. Documentation shall be completed and uploaded in the I**nspection Tab, Media Task** under the Bridge Context in BrM documenting the lithology of the rock and determination of the correct coding for **Item 113**.

Inter-Disciplinary Team

Scour assessments of new and existing bridges should be conducted by an inter-disciplinary team comprised of structural, geotechnical, hydraulic and scour engineers. KYTC scour engineer may perform scour assessments per KYTC qualifications and expertise under multiple roles of the inter-disciplinary team.

Resources

FHWA Technical Advisory T5140.23

This document provides guidance on developing and implementing a scour evaluation program for: Designing new bridges to resist damage resulting from scour; evaluating existing bridges for vulnerability to scour; using scour countermeasures; and improving the state-of-practice of estimating scour at bridges.
https://www.fhwa.dot.gov/engineering/hydraulics/policymemo/t514023.cfm

HEC 20- Stream Stability at Highway Structures

This document provides guidelines for identifying stream instability problems at highway stream crossings. It covers geomorphic and hydraulic factors that affect stream stability and provides a step-by-step analysis procedure for evaluation of stream stability problems. Stream channel classification, stream reconnaissance techniques, and rapid assessment methods for channel stability are covered in detail. Quantitative techniques for channel stability analysis, including degradation analysis, are provided, and channel restoration concepts are introduced. Significant new material in this edition includes chapters on sediment transport concepts and channel stability in gravel bed streams, as well as expanded coverage of channel restoration concepts. https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12004.pdf

HEC 18- Evaluating Scour at Bridges

This document presents the state of knowledge and practice for the design, evaluation and inspection of bridges for scour. The major changes in the fifth edition of HEC-18 are: expanded discussion on the policy and regulatory basis for the FHWA Scour Program, including risk-based approaches for evaluations, developing Plans of Action (POAs) for scour critical bridges, and expanded discussion on countermeasure design philosophy (new vs. existing bridges). This fifth edition includes: a new section on contraction scour in cohesive materials, an updated abutment scour section, alternative abutment design approaches, alternative procedures for estimating pier scour, and new guidance on pier scour with debris loading. There is a new chapter on soils, rock and geotechnical considerations related to scour. Additional changes include: a new approach for pier scour in coarse material, new sections on pier scour in cohesive materials and pier scour in erodible rock, revised guidance for vertical contraction scour (pressure flow) conditions, guidance for predicting scour at bottomless culverts, deletion of the "General Scour" term, and revised discussion on scour at tidal bridges to reflect material now covered in HEC-25 (1st and 2nd Editions).
https://www.fhwa.dot.gov/engineering/hydraulics/pubs/hif12003.pdf

HEC 23- Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance Vol 1&2

This document identifies and provides design guidelines for bridge scour and stream instability countermeasures that are suggested for use by various State departments of transportation (DOTs) in the United States. Countermeasure experience, selection, and design guidance are consolidated from other FHWA publications in this document to support a comprehensive analysis of scour and stream instability problems and provide a range of solutions to those problems. Selected innovative countermeasure concepts and guidance derived from practice outside the United States are introduced. Management strategies for developing a Plan of Action (POA) for scour critical bridges are outlined, and guidance is provided for scour monitoring using portable and fixed instrumentation.
https://www.fhwa.dot.gov/engineering/hydraulics/pubs/09111/09111.pdf
https://www.fhwa.dot.gov/engineering/hydraulics/pubs/09111/09112.pdf

Geotechnical Guidance Manual

Chapter 606 discusses the scour considerations concerning substructure units in soil and bedrock.
http://transportation.ky.gov/Organizational-Resources/Policy%20Manuals%20Library/Geotechnical.pdf

Drainage Guidance Manual

Chapter 804 discusses the hydraulic considerations concerning scour.
http://transportation.ky.gov/Highway-Design/Drainage%20Manual/DR%20800%20Bridges.pdf

KTC-99-57/SPR 157-94 KTC Correlation of Rock Quality Designation and Rock Scour around Bridge Piers and Abutments Founded on Rock

This research project correlates the Rock Quality Designation (RQD) and the scour susceptibility of rock in Kentucky. Based on observations of bridge foundations founded on exposed rock

beds of bridges, scour around bridge footings founded in rock is not a significant problem in Kentucky.
http://www.ktc.uky.edu/files/2012/06/KTC_99_57_SPR_157_94.pdf

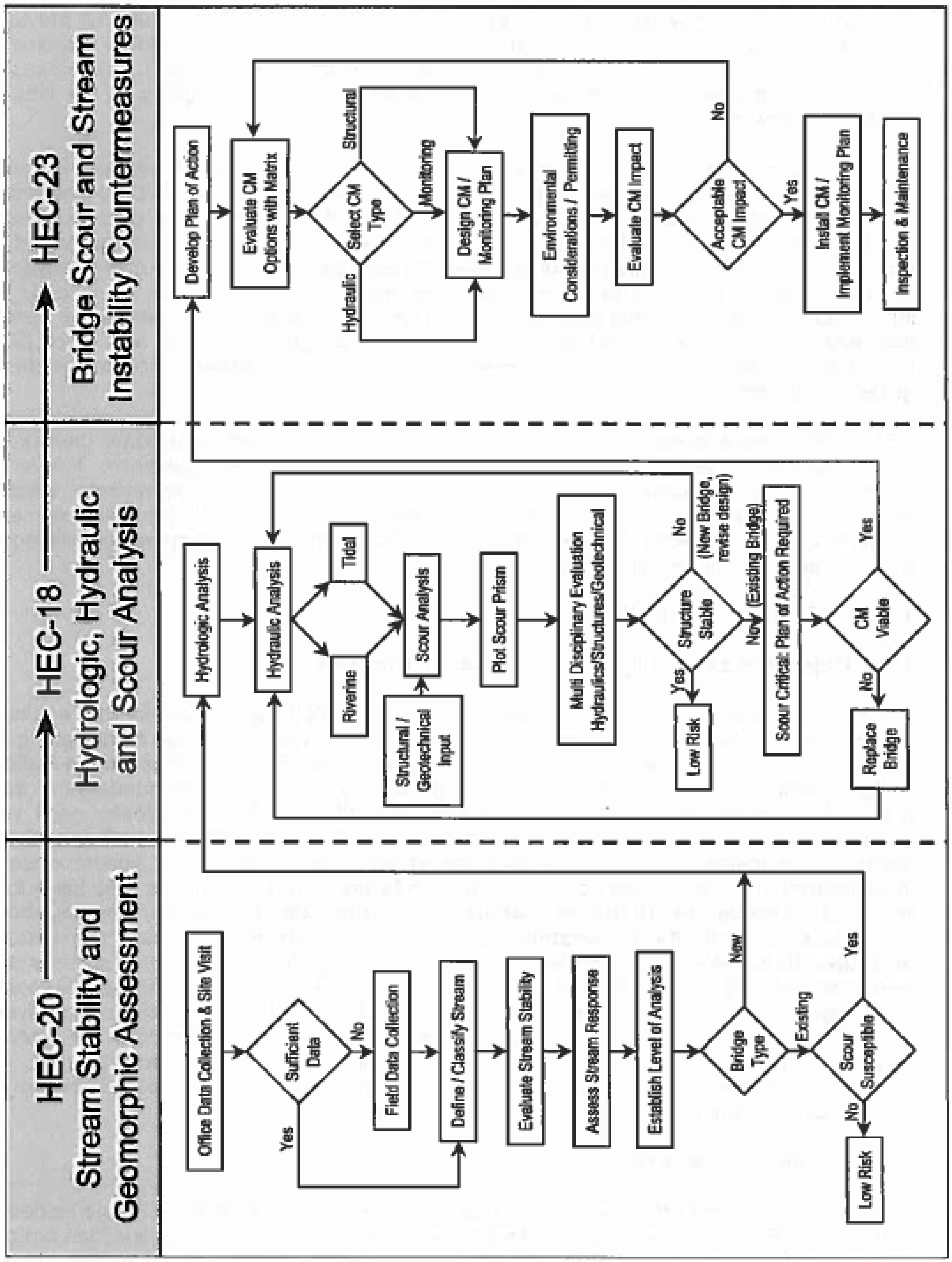


Figure 3: Flow Chart for Scour and Stream Stability and Evaluation

Scour Observed Field Coding Guideline

Target Audience: Bridge Inspector, District Bridge Engineer, Scour Engineer

Purpose: This coding guideline should be used by the inspector to properly code the "**Scour Observed**" field under the **KYTC Tab, Summary & Miscellaneous Task in BrM**. This field will be utilized to assess the correct coding for Item 113, alerting Scour Engineers for critical findings and planning future scour countermeasure projects. Coding of Item 113 under the **Inspection Tab, Appraisal Task in BrM** can only be changed or updated by KYTC's Scour Engineers. Central Office shall maintain a master list of all bridges that are scour critical. The District Bridge Engineer shall also maintain a list of scour critical bridges in their district.

Procedures: The following guide should be used when coding the "Scour Observed" field.

Code	Description
N/A	Bridge not over waterway.
No Scour Observed	Field observation shows the bridge has not exhibited any form of scour from the as-built condition.
Minor Scour Observed	Field observation shows the bridge is **starting** to exhibit signs of scour. Examples include but are not limited to: aggradation/degradation, lateral stream instability, loss of embankment and scour hole formation around substructure units. Foundations (piles and/or footings) are not currently exposed or have not changed from the as-built conditions.
Moderate Scour Observed	Field observation shows the bridge **has or currently shows** signs of scour. Examples include but are not limited to: undermining of substructure unit, headcutting, unstable banks and loss of slope. Foundations (piles and/or footings) are exposed and have changed from the as-built conditions but currently pose no structural capacity concern.
Major Scour Observed	Field observation shows the bridge has exhibited **major signs and/or problems** associated with scour. Examples include but are not limited to: rotation, settling and/or buckling of substructure unit, complete loss of fill embankment and/or slope. Foundations (piles and/or footings) are exposed and have changed from the as-built conditions which pose a structural capacity concern. District Bridge Engineers, Load Rating Engineers, Scour

	Engineers and/or Chief Bridge Inspector/Engineer should be notified immediately for closure or posting recommendations documented in a CBMNI report.
Scour Unobservable	Scour condition cannot be assessed because of environmental factors (i.e., high water, debris, etc.). Indicate reason in an Inspection Note. Structures that repeatedly have high water conditions will be considered to be added to the Underwater Inspection list.

Action: The **"Scour Observed"** field shall be updated each inspection. This information will be used, along with **Item 113**, for managing cross section frequencies and prioritizing scour/hydraulic analysis or assessments.

Scour Risk Calculation

Target Audience: Bridge Inspector, District Bridge Engineer, Scour Engineer

Purpose: The following guidelines should be used to properly code the "**Scour Risk**" field under the **KYTC Tab, Summary & Miscellaneous Task in BrM**. This field will be utilized to assess the potential criticality of a bridge scour. This risk assessment will also be used to prioritize bridges for more rigorous scour assessments and analyses.

Procedures: The risk calculation will indicate the structure's vulnerability to scour. The lower the scour risk score, the less vulnerable the structure is to scour. If the number is greater than or equal to 300, the structure will be flagged as "High Risk" and further investigation is required. The structures where the scour score does not indicate scour susceptibility (i.e., scour score less than 300) will be flagged as "Low Risk". **See Exhibit 9501** for field sheet for collecting the following data. The following factors will be added into an excel program to calculate the scour risk calculation. **See Exhibit 9502**. Total Scour Risk Calculation = a + b + c + d + e + f + g + h. Below are the risk factors.

<u>Scour Risk Factors</u>

a. Element Skew to Flow
(3.5 x Max Skew Angle in Degrees, *max = 150pts*)

This factor is the estimated acute angle between a straight line projected from the centerline of the substructure unit and the direction of the oncoming flow. Skew angle is a significant contributing factor to scour depths. In general, higher skew angles result in larger scour depths. A skew angle of 0 degrees is generally the best case and a skew of 90 degrees is the worst case. The figure below shows skew angle. **Enter the degree of skew.**

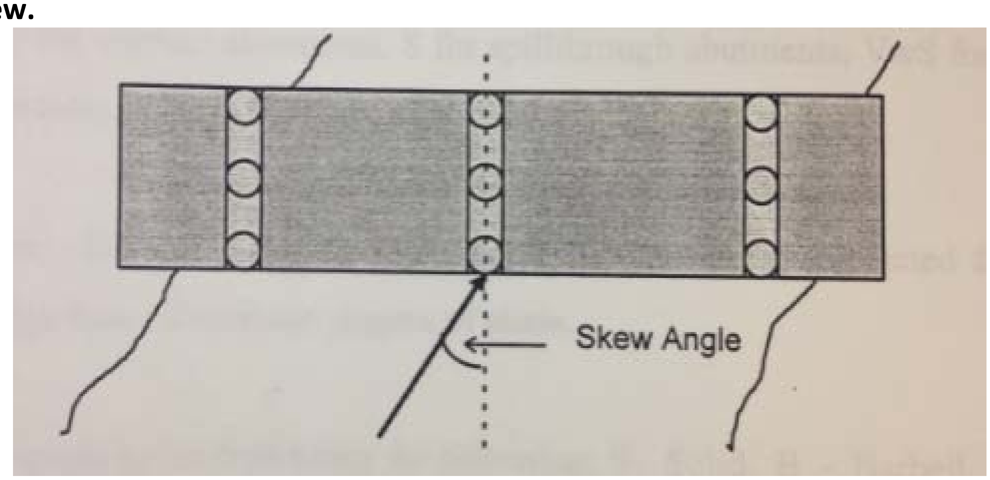


Figure 4: Skew Angle

b. Local Scour
(40 x Max Local Scour Depth in Feet, *max 150pts*)

This factor is the max local scour approximate depth of the scour hole around any substructure unit. Probing around suspect areas will be used to approximate the depth. If the scour hole is submerged, the scour depth can be approximated by estimating the difference between the depth of the water in the adjacent channel area and the depth of water in the scoured area. **Enter the approximate depth of the scour hole in feet.**

c. Debris
(8 x Percent Blocked, *max 150pts*)

This factor is the amount of debris currently blocking the hydraulic opening of the structure. Scour susceptibly is increased when the hydraulic opening is decreased due to increased velocities. The percent of opening blocked by debris will be estimated to the nearest 5%. **Enter the estimated percent of blockage.**

d. Channel Erosion/Protection
(6 x (Bank Erosion + Vegetative Cover) x Erosion Control x Sinuosity, *max 150pts*)

Each of the following will be taken as the max value obtained at upstream left, upstream right, bridge reach left or bridge reach right

Bank Erosion- Note the presence of exposed roots and leaning or fallen trees.

If bank erosion is present, **Enter "1".**
If bank erosion is not present, **Enter "0".**

Vegetative Cover- Note the presence of ground cover on all sides of the bank

If percent covered is greater than 90, **Enter "1"**
If percent covered is between 50 and 89, **Enter "2"**
If percent covered is less than 50, **Enter "3"**
If percent covered is essentially 0 **Enter "4"**

Erosion Control Condition- Assess condition of in place erosion control systems such as rip rap, gabions, sacked concrete, retaining wall, spur, dike/levee, guide bank, check dam, paved slope, etc.

If NA, **Enter "1"**
If Good, **Enter "2"**
If Fair, **Enter "3"**
If Poor, **Enter "4"**

Sinuosity- When considering sinuosity, assess the up and downstream segment beyond the influence of the bridge.

If Straight, **Enter "1"**
If Sinuous, **Enter "2"**
If Meandering, **Enter "3"**
If Highly Meandering, **Enter "4"**

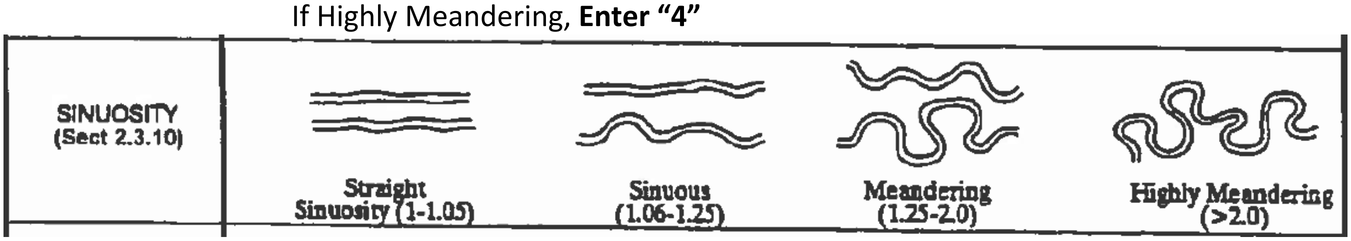


Figure 5: Sinuosity

e. Contraction Scour
(*max 50pts*)

This entry should be based on the level of clearly defined scour processes present at the bridge which are obviously influenced by contraction scour. The following is guidance on what evidence to look for as indicators of contraction scour potential.

- If "as built" plans indicate substantial water depth in the overbank floodplain that is obstructed by bridge approaches and forced through the bridge opening.
- If depth of floodwater is in contact with superstructure and does not overtop bridge or bridge approaches there is potential for pressure flow and vertical contraction scour.
- If observed channel width upstream widens in the bridge opening and downstream channel width approximates the upstream channel width.
- If the observed channel water surface depth beneath the bridge is deeper than the upstream and downstream water depth.

If any of the above field situations exist then, contraction scour exists. **Enter "50".**
If not, **Enter "0".**

f. Channel Migration
(*max 50pts*)

Use historical channel cross sections, bank shape or soil stains on substructure units to help identify the migration of the channel location since the bridge was constructed.

If migration has occurred, **Enter "50"**
If not, **Enter "0"**

g. Flood Plain Descriptions
(Evd. Of Flow + Lat. Inflow + (Veg. Cover x 4) + Obstr. Pres. + (Floodplain Width x 2) + Nat. Lev. + Incision, *max 50pts*)

Each of the following will be taken as the max value obtained at upstream left floodplain or upstream right floodplain.

Evidence of Flow- Does the flow patterns within the vegetation, debris or other indicators imply overbank flow?

If yes, **Enter "12"**
If no, **Enter "0"**

Lateral/Tributary Inflow- Is there a lateral/tributary with the potential of altering the channel flow at the bridge confluences with the main channel near the bridge?

If yes, **Enter "12"**
If no, **Enter "0"**

Vegetative Cover- What is the majority of the vegetative cover in the floodplain?

If Light Woods, Heavy Woods or Brush, **Enter "1"**
If tall or short grass, **Enter "2"**
If bare, row crops, paved or other, **Enter "3"**

Obstructions Present- Are there any obstructions present in the floodplain such as fill, buildings, trash, debris, retaining wall, etc.?

If yes, **Enter "4"**
If no, **Enter "0"**

Floodplain Width- Categorize the floodplain width in relation to the channel

Little or None (<2x channel width), **Enter "1"**
Narrow (2-10x channel width), **Enter "2"**
Wide (>10x channel width), **Enter "3"**

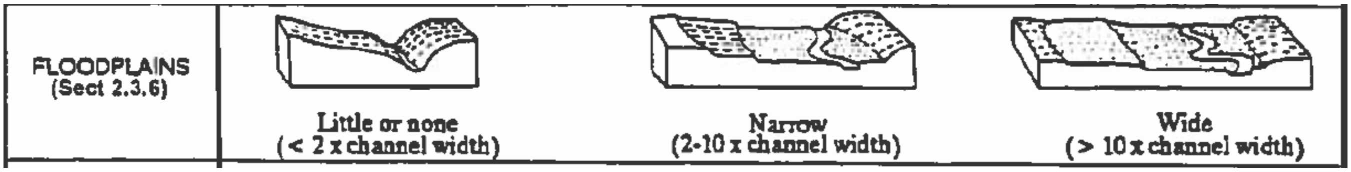


Figure 6: Floodplain Width

Natural Levees- Are there deposits of sediment near the top-of-bank which form a high point when compared to the typical floodplain elevation?

If yes, **Enter "2"**

If no, **Enter "0"**

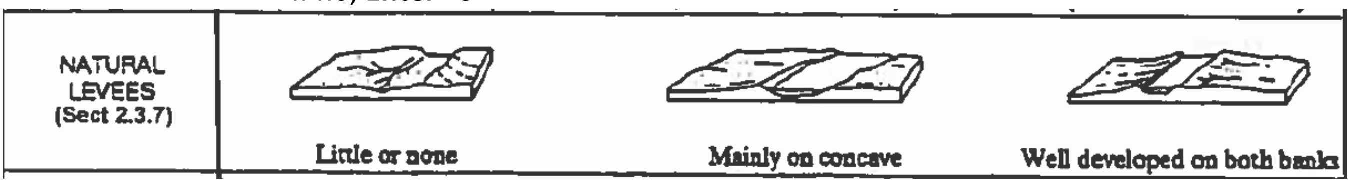


Figure 7: Natural Levee

Incision- Is the channel well-defined (i.e. the banks high)?

If yes, **Enter "0"**

If no, **Enter "2"**

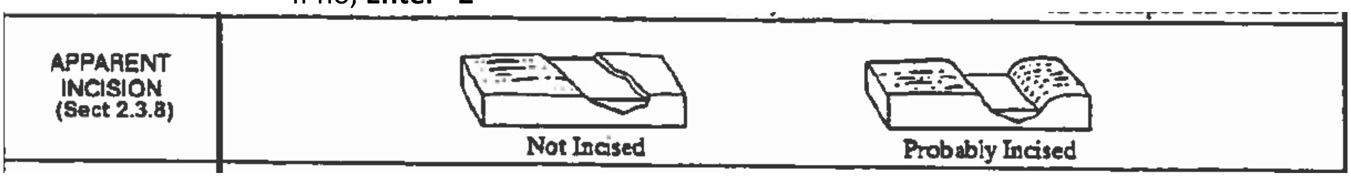


Figure 8: Incision

h. Bed Material

(10 x Bed Material, *max 50pts*)

What predominantly is the soil type of the streambed?

If Solid Rock, **Enter "0"**

If Cobble, **Enter "1"**

If Clay, **Enter "2"**

If Gravel, **Enter "3"**

If Sand, **Enter "4"**

If Silt, **Enter "5"**

Action: After scour risk calculation excel file and/or field sheet is completed, upload documents in the **Inspection Tab, Media Task** under the Bridge Context in BrM. Update calculation as warranted by inspector, District Bridge Engineer or Scour Engineer.

Stream Channel Documentation

Target Audience: Bridge Inspector, District Bridge Engineer, Scour Engineer

Purpose: The most common cause of bridge failure stems from the scouring of bridge foundations. In order to document changes in the streambed elevations at the bridge fascias, a stream channel cross section must be performed. Measurements from successive inspections may reveal channel movement over time and help assess and identify any scour problems before they endanger the bridge.

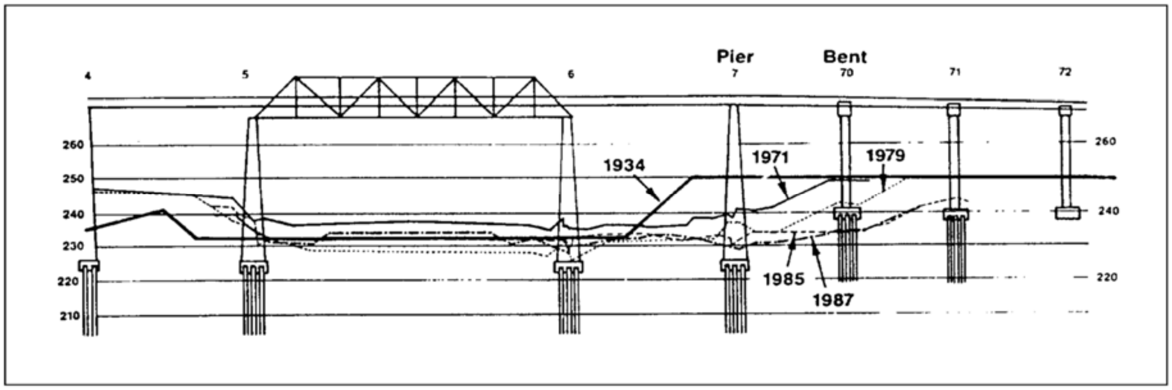


Figure 9 - The change in the stream profile of the Hatchie River leading to a catastrophic failure.

Equipment: See the section titled "Equipment List for Bridge Inspection" for examples of tools and equipment needed for accessing and performing stream cross sections.

Procedures:
There are two main objectives to be accomplished in inspecting bridges for scour;

- Accurately record the present condition of the bridge and the stream; and
- Identify conditions that are indicative of potential problems with scour and stream stability for further review and evaluation by others.

Stream Cross Sections at Bridge Fascias
Take and plot cross section measurements of the channel along the upstream and downstream edges of the bridge deck from abutment to abutment. Cross sections will be performed along both edges of the bridge deck in all spans by the following guidelines.

1. Determine the downstream flow of the body of water. All cross section measurements will be taken left to right with the orientation looking downstream at both fascias of the bridge. Therefore, the first measurement on some structures MAY NOT be at substructure unit 1.
2. Determine the number of spans and sketch an elevation view of bridge on paper with labels for each substructure unit. Once again, the first substructure unit where the initial measurment is performed may not be Abutment/End Bent 1.
3. Starting on the upstream side, take a vertical (y) measurement along fascia starting at the face of the abutment/end bent. If the footing is exposed, take the first measurement at the face of the footing. Whatever case, the first measurement will be where the ground hits the substructure unit. Note: x=0 will be the beginning of the structure. Therefore, most (if not all) of your first vertical measurements will be taken at x not equal to 0ft.

4. Keeping track of your horizontal (x) dimensions, take vertical (y) measurements along the upstream side of the bridge when elevations change significantly. Always take a vertical (y) measurement at the following locations:
    - Beginning and end of a slope, beginning and end of a scour hole, at the centerline of each pier/intermediate bent if applicable, at the edges of water, at the deepest part of the stream and any other substantial elevation change where the inspector deems necessary. If there is a significant length of "flat" area along the cross section, take a measurement at the midpoint to document that it is indeed "flat".
    - All vertical (y) measurements should be measured to the nearest half of foot unless you are documenting a scour hole. Scour hole measurements should be to the nearest tenth of a foot. All horizontal (x) measurements can be taken to the nearest foot.
5. The final vertical (y) measurement should be taken at the face of the last substructure unit. If the footing is exposed, take the measurement at the face of the footing.
6. After completion of the upstream sketch, draw a downstream elevation view of the bridge. This sketch should be drawn below the upstream sketch. Label each substructure unit on the downstream sketch in the same manner and make sure the substructure units line up on the sketch. If it is not possible to have both sketches on the same page, draw the downstream sketch on another sheet of paper and label both sheets accordingly.
7. Repeat steps 3-5 on the downstream face of bridge
8. The final sketch should be neat, legible and be easily reproduced by another inspector. See **Figure 10** for an example.
9. Please make sure the following is on the sketch before uploading to the **Inspection Tab, Media Task** under the Bridge Context in BrM.
    - ✓ Upstream Cross Section with x and y dimensions
    - ✓ Downstream Cross Section with x and y dimensions
    - ✓ Indication of reference datum
    - ✓ Inspector Name
    - ✓ Date of Cross Section
    - ✓ Bridge ID
    - ✓ District
    - ✓ Remarks/Notes on scour holes, undermining, etc.
10. On the **KYTC Tab, Summary & Miscellaneous Task** in BrM, update "Stream Cross Section" to *Yes* and enter the date the sketch was performed in the "Cross Section Date" field.

Notes:

- Vertical (y) measurements should be measured to a reference datum line on the bridge that is not likely to change with time. These datum lines can be barrier walls, curbs, bottom of barrels, top of deck, etc. If using guardrail, indicate the height of the guardrail from the top of the deck to the top of the guardrail in case the guardrail is replaced in the future.
- If there is a set of twin bridges that are close together (i.e., twin bridges on the interstate that have 10' or less clearance between the barriers), only do the one cross section for the correlating bridge. Indicate on the sketch that

the upstream (or downstream) cross section is located on the twin structure's cross section. Both sets of cross sections should be uploaded to the **Inspection Tab, Media Task** under the Bridge Context in BrM for each bridge.

<u>Stream Cross Sections at Culverts</u>

Take and plot cross section measurements of the channel along the inlet and outlet of the barrel openings from end wall to end wall. Cross sections will be performed along all barrels by the following guidelines. If the culvert has an apron, cross section measurements will be taken at the end of the apron with the top of the apron as the reference datum.

1. Determine the downstream flow of the body of water. All cross section measurements will be taken left to right with the orientation looking downstream at both ends of the culvert. Therefore, the first measurement on some structures MAY NOT be at barrel 1.
2. Determine the number of barrels and sketch out elevation view of culvert on paper with labels for each barrel. Once again, the first barrel where the initial measurment is performed may not be barrel 1.
3. Starting on the inlet side, take a vertical (y) measurement along the face of the barrel. Note: x=0 will be the opening of the first barrel you come to. Therefore, all of your first vertical (y) measurements will be taken at x equal to 0ft.
4. Keeping track of your horizontal (x) dimensions, take vertical (y) measurements along the upstream side of the culvert when elevations change significantly. Always take a vertical (y) measurement at the following locations:
    - Beginning and end of a slope, beginning and end of a scour hole, at the beginning and end of the barrel opening, at the edges of water, at the deepest part of the stream and any other substantial elevation change where the inspector deems necessary. If there is a significant length of "flat" area along the cross section, take a measurement at the midpoint to document that it is indeed "flat".
    - All vertical (y) measurements should be measured to the closest half of foot unless you are documenting a scour hole. These measurements should be to the closest tenth of a foot. All horizontal (x) measurements can be taken to the nearest foot.
5. The final vertical (y) measurement should be taken at the face of the last end wall.
6. After completion of the inlet sketch, draw an outlet elevation view of the culvert. This sketch should be drawn below the inlet sketch. Label each barrel on the outlet sketch in the same manner and make sure the barrels line up on the sketch. If it is not possible to have both sketches on the same page, draw the outlet sketch on another sheet of paper. Label both sheets accordingly.
7. Repeat steps 3-5 on the outlet face of culvert.
8. The final sketch should be neat, legible and be easily reproduced by another inspector. See **Figure 11** for an example.
9. Please make sure the following is on the sketch before uploading to the **Inspection Tab, Media Task** under the Bridge Context in BrM.
    - ✓ Inlet Cross Section with x and y dimensions
    - ✓ Outlet Cross Section with x and y dimensions

- ✓ Indication of reference datum
- ✓ Inspector Name
- ✓ Date of Cross Section
- ✓ Bridge ID
- ✓ District
- ✓ Remarks/Notes on scour holes, undermining, etc.

10. On the **KYTC Tab, Summary & Miscellaneous Task** in BrM, update "Stream Cross Section" to *Yes* and enter the date the sketch was made in the "Cross Section Date" field.

Notes:

- Vertical (y) measurements should be measured to a reference datum line on the culvert that is not likely to change with time. These datum lines can be top of headwalls or bottom of the culvert ceiling. If using guardrail, indicate the height of the guardrail from the top of the deck to the top of the guardrail in case the guardrail is replaced in the future.
- If the culvert has an apron, x equal to 0 will be the beginning of the apron going from left to right looking downstream. All vertical (y) measurements will be taken from the top of the apron. See **Figure 12** for an example.

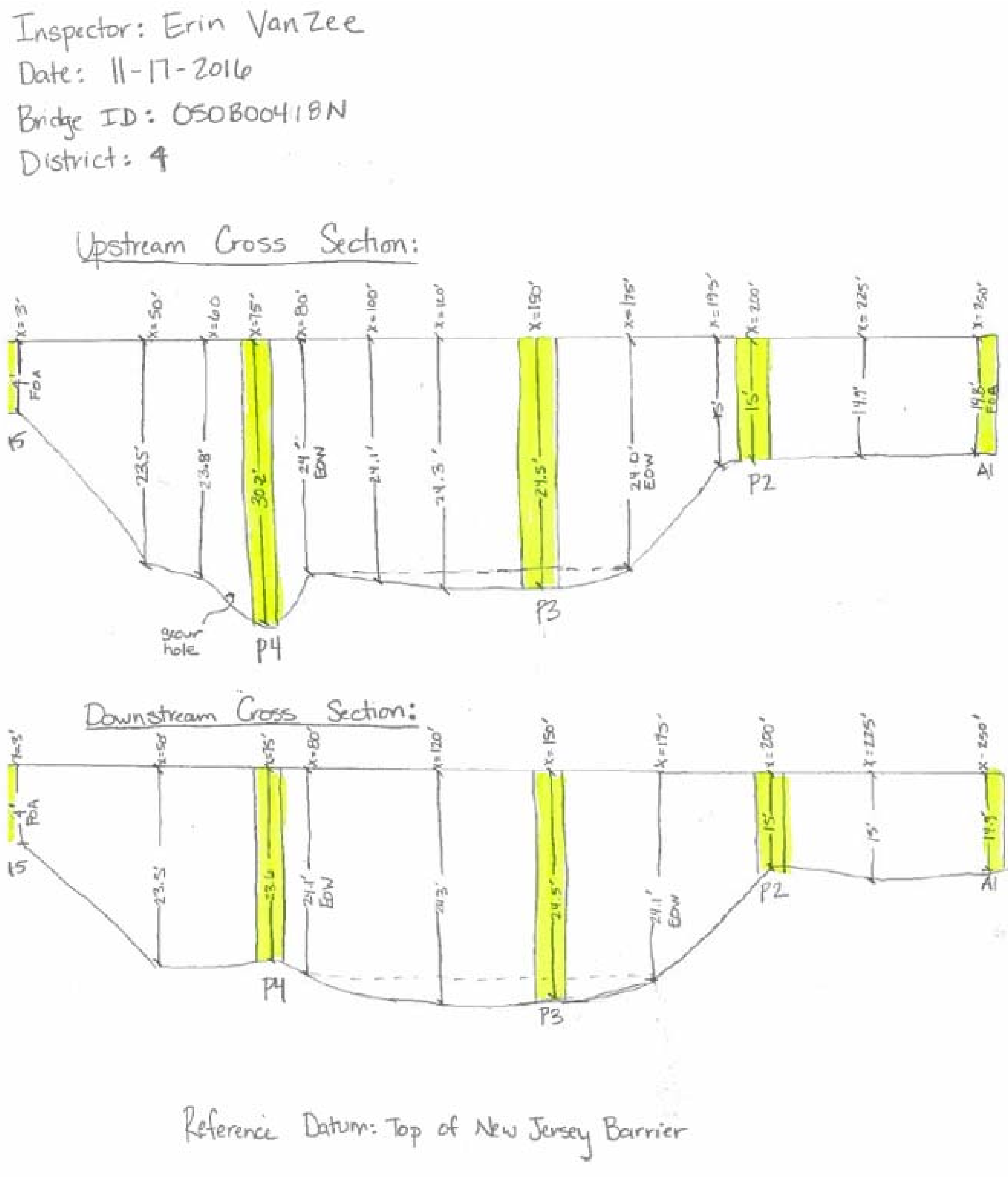


Figure 10- Example of a Stream Cross Sections at Bridge Fascias

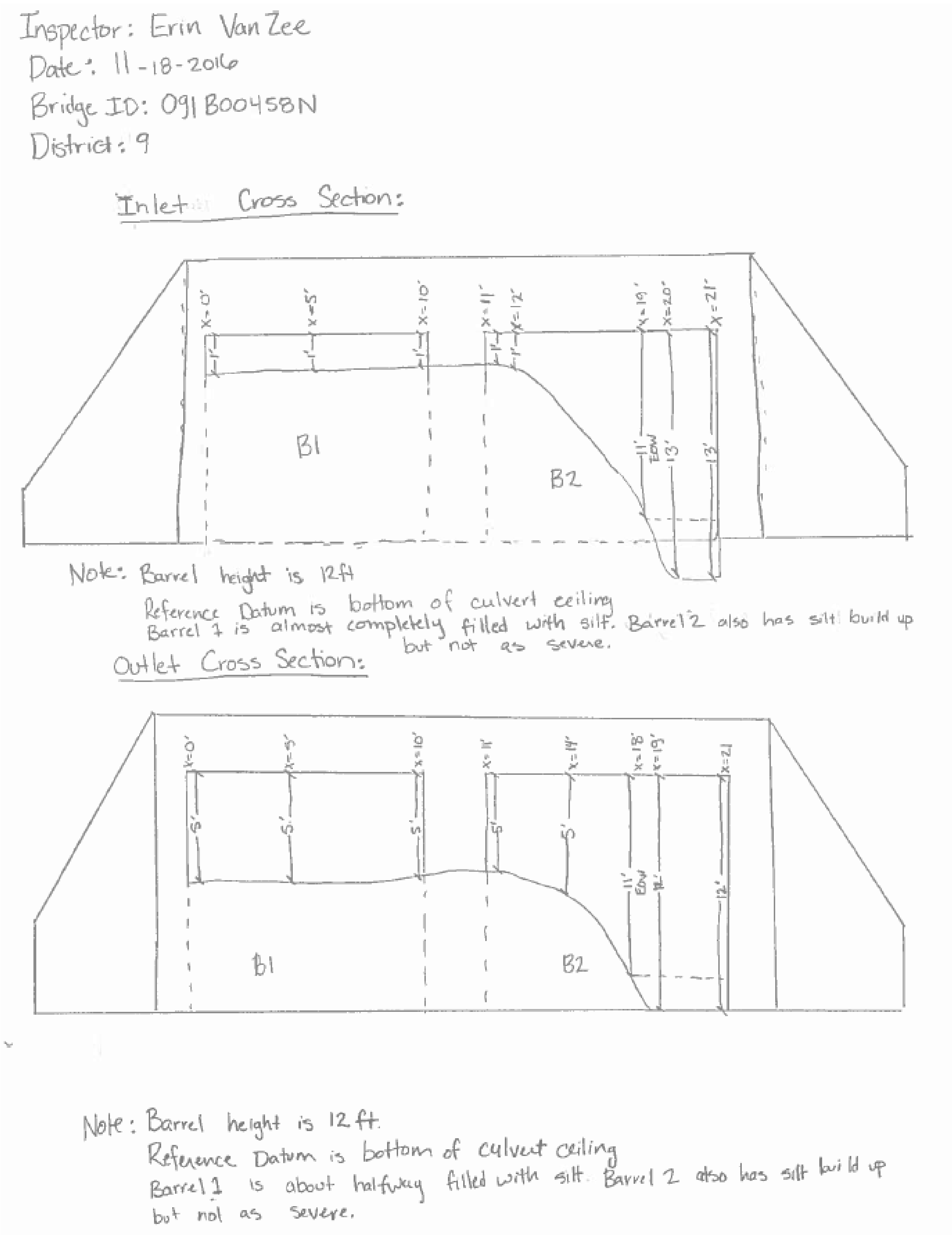


Figure 11- Example of a Stream Cross Sections at Culverts without Aprons

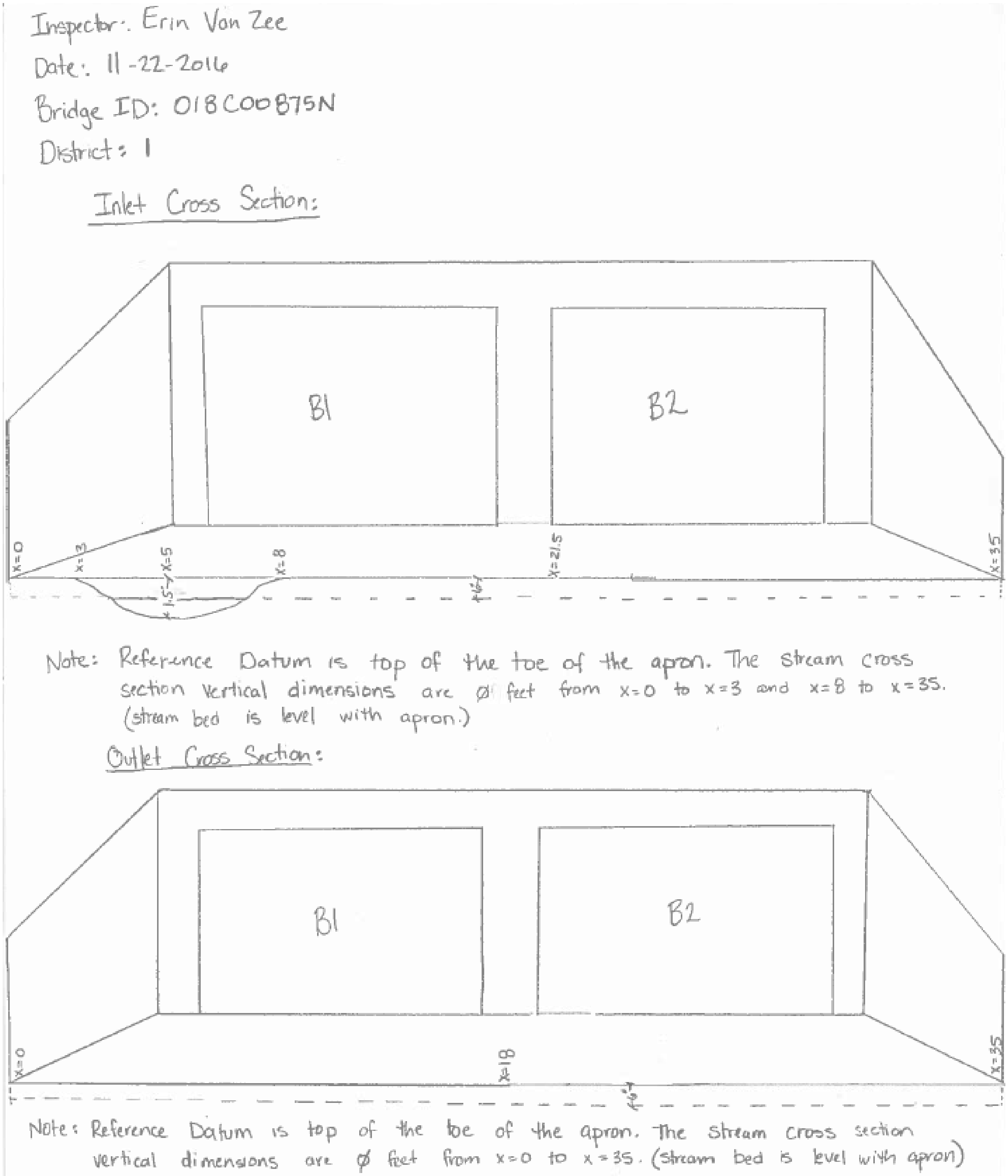


Figure 12- Example of a Stream Cross Sections at Culverts with Aprons

Stream Cross Section Frequency

Stream cross sections should be performed on all structures located over a waterway. Frequency as stated below begins when the initial baseline is completed.

- If Item 113 ≥ 8 and photographic evidence taken during each inspection cycle shows no change; baseline cross section will be completed and updated as warranted by change.
- If Item 113 = 7 and photographic evidence taken during each inspection cycle shows no change in countermeasure; baseline cross section will be completed and updated as warranted by change.
- If Item 113 = 7 and photographic evidence taken during each inspection cycle shows change in countermeasure; update cross section every **4 years.** Note: If a bridge is on the Underwater Inspection Cycle, the cross section taken during that inspection will be sufficient and will follow the **underwater inspection frequency**.
- If Item 113 = 6; these are new inventories and a scour analysis or assessement has not been made. After the scour analysis/assessement is made, follow the frequency for the new Item 113.
- If Item 113 = 5, designed or built as a 5, and photographic evidence taken during each inspection cycle shows no change; baseline cross section will be completed and updated as warranted by change.
- If Item 113 = 5, and photographic evidence taken during each inspection cycle shows change; update cross section every **4 years.** Note: If a bridge is on the Underwater Inspection Cycle, the cross section taken during that inspection will be sufficient and will follow the **underwater inspection frequency.**
- If Item 113 ≤ 4 or U; update cross section **every standard/substandard inspection cycle (i.e., every 24 or 12 months) or if a high water event warrants a new cross section.**

When Item 113 changes based on new scour analysis/assessment to a lower rating, a cross section shall be completed and the frequency will follow new criteria above.

Subsequent Inspections: Cross sections from subsequent inspections shall be overlain onto the initial drawings to detect any changes in the horizontal or vertical alignment and streambed elevation of the stream channel. This can be done on the initial cross section if the sketch is still neat and legible. If numerous overlays inhibit the effective display of cross sections, it is acceptable to graph all of the cross sections in a graphing program. However, keep all previous cross sections labeled in the **Inspection Tab, Media Task** under the Bridge Context in BrM.

Action: The streambed cross sections and the bridge elevations shall be plotted by Bridge Inspection Personnel. Comparison shall be made, at the District level, of the plotted elevations on the original cross sections and the results of previous surveys, foundation and/or pile tip elevations to determine if the bridge has experienced scour activity. If scour activity has been detected, the district should contact Central Office for review of the coding for Item 113. Upon request, the Central Office will assist in determining pile tip elevations needed in the evaluation for bridges on the State's highway system for which "As Built" construction plans or field books are available. If a State bridge has observed scour or is found to be scour critical, appropriate actions, shall be taken by the District Bridge Engineer to insure that the bridge has adequate foundation support. Owners of Non-State system bridges having observed scour or found to be scour critical shall be notified by the District Bridge Engineer and advised if immediate action and/or bridge closure is required. See the section titled “Posting & Closure”.

Reports: Results of the scour detection surveys and assessments shall be documented in a brief narrative report. Plots of stream cross sections, and bridge elevations together with photographs are to be attached. The report will be included as a part of the Initial, Routine, Interim or Damage Inspection report as appropriate. Distribution: See the section titled "Distribution List for Bridge Inspection Reports” for the required report.

Scour Documentation

Target Audience: Bridge Inspector, District Bridge Engineer, Scour Engineer

Purpose: Since cross section documentation only shows scour along the longitudinal direction, other scour documentation should be taken in the transverse direction along the substructure units if scour is present. Measurements from successive inspections may reveal scour problems over time and help assess and identify any scour problems before they endanger the bridge.

Equipment: See the section titled "Equipment List for Bridge Inspection" for examples of tools and equipment needed for accessing and performing stream cross sections.

Procedures:
There are two main objectives to be accomplished in inspecting bridges for scour;

- Accurately record the present condition of the bridge and the stream; and
- Identify conditions that are indicative of potential problems with scour and stream stability for further review and evaluation by others.

Substructure Undermining and Scour Documentation
In addition to stream cross sections, investigating and measuring void areas under or near pier footings, abutment footings and at the outlet ends of culverts should be completed when a scour problem exists. Documentation shall consist of a sketch showing the problem location and all three dimensions of the limits of material loss. Measure vertical and horizontal distances under footings and wingwalls and record the location of undermined or scoured areas along substructure unit. Use existing scour and exposure sheets and probing as appropriate to determine the current elevation of the stream bed in relation to elevations found on previous inspections. In order to detect possible scour that the cross sections will not reveal, additional depth measurements shall be made at the ends and along the sides of piers or bents. These depth measurements shall be referenced to the substructures. When measuring and probing a void area that may be too extensive for a routine inspection, an underwater inspection may be necessary to investigate the problem area.

In cases where scour extends underneath a footing, both plan and elevation view drawings (of each affected substructure unit) shall be submitted showing the exact extent of affected area and the remaining unaffected area. In the presence of piles, the following should be provided:

- Pile material (Timber, Concrete, Steel)
- Pile Dimensions
- Pile layout with spacing
- Condition of pile
- Section loss including method of measurement
- Vertical exposed length of each pile
- Pile tip elevation and the embedment length. For unknown pile-tip elevation, documentation should state "pile-tip information unknown".

Other information gathered should include the following:

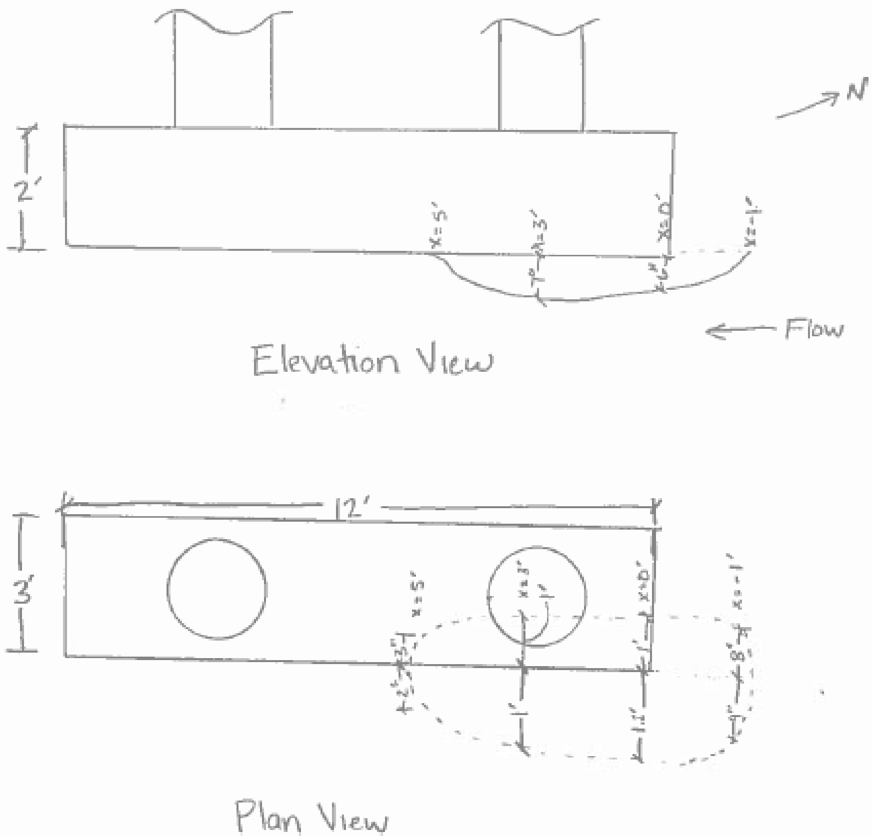
a. Inspection of the stream condition stream and channel protection (Rip rap, or other)
b. Check the channel for migration
c. Probe deposits around substructures checking substructure for drift damage
d. On susceptible streams, locate limits of excessive channel degradation (Head-cutting).
e. Movement of rip-rap or other countermeasures downstream.

Substructure undermining and scour documentation should be performed at every inspection cycle to determine if there are any significant changes that warrant an immediate action. See **Figure 13**, **Figure 14** and **Figure 15** for sample sketches.

Inspector: Erin Van Zee
Date: 11-22-2016
Bridge ID: 086C00224N
District: 3

Pier Undermining Sketch:

Information for Pier 5



Note: Undermining at Pier 5, 6ft x 2ft scour hole, up to 7" depth, NE corner Pier is currently stable. No tilting, cracking or distress present.

Figure 13- Example of a Pier Undermining and Scour Documentation

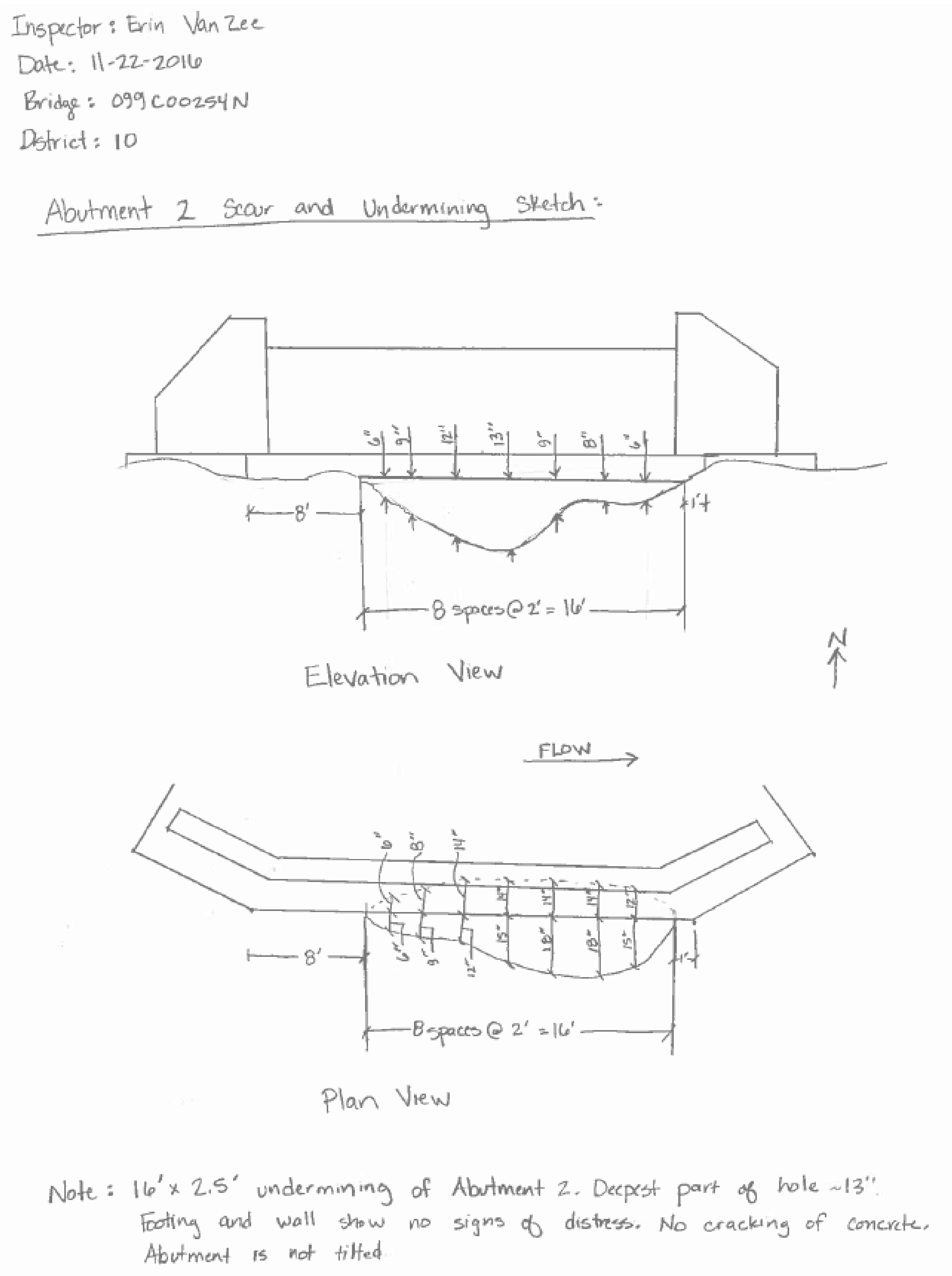


Figure 14- Example of a Abutment Undermining and Scour Documentation

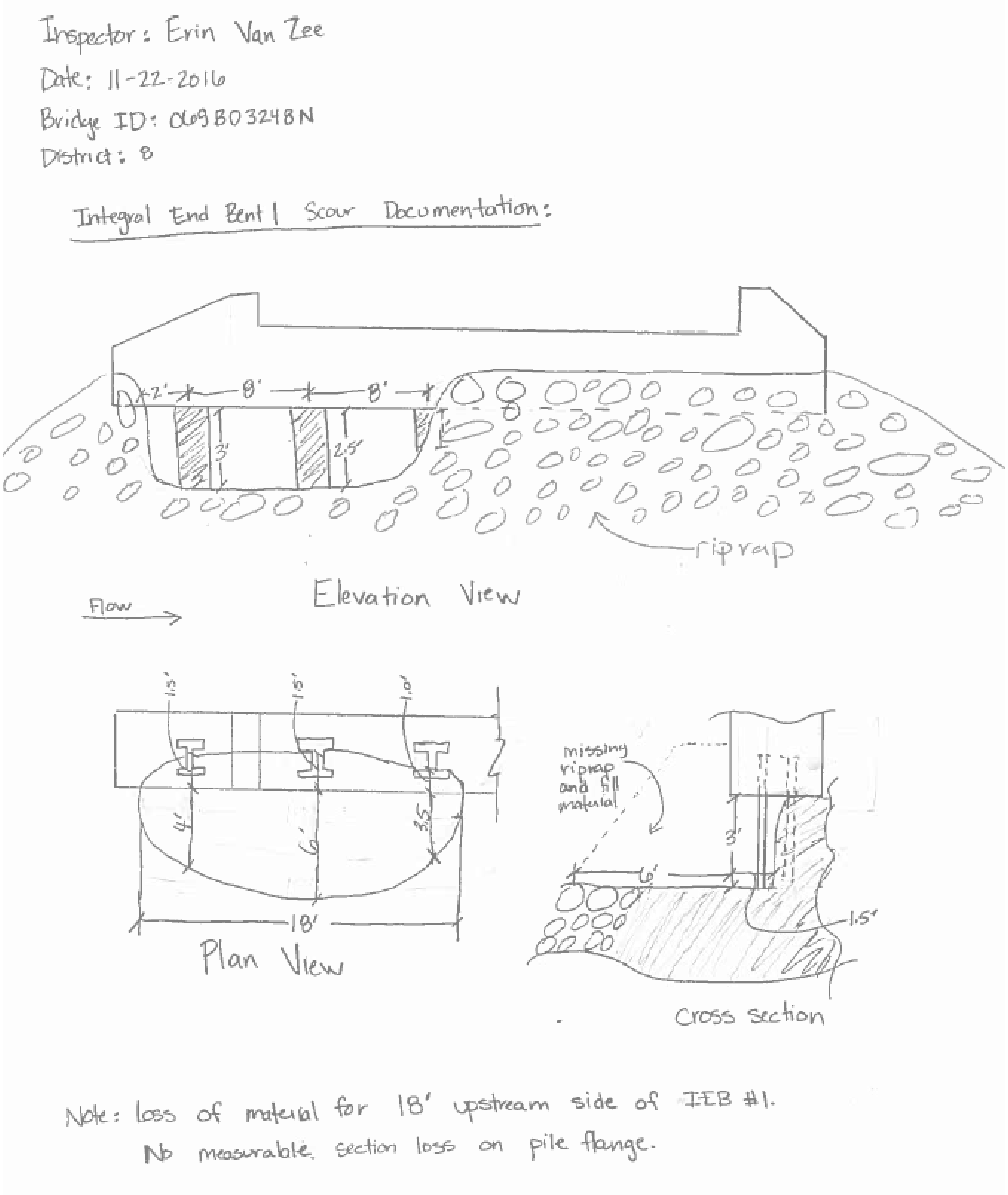


Figure 15- Example of an Integral End Bent with Piles Undermining and Scour Documentation

Subsequent Inspections: Scour documentation from subsequent inspections shall be overlain onto the initial drawings to detect any changes in the horizontal or vertical alignment of the streambed elevation of the stream channel. This can be done on the initial cross section if the sketch is still neat and legible. If numerous overlays inhibit the effective display of cross sections, it is acceptable to graph all of the cross sections in a graphing program. However, keep all previous scour documentation labeled in the **Inspection Tab, Media Task** under the Bridge Context in BrM.

Action: The scour documentation shall be plotted by Bridge Inspection Personnel. Comparison shall be made, at the District level, of the plotted elevations on the original documentation and the results of previous surveys, foundation and/or pile tip elevations to determine if the bridge has experienced scour activity. If scour activity has been detected, the district should contact central office for review of the coding for Item 113. Upon request, the Central Office will assist in determining pile tip elevations needed in the evaluation for bridges on the State's highway system for which "As Built" construction plans or field books are available. If a State bridge has observed scour or is found to be scour critical, appropriate actions, shall be taken by the District Bridge Engineer to insure that the bridge has adequate foundation support. Owners of Non-State system bridges having observed scour or found to be scour critical shall be notified by the District Bridge Engineer and advised if immediate action and/or bridge closure is required. See the section titled "Posting & Closure".

Reports: Results of the scour detection surveys and assessments shall be documented in a brief narrative report. Plots of scour documentation together with photographs are to be attached. The report will be included as a part of the Initial, Routine, Interim or Damage Inspection report as appropriate. Distribution: See the section titled "Distribution List for Bridge Inspection Reports" for the required report.

Plan of Action (POA) for Scour Critical Bridges

Target Audience: District Bridge Engineer, Scour Engineer

Purpose: Once a bridge is deemed scour critical, a POA is developed as a clear plan for dealing with scour at the structure.

Background: The most common cause of bridge failure is scour. These failures usually result from the scour of the stream bed and bank material around the bridge foundations. Currently, the effect of contraction and local scour is taken into account during bridge design. However, it is not economically feasible to construct all bridges to ensure absolute invulnerability to scour damage. Scour counter-measures are therefore provided where feasible and justified.

Considering today's emerging technology, the effect of scour was not adequately accounted for in the design of most bridges constructed prior to 1989. The cost of installation of scour countermeasures for both new and existing bridges is small compared to the cost of replacing a bridge after failure.

Procedure: Central Office shall maintain a "Plan of Action for Scour Critical Bridges" list. This list contains the individual plan of action for each scour critical bridge. The District Bridge Engineer develops the POA.

A POA is required for structures with the following codes for Item 113= 3, 2, 1, 0, and U. However, note that a coding of '0' indicates the bridge has failed due to scour. The "Scour Critical Bridge – Plan of Action" template can be found in Exhibit #9503. Central Office will notify Districts if a POA is required for a bridge. If a structure has an item 113 coding listed above, then the District shall use the template to complete the POA. The template includes general information of the structure, personnel responsible for creating, implementing, and updating the POA, recommended actions, and a bridge closure plan. KYTC Scour Engineers will concur with the POA or make recommendations of changes and notify the District.

Subsequent Inspections: The POA should be checked and updated during each inspection cycle. The POA is a living document and might change with the life of the bridge. If nothing has changed, inspectors should document the "no change" condition on the current inspection cycle. If there is a change, update the POA and follow the documented procedure above.

Action: KYTC Scour Engineers will keep a record of all POAs on the **Inspection Tab, Media Task** under the Bridge Context in BrM for each Scour Critical Bridge. On the **KYTC Tab, Scour Task** in BrM, all active and non-active POAs will to be documented with the correlating date.

600 – BrM Bridge Element Reference Material

Element Location Matrix

This Section is designed to give inspectors a quick reference guide to the defined elements. The matrix of elements is grouped into National Bridge Elements (NBEs) and Bridge Management Elements (BMEs), then by general element type, material, and in accordance to their physical location on the bridge to facilitate ease of use by bridge inspectors in the field.

- Measure length in feet and area in square feet.

2.1 – NATIONAL BRIDGE ELEMENTS (NBEs)

2.1.1 – Decks and Slabs	Units	Decks	Slab	Other
Reinforced Concrete Deck/Slab	area	12	38	
Prestressed Concrete Deck	area	13		
Prestressed Concrete Top Flange	area	15		
Reinforced Concrete Top Flange	area	16		
Steel Deck-Open Grid	area	28		
Steel Deck-Concrete Filled Grid	area	29		
Steel Deck-Corrugated/Orthotropic/Etc.	area	30		
Timber Deck/Slab	area	31	54	
Other Material Deck/Slab	area	60	65	

2.1.2 – Railings	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Metal Bridge Railing	length	330					
Reinforced Concrete Bridge Railing	length			331			
Timber Bridge Railing	length				332		
Other Bridge Railing	length						333
Masonry Bridge Railing	length					334	

2.1.3 – Superstructure	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Girder/Beam	length	107	109	110	111		112
Closed Web/Box Girder	length	102	104	105			106
Stringer	length	113	115	116	117		118
Truss	length	120			135		136
Arch	length	141	143	144	146	145	142
Floor Beam	length	152	154	155	156		157
Cable – Primary	length	147					
Cable – Secondary	each	148					149
Gusset Plate	each	162					
Pin, Pin and Hanger Assembly, or Both	each	161					

2.1.4 – Bearings	Units	Elem #
Elastomeric	each	310
Movable (roller, sliding, etc.)	each	311
Enclosed/Concealed	each	312
Fixed	each	313
Pot	each	314
Disk	each	315
Other	each	316

2.1.5 – Substructure	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Columns	each	202	204	205	206		203
Column Tower (Trestle)	length	207			208		
Pier Wall	length			210	212	213	211
Abutment	length	219		215	216	217	218
Pile	each	225	226	227	228		229
Pier Cap	length	231	233	234	235		236
Pile Cap/Footing	length			220			

2.1.6-Culverts	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Culvert	length	240	245	241	242	244	243

2.2 – BRIDGE MANAGEMENT ELEMENTS (BMEs)

2.2.1 – Joints	Units	Elem #
Strip Seal Expansion Joint	length	300
Pourable Joint Seal	length	301
Compression Joint Seal	length	302
Assembly Joint/Seal (Modular)	length	303
Open Expansion Joint	length	304
Assembly Joint without Seal	length	305
Other Joint	length	306

2.2.2 – Approach Slabs	Units	Elem #
Prestressed Concrete Approach Slab	area	320
Reinforced Concrete Approach Slab	area	321

2.2.3 – Wearing Surfaces, Protective Coatings, and Concrete Reinforcing Steel Protective Systems	Units	Elem #
Wearing Surfaces	area	510
Steel Protective Coating	area	515
Concrete Reinforcing Steel Protective System	area	520
Concrete Protective Coating	area	521

Element Lookup (fromPontis to BrM)

Element Lookup (from PONTIS to BrM)

Legend
Same
Different
New

CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
	Decks		
12	Bare Concrete Deck	12	Reinforced Concrete Deck
13	Unprotected Concrete Deck with AC Overlay	12	Reinforced Concrete Deck
14	Protected Concrete Deck with AC Overlay	12	Reinforced Concrete Deck
18	Concrete Deck Protected with Thin Overlay	12	Reinforced Concrete Deck
22	Concrete Deck Protected with Rigid Overlay	12	Reinforced Concrete Deck
26	Concrete Deck Protected with Coated Bars	12	Reinforced Concrete Deck
27	Concrete Deck Protected with Cathodic System	12	Reinforced Concrete Deck
		13	Prestressed Concrete Deck
		15	Prestressed Concrete Top Flange
		16	Reinforced Concrete Top Flange
28	Steel Deck - Open Grid	28	Steel Deck - Open Grid
29	Steel Deck - Concrete Filled Grid	29	Steel Deck - Concrete Filled Grid
30	Steel Deck - Corrugated/Orthotropic	30	Steel Deck - Corrugated/Orthotropic
31	Bare Timber Deck	31	Timber Deck
32	Timber Deck with AC Overlay	31	Timber Deck
		60	Other Material Deck
	Slabs		
38	Bare Concrete Slab	38	Reinforced Concrete Slab
39	Unprotected Concrete Slab with AC Overlay	38	Reinforced Concrete Slab
40	Protected Concrete Slab with AC Overlay	38	Reinforced Concrete Slab
44	Concrete Slab Protected with Thin Overlay	38	Reinforced Concrete Slab
48	Concrete Slab Protected with Rigid Overlay	38	Reinforced Concrete Slab
52	Concrete Slab Protected with Coated Bars	38	Reinforced Concrete Slab
53	Concrete Slab Protected with Cathodic System	38	Reinforced Concrete Slab
54	Bare Timber Slab	54	Timber Slab
55	Timber Slab with AC Overlay	54	Timber Slab
		65	Other Material Slab
	Superstructure		
101	Unpainted Steel Box Girder	102	Steel Closed Web/Box Girder
102	Painted Steel Box Girder	102	Steel Closed Web/Box Girder
104	Prestressed Concrete Box Girder	104	Prestressed Concrete Closed Web/Box Girder
105	Reinforced Concrete Box Girder	105	Reinforced Concrete Closed Web/Box Girder
		106	Other Closed Web/Box Girder
		806	Steel Closed Web/Box Cross Girder
106	Unpainted Steel Open Girder	107	Steel Girder/Beam
107	Painted Steel Open Girder	107	Steel Girder/Beam
109	Prestressed Concrete Open Girder	109	Prestressed Concrete Girder/Beam
110	Reinforced Concrete Open Girder	110	Reinforced Concrete Girder/Beam

1

Element Lookup (from PONTIS to BrM)

CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
111	Timber Open Girder	111	Timber Girder/Beam
		112	Other Girder/Beam
		807	Steel Cross Girder/Beam
112	Unpainted Steel Stringer	113	Steel Stringer
113	Painted Steel Stringer	113	Steel Stringer
115	Prestressed Concrete Stringer	115	Prestressed Concrete Stringer
116	Reinforced Concrete Stringer	116	Reinforced Concrete Stringer
117	Timber Stringer	117	Timber Stringer
		118	Other Stringer
120	Unpainted Steel Thru Truss - Bottom Chord	120	Steel Truss
121	Painted Steel Thru Truss - Bottom Chord	120	Steel Truss
125	Unpainted Steel Thru Truss - Top Chord	120	Steel Truss
126	Painted Steel Thru Truss - Top Chord	120	Steel Truss
130	Unpainted Steel Deck Truss	120	Steel Truss
131	Painted Steel Deck Truss	120	Steel Truss
135	Timber Truss/Arch	135 146	Timber Truss Timber Arch
		136	Other Truss
140	Unpainted Steel Arch	141	Steel Arch
141	Painted Steel Arch	141	Steel Arch
143	Prestressed Concrete Arch	143	Prestressed Concrete Arch
144	Reinforced Concrete Arch	144	Reinforced Concrete Arch
145	Other Arch	142	Other Arch
		145	Masonry Arch
146	Cable - Uncoated		See Elements 147-149 under "Superstructure"
147	Cable - Coated		See Elements 147-149 under "Superstructure"
		147	Steel Cable - Primary
		148	Steel Cable - Secondary
		149	Other Cable - Secondary
		809	Cable Anchorage
151	Unpainted Steel Floorbeam	152	Steel Floorbeam
152	Painted Steel Floorbeam	152	Steel Floorbeam
154	Prestressed Concrete Floorbeam	154	Prestressed Concrete Floorbeam
155	Reinforced Concrete Floorbeam	155	Reinforced Concrete Floorbeam
156	Timber Floorbeam	156	Timber Floorbeam
		157	Other Floorbeam
160	Unpainted Steel Pin/Hanger Assembly	161	Steel Pin/Hanger Assembly
161	Painted Steel Pin/Hanger Assembly	161	Steel Pin/Hanger Assembly
		162	Steel Gusset Plate
		805	Transverse Tensioning Rod
		808	Tunnel

Substructure

201	Unpainted Steel Column or Pile Extension	202	Steel Column
202	Painted Steel Column or Pile Extension	202	Steel Column
204	Prestressed Concrete Column or Pile Extension	204	Prestressed Concrete Column
205	Reinforced Concrete Column or Pile Extension	205	Reinforced Concrete Column

2

Element Lookup (from PONTIS to BrM)

CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
206	Timber Column or Pile Extension	206	Timber Concrete Column
		203	Other Column
		207	Steel Column Tower/Trestle
		208	Timber Column Tower/Trestle
210	Reinforced Concrete Pier Wall	210	Reinforced Concrete Pier Wall
211	Other Material Pier Wall	211	Other Material Pier Wall
		212	Timber Pier Wall
		213	Masonry Pier Wall
215	Reinforced Concrete Abutment	215	Reinforced Concrete Abutment
216	Timber Abutment	216	Timber Abutment
217	Other Material Abutment	218	Other Material Abutment
		217	Masonry Abutment
		219	Steel Abutment
220	Reinforced Concrete Submerged Pile Cap/Footing	220	Reinforced Concrete Pile Cap/Footing
225	Unpainted Steel Submerged Pile	225	Steel Pile
226	Prestressed Concrete Submerged Pile	226	Prestressed Concrete Pile
227	Reinforced Concrete Submerged Pile	227	Reinforced Concrete Pile
228	Timber Submerged Pile	228	Timber Submerged Pile
		229	Other Pile
230	Unpainted Steel Cap	231	Steel Pier Cap
231	Painted Steel Cap	231	Steel Pier Cap
233	Prestressed Concrete Cap	233	Prestressed Concrete Pier Cap
234	Reinforced Concrete Cap	234	Reinforced Concrete Pier Cap
235	Timber Cap	235	Timber Pier Cap
		236	Other Pier Cap

Culverts

240	Steel Culvert	240	Steel Culvert
241	Reinforced Concrete Culvert	241	Reinforced Concrete Culvert
242	Timber Culvert	242	Timber Culvert
243	Other Culvert	243	Other Culvert
		244	Masonry Culvert
		245	Prestressed Concrete Culvert

Joints

300	Strip Seal Expansion Joint	300	Strip Seal Expansion Joint
301	Pourable Joint Seal	301	Pourable Joint Seal
302	Expansion Joint Seal	302	Compression Joint Seal
303	Assembly Joint/Seal (Modular)	303	Assembly Joint/Seal (Modular)
304	Open Expansion Joint	304	Open Expansion Joint
		305	Assembly Joint without Seal
		306	Other Joint

Element Lookup (from PONTIS to BrM)

CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
		Bearings	
310	Elastomeric Bearing	310	Elastomeric Bearing
311	Moveable Bearing Device	311	Moveable Bearing (Roller, Sliding, etc.)
312	Enclosed/Concealed Bearing	312	Enclosed/Concealed Bearing
313	Fixed Bearing	313	Fixed Bearing
314	Pot Bearing	314	Pot Bearing
315	Disk Bearing	315	Disk Bearing
		316	Other Bearing
		Approach Slabs	
320	Prestressed Concrete Approach Slab	320	Prestressed Concrete Approach Slab
321	Reinforced Concrete Approach Slab	321	Reinforced Concrete Approach Slab
		Railings	
330	Metal Bridge Railing - Uncoated	330	Metal Bridge Railing
331	Reinforced Concrete Bridge Railing	331	Reinforced Concrete Bridge Railing
332	Timber Bridge Railing	332	Timber Bridge Railing
333	Other Bridge Railing	333	Other Bridge Railing
334	Metal Bridge Railing - Coated	330	Metal Bridge Railing
		334	Masonry Bridge Railing
		Smart Flags/Defects	
356	Steel Fatigue Smart Flag		See Element 1010 under "Material Defects"
357	Pack Rust Smart Flag		See Element 1020 under "Material Defects"
358	Deck Cracking Smart Flag		See Element 1130 under "Material Defects"
359	Soffit Smart Flag		REMOVED
360	Settlement Smart Flag	4000	Settlement
361	Scour Smart Flag	6000	Scour
362	Traffic Impact Smart Flag	7000	Damage
363	Section Loss Smart Flag		See Element 1000 under "Material Defects"
		KY Specific Elements & Wearing Surfaces	
500	Reinforced Concrete Culvert Wingwall	800	Reinforced Concrete Culvert Wingwall
501	Reinforced Concrete Culvert Headwall	801	Reinforced Concrete Culvert Headwall
502	Reinforced Concrete Culvert Parapet Wall		REMOVED
		802	Drainage System
503	Reinforced Concrete Curb	803	Reinforced Concrete Curb
504	Wearing Surface	510	Wearing Surfaces
505	Reinforced Concrete Sidewalk	804	Reinforced Concrete Sidewalk
		Protective Systems	
		515	Steel Protective Coating
		520	Concrete Reinforcing Steel Protective System
		521	Concrete Protective Coating

4

Element Lookup (from PONTIS to BrM)

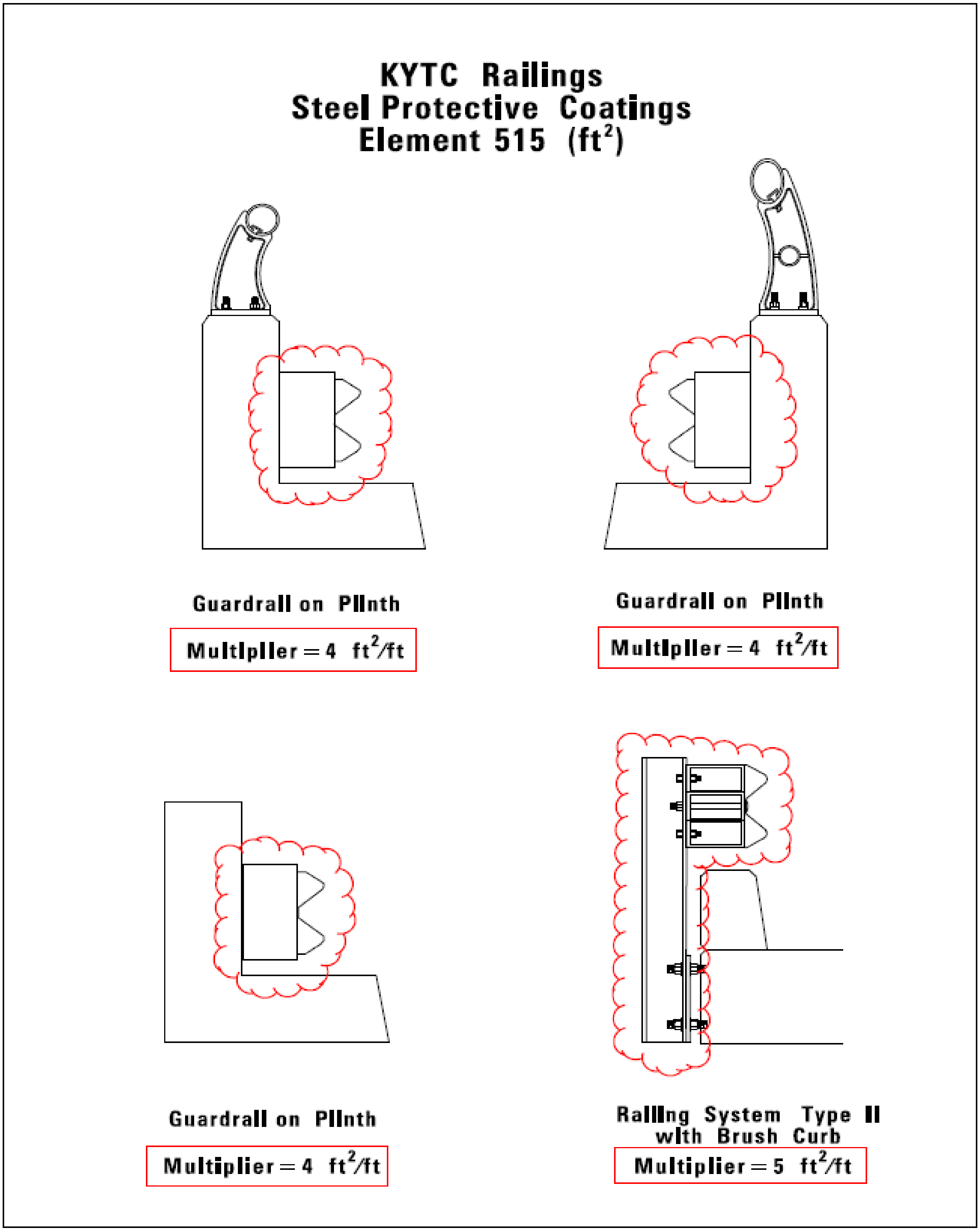
CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
	KY Specific Smart Flags/Defects		
601	Alignment/Out-Of-Plane Smart Flag		See Element 1900 under "Material Defects"
602	Vibration/Oscillation Smart Flag		REMOVED
603	Plastic Deformation Smart Flag		See Element 1900 under "Material Defects"
604	Second Element Distress Smart Flag	850	Secondary Element
605	Transitions Smart Flag	851	Transitions
606	Drains Smart Flag	852	Drains
607	Utilities Smart Flag	853	Utilities
608	Longitudinal Shear Keys Smart Flag	854	Longitudinal Shear Key
609	Debris on Superstructure Smart Flag	855	Debris On and Around Superstructure
610	Channel Drift Smart Flag	856	Channel Drift
611	Embankment Erosion Smart Flag	857	Embankment Erosion
612	Channel Alignment Smart Flag	858	Channel Alignment
613	Vegetation Smart Flag	859	Vegetation
614	Erosion Control/Protection Smart Flag	860	Erosion Control/Protection
615	Critical Maintenance Needs		REMOVED
	Material Defects		
		899	Shear Cracking
		1000	Corrosion
		1010	Cracking (Steel or Other Metals)
		1020	Connection
		1080	Delamination/Spall/Patched Area
		1090	Exposed Rebar
		1100	Exposed Prestressing
		1110	Cracking (Prestressed Concrete)
		1120	Efflorescence/Rust Staining
		1130	Cracking (Reinforced Concrete)
		1140	Decay/Section Loss
		1150	Check/Shake
		1160	Cracking (Timber)
		1170	Split/Delamination (Timber)
		1180	Abrasion/Wear (Timber)
		1190	Abrasion/Wear (Concrete)
		1220	Deterioration (Other Materials)
		1610	Mortar Breakdown (Masonry)
		1620	Split/Spall (Masonry)
		1630	Patched Area (Masonry)
		1640	Masonry Displacement
		1900	Distortion
		2210	Movement (Bearings)
		2220	Alignment (Bearings)
		2230	Bulging, Splitting, or Tearing (Bearings)
		2240	Loss of Bearing Area
		2310	Leakage (Joints)
		2320	Seal Adhesion (Joints)

5

Element Lookup (from PONTIS to BrM)

CORE #	OLD CORE ELEMENT DESCRIPTION	NBE/BME #	NEW NBE/BME/ADE DESCRIPTION
		2330	Seal Damage (Joints)
		2340	Seal Cracking (Joints)
		2350	Debris Impaction (Joints)
		2360	Adjacent Deck or Header (Joints)
		2370	Metal Deterioration or Damage (Joints)
		3210	Delamination/Spall/Patched Area/Pothole (Wearing Surfaces)
		3220	Cracking (Wearing Surfaces)
		3230	Effectiveness (Wearing Surfaces)
		3410	Chalking (Steel Protective Coatings)
		3420	Peeling/Bubbling/Cracking (Steel Protective Coatings)
		3430	Oxide Film Degradation Color/Texture Adherence (Steel Protective Coatings)
		3440	Effectiveness (Steel Protective Coatings)
		3510	Wear (Concrete Protective Coatings)
		3540	Effectiveness (Concrete Protective Coatings)
		3600	Effectiveness (Protective Systems)

Barrier Multiplier for Protective Coating, Element #515



KYTC Specific Elements (ADEs)

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

800 - Culvert Wingwall (LF)

CS1	GOOD: Superficial cracks, spalls or stone deterioration may be present, but there is no exposed reinforcing or evidence of reinforcement corrosion. Little or no deterioration or separation of joints may be present.
CS2	FAIR: Minor deterioration, chloride contamination/efflorescence, abrasion, cracking, delaminations, spalls with exposed reinforcement without considerable section loss, mortar breakdown, or small portions of stones missing. Minor distortion, settlement, or misalignment may be present. Deterioration and separation of joints may be present.
CS3	POOR: Moderate deterioration, chloride contamination/efflorescence, abrasion, extensive cracking, spalls with exposed reinforcement, mortar breakdown, or portions of stones missing. Moderate distortion, settlement, or misalignment may be present. Considerable deterioration and separation of joints may be present.
CS4	SEVERE: Major deterioration, chloride contamination/efflorescence, abrasion, extensive cracking, large areas of spalls with exposed reinforcement, and stones missing. Major distortion, settlement, or misalignment may be present. Complete separation of joints and/or holes in the barrel walls may be present.

801 - Culvert Headwall (LF)

CS1	GOOD: Superficial cracks, spalls or stone deterioration may be present, but there is no exposed reinforcing or evidence of reinforcement corrosion. Little or no deterioration or separation of joints may be present.
CS2	FAIR: Minor deterioration, chloride contamination/efflorescence, abrasion, cracking, delaminations, spalls with exposed reinforcement without considerable section loss, mortar breakdown, or small portions of stones missing. Minor distortion, settlement, or misalignment may be present. Deterioration and separation of joints may be present.
CS3	POOR: Moderate deterioration, chloride contamination/efflorescence, abrasion, extensive cracking, spalls with exposed reinforcement, mortar breakdown, or portions of stones missing. Moderate distortion, settlement, or misalignment may be present. Considerable deterioration and separation of joints may be present.
CS4	SEVERE: Major deterioration, chloride contamination/efflorescence, abrasion, extensive cracking, large areas of spalls with exposed reinforcement, and stones missing. Major distortion, settlement, or misalignment may be present. Complete separation of joints and/or holes in the barrel walls may be present.

802 - Drainage System (1)

CS1	GOOD: Functioning as intended.
CS2	FAIR: Functioning as intended with minor repairs needed.
CS3	POOR: Limited functionality with moderate repairs needed.
CS4	SEVERE: Not functioning as intended with major repairs needed.

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

803 - Curb (LF)

CS1	GOOD: The element shows little or no deterioration. Discoloration, efflorescence, and/or superficial cracking may be present.
CS2	FAIR: Minor cracks, surface scaling, or spalls may be present, but there is no exposed reinforcing or surface evidence of reinforcement corrosion.
CS3	POOR: Some delaminations and/or spalls with exposed reinforcement may be present.
CS4	SEVERE: Deterioration, corrosion of reinforcement and/or loss of concrete section is advanced. Repairs should be considered.

804 - Sidewalk (LF)

CS1	GOOD: The element shows little or no deterioration. Discoloration, efflorescence, and/or superficial cracking may be present.
CS2	FAIR: Minor cracks, surface scaling, or spalls may be present, but there is no exposed reinforcing or surface evidence of reinforcement corrosion. There may be vertical displacement (up to 1/4 inch).
CS3	POOR: Some delaminations and/or spalls with exposed reinforcement may be present. There may be vertical displacement (up to 1/2 inch).
CS4	SEVERE: Deterioration, corrosion of reinforcement and/or loss of concrete section is advanced. There may be vertical displacement (1/2 inch or more). Repairs should be considered.

805 - Transverse Tensioning Rods (EA)

CS1	GOOD: In place, and functioning as intended.
CS2	FAIR: In place with minor deficiencies (corroded nuts and/or plates, missing grout, etc.), and functioning as intended.
CS3	POOR: In place with moderate to severe deficiencies (heavily corroded nuts and/or plates, missing nuts and/or plates, missing grout, rod not secure, etc.), and not functioning as intended.
CS4	SEVERE: Broken or completely missing. Structural analysis needs to be performed.

806 - Steel Closed Web/Box Cross Girder (LF)

CS1	GOOD: No corrosion, cracking, distortion, or damage. Connection is in place and functioning as intended.
CS2	FAIR: Freckled rust. Corrosion of the steel has initiated. Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar. Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended. Distortion not requiring mitigation or mitigated distortion. The element has impact. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.
CS3	POOR: Section loss is evident or pack rust is present but does not warrant structural review. Identified crack that is not arrested but does not warrant structural review. Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review. Distortion that requires mitigation that has not been addressed but does not warrant structural review. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.
CS4	SEVERE: The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength and serviceability of the element or bridge. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

807 - Steel Cross Girder/Beam (LF)

CS1	GOOD: No corrosion, cracking, distortion, or damage. Connection is in place and functioning as intended.
CS2	FAIR: Freckled rust. Corrosion of the steel has initiated. Crack that has self-arrested or has been arrested with effective arrest holes, doubling plates, or similar. Loose fasteners or pack rust without distortion is present but the connection is in place and functioning as intended. Distortion not requiring mitigation or mitigated distortion. The element has impact. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.
CS3	POOR: Section loss is evident or pack rust is present but does not warrant structural review. Identified crack that is not arrested but does not warrant structural review. Missing bolts, rivets, or fasteners; broken welds; or pack rust with distortion but does not warrant a structural review. Distortion that requires mitigation that has not been addressed but does not warrant structural review. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.
CS4	SEVERE: The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

808 - Tunnel (LF)

CS1	GOOD: No delaminations/spalls/patched areas, exposed reinforcement, efflorescence/rust staining, abrasion/wear, or damage. Crack width less than 0.012 inch or spacing greater than 3.0 feet.
CS2	FAIR: Delaminated. Spall 1 inch or less deep or 6 inches or less in diameter. Patched area is sound. Exposed reinforcement is present without measurable section loss. Surface efflorescence is white without build-up or leaching without rust staining. Crack width 0.012-0.05 inch or spacing of 1.0-3.0 feet. Abrasion or wearing has exposed coarse aggregate but the aggregate remains secure in the concrete. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 2 under the appropriate material defect entry.
CS3	POOR: Spall greater than 1 inch deep or greater than 6 inches diameter. Patched area that is unsound or showing distress. Does not warrant structural review. Exposed reinforcement is present with measurable section loss but does not warrant structural review. Heavy efflorescence build-up with rust staining. Crack width greater than 0.05 inch or spacing of less than 1.0 feet. Coarse aggregate is loose or has popped our of the concrete matrix due to abrasion or wear. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 3 under the appropriate material defect entry.
CS4	SEVERE: The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge. The element has impact damage. The specific damage caused by the impact has been captured in Condition State 4 under the appropriate material defect entry.

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

809 - Cable Anchorage (EA)

CS1	GOOD: Anchorage is in place and functioning as intended. No corrosion, cracking, distortion, leakage or damage is evident.
CS2	FAIR: Anchorage is in place and functioning as intended with minor leakage or seepage present. Freckled rust. Corrosion of the steel has not initiated. There may be loose fasteners or pack rust.
CS3	POOR: Anchorage is in place with moderate leakage or seepage present. Corrosion of the steel has initiated. There may be loose fasteners with pack rust.
CS4	SEVERE: Anchorage not functioning as intended with extensive leakage or seepage is present. Corrosion of the steel is throughout.

850 - Secondary Element (1)

CS1	GOOD: Little or no distress.
CS2	FAIR: Minor distress in the form of cracking, spalling or misalignment of cross bracing, diaphragms and/or secondary bracing.
CS3	POOR: Moderate distress in the form of cracking, spalling with exposed reinforcement and/or noticeable misalignment.
CS4	SEVERE: Major distress in the form of heavy cracking, spalling with exposed reinforcement and section loss. Steel members may be buckled, twisted and/or bent, and are not functioning as intended.

851 - Transitions (1)

CS1	GOOD: Little or no settlement.
CS2	FAIR: Settlement is progressing (up to 1/2 inch).
CS3	FAIR: Settlement is progressing (up to 1 inch).
CS4	SEVERE: Settlement has progressed (1 inch or more).

852 - Drains (1)

CS1	GOOD: 100% open.
CS2	FAIR: Up to 50% blocked.
CS3	POOR: Greater than 50% blocked.
CS4	SEVERE: 100% blocked.

853 - Utilities (1)

CS1	GOOD: No deficiencies.
CS2	FAIR: Minor problems exist (minor corrosion, loose connections, exposed wiring, etc.).
CS3	POOR: Moderate problems exist (moderate corrosion, several loose connections or unsecure attachments, exposed wiring, etc.).
CS4	SEVERE: Major problems exist, and could effect the safety of the traveling public. Contact the utility owner.

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

854 - Longitudinal Shear Key (1)

CS1	GOOD: Minor deterioration of grout. May be allowing minor seepage.
CS2	FAIR: Moderate deterioration of grout, with cracking or edge failure. Moderate leakage may be present.
CS3	POOR: Major deterioration of grout, with large sections being de-bonded, cracked, displaced or removed, and are not functioning as intended. Heavy leakage may be present.
CS4	SEVERE: Failure of grout throughout, with large amounts of seepage onto structural members. Adjacent structural members exhibit major deterioration. Structural analysis needs to be performed.

855 - Debris On and Around Superstructure (1)

CS1	GOOD: Debris doesn't exist, or previously noted debris has been removed.
CS2	FAIR: Debris on and/or around superstructure exists, but is of little or no concern at this time.
CS3	POOR: Debris exists on and/or around superstructure, and is trapping moisture and causing accelerated deterioration.
CS4	SEVERE: Debris exists on and/or around superstructure, and is trapping moisture and causing accelerated deterioration. Debris has restricted ability to perform adequate inspection of elements and needs removal.

856 - Channel Drift (1)

CS1	GOOD: Drift doesn't exist, or previously noted drift has been removed.
CS2	FAIR: Drift exists, but is of little or no concern at this time.
CS3	POOR: Drift along and in the channel. Restricting flow less than 25%. Diverting stream flow into channel embankment or substructure is causing minor scour/erosion.
CS4	SEVERE: Drift along and in the channel. Restricting flow more than 25%. Diverting stream flow into channel embankment or substructure is causing moderate to major scour/erosion.

857 - Embankment Erosion (1)

CS1	GOOD: Erosion doesn't exist, or previously noted erosion has been corrected.
CS2	FAIR: Erosion exists, but is of little or no concern at this time.
CS3	POOR: Erosion exists and if left unchecked, could adversely affect the structural integrity of the structure.
CS4	SEVERE: Erosion exists and warrants correction.

858 - Channel Alignment (1)

CS1	GOOD: Alignment is good, or previously noted misalignment has been corrected.
CS2	FAIR: Alignment is causing only minor scour/erosion around structure and/or embankments.
CS3	POOR: Alignment is causing moderate scour/erosion around structure and/or embankments.
CS4	SEVERE: Alignment is causing major scour/erosion around structure and/or embankments, and warrants correction.

KYTC SPECIFIC ELEMENTS WITH CONDITION STATES

859 - Vegetation (1)

CS1	GOOD: Vegetation is of little or no concern at this time, or previously noted vegetation has been removed.
CS2	FAIR: Vegetation under/around structure is causing minor problems (aggradation of stream/catching debris, embankments lack proper cover with limited erosion protection, etc.), and slightly restricting proper inspection of the structure.
CS3	POOR: Vegetation under/around structure is causing moderate problems (aggradation of stream/catching debris, embankments lack proper cover with limited erosion protection, etc.), and restricting proper inspection of the structure. Altering flow or allowing scour/erosion due to lack of protection may be present.
CS4	POOR: Vegetation under/around structure causing major problems and, proper inspection of the structure is adversely affected. Altering flow or allowing significant scour/erosion due to lack of protection may be present.

860 - Erosion Control/Protection (1)

CS1	GOOD: Erosion control or protection has been placed at structure and is performing adequately at this time.
CS2	FAIR: Erosion control system has minor deterioration, but is functioning as intended.
CS3	POOR: Erosion control system has moderate deterioration, but has limited functionality.
CS4	SEVERE: Erosion control system has major deterioration, and is no longer functioning as intended.

899 - Shear Cracking (LF)

CS1	GOOD: Shear cracking doesn't exist.
CS2	FAIR: Concrete shear cracking with width less than 0.012 inch with minor efflorescence present. Steel shear cracking that has been arrested with effective arrest holes, doubling plates, or similar.
CS3	POOR: Concrete shear cracking with width 0.012-0.05 inch with moderate efflorescence present. Steel shear cracking that is not arrested but does not warrant structural review.
CS4	SEVERE: Concrete shear cracking with width greater than 0.05 inch with heavy efflorescence present. Steel condition warrants a structural review to determine the effect on the strength or the serviceability of the element.

BrM Tab Locations

Item #	Data Item	BrM Loc.
1A	State Code	Inspection > Inventory > Admin
1B	FHWA Region	Inspection > Inventory > Admin
2	Highway Agency District	Inspection > Inventory > Admin
3	County (Parish) Code	Inspection > Inventory > Admin
4	Place Code	Inspection > Inventory > Admin
5A	Record Type	Inspection > Inventory > Roads
5B	Route Signing Prefix	Inspection > Inventory > Roads
5C	Designated Level of Service	Inspection > Inventory > Roads
5D	Route Number	Inspection > Inventory > Roads
5E	Directional Suffix	Inspection > Inventory > Roads
6A	Features Intersected	Inspection > Inventory > Admin
6B	Critical Facility Indicator	Inspection > Inventory > Roads
7	Facility Carried by Structure	Inspection > Inventory > Admin
8	Structure Number	Inspection > Inventory > Admin
9	Location	Inspection > Inventory > Admin
10	Inventory Route, Minimum Vertical Clearance	Inspection > Inventory > Roads
11	Kilometer Point	Inspection > Inventory > Roads
12	Base Highway Network	Inspection > Inventory > Roads
13A	LRS Inventory Route	Inspection > Inventory > Roads
13B	Subroute Number	Inspection > Inventory > Roads
14	(Reserved)	-
15	(Reserved)	-
16	Latitude	Inspection > Inventory > Admin
17	Longitude	Inspection > Inventory > Admin
18	(Reserved)	-
19	Bypass, Detour Length	Inspection > Inventory > Roads
20	Toll	Inspection > Inventory > Roads
21	Maintenance Responsibility	Inspection > Inventory > Admin
22	Owner	Inspection > Inventory > Admin
23	(Reserved)	-
24	(Reserved)	-
25	(Reserved)	-
26	Functional Classification of Inventory Route	Inspection > Inventory > Roads
27	Year Built	Inspection > Inventory > Admin
28A	Lanes On Structure	Inspection > Inventory > Roads
28B	Lanes Under the Structure	Inspection > Inventory > Admin
29	Average Daily Traffic	Inspection > Inventory > Roads
30	Year of Average Daily Traffic	Inspection > Inventory > Roads
31	Design Load	Inspection > Appraisal
32	Approach Roadway Width	Inspection > Inventory > Roads
33	Bridge Median	Inspection > Inventory > Design
34	Skew	Inspection > Inventory > Design
35	Structure Flared	Inspection > Inventory > Design
36	Traffic Safety Features	Inspection > Appraisal
36A	Bridge Railings	Inspection > Appraisal
36B	Transitions	Inspection > Appraisal
36C	Approach Guardrail	Inspection > Appraisal
36D	Approach Guardrail Ends	Inspection > Appraisal
37	Historical Significance	Inspection > Inventory > Admin
38	Navigation Control	Inspection > Appraisal
39	Navigation Vertical Clearance	Inspection > Appraisal
40	Navigation Horizontal Clearance	Inspection > Appraisal

Item #	Data Item	BrM Loc.
41	Structure Open, Posted, or Closed to Traffic	Inspection > Appraisal
42A	Type of Service On	Inspection > Inventory > Admin
42B	Type of Service Under	Inspection > Inventory > Admin
43A	Main Span Material	Inspection > Inventory > Design
43B	Main Span Design	Inspection > Inventory > Design
44A	Approach Span Material	Inspection > Inventory > Design
44B	Approach Span Design	Inspection > Inventory > Design
45	Number of Spans in Main Unit	Inspection > Inventory > Design
46	Number of Approach Spans	Inspection > Inventory > Design
47	Inventory Route, Total Horizontal Clearance	Inspection > Inventory > Roads
48	Length of Maximum Span	Inspection > Inventory > Design
49	Structure Length	Inspection > Inventory > Design
50	Curb or Sidewalk Widths	Inspection > Inventory > Design
51	Bridge Roadway Width, Curb-to-Curb	Inspection > Inventory > Roads
52	Deck Width, Out-to-Out	Inspection > Inventory > Design
53	Minimum Vertical Clearance Over Structure	KYTC > HIS & Clearance
54A	Minimum Vertical Underclearance (Reference)	Inspection > Appraisal
54B	Minimum Vertical Underclearance	Inspection > Appraisal KYTC > HIS & Clearance
55A	Minimum Lateral Underclearance (Reference)	Inspection > Appraisal
55B	Minimum Lateral Underclearance on Right	Inspection > Appraisal
56	Minimum Lateral Underclearance on Left	Inspection > Appraisal
57	(Reserved)	-
58	Deck	Inspection > Conditions
59	Superstructure	Inspection > Conditions
60	Substructure	Inspection > Conditions
61	Channel and Channel Protection	Inspection > Conditions
62	Culverts	Inspection > Conditions
63	Method Used to Determine Operating Rating	Inspection > Appraisal
64	Operating Rating	Inspection > Appraisal
65	Method Used to Determine Inventory Rating	Inspection > Appraisal
66	Inventory Rating	Inspection > Appraisal
67	Structural Evaluation	Inspection > Appraisal
68	Deck Geometry	Inspection > Appraisal
69	Underclearances, Vertical and Horizontal	Inspection > Appraisal
70	Bridge Posting	Inspection > Appraisal
71	Waterway Adequacy	Inspection > Conditions
72	Approach Roadway Alignment	Inspection > Appraisal
73	(Reserved)	-
74	(Reserved)	-
75	Type of Work	Inspection > Work > Project Information
76	Length of Structure Improvement	Inspection > Work > Project Information
77 - 89	(Reserved)	-
90	Inspection Date	Inspection > Schedule
91	Designated Inspection Frequency	Inspection > Schedule
92A	Fracture Critical Details	Inspection > Schedule
92B	Underwater Inspection	Inspection > Schedule
92C	Other Special Inspection	Inspection > Schedule
93A	Fracture Critical Details Date	Inspection > Schedule
93B	Underwater Inspection Date	Inspection > Schedule
93C	Other Special Inspection Date	Inspection > Schedule

FHWA required Elements

REQUIRED ELEMENTS TO BE CAPTURED
Reference: FHWA Specification for the National Bridge Inventory Bridge Elements

Table 1. Bridge Elements.

Element	Units	Element Number					
		Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Deck/Slab							
Deck	SF		13	12	31		60
Open Grid Deck	SF	28					
Concrete Filled Grid Deck	SF	29					
Corrugated or Orthotropic Deck	SF	30					
Slab	SF			38	54		65
Top Flange	SF		15	16			
Superstructure							
Closed Web/Box Girder	LF	102	104	105			106
Girder/Beam	LF	107	109	110	111		112
Stringer	LF	113	115	116	117		118
Truss	LF	120			135		136
Arch	LF	141	143	144	146	145	142
Main Cable	LF	147					
Secondary Cable	EA	148					149
Floor Beam	LF	152	154	155	156		157
Pin, Pin and Hanger Assembly	EA	161					
Gusset Plate	EA	162					
Substructure							
Column	EA	202	204	205	206		203
Column Tower (Trestle)	LF	207			208		
Pier Wall	LF			210	212	213	211
Abutment	LF	219		215	216	217	218
Pile Cap/Footing	LF			220			
Pile	EA	225	226	227	228		229
Pier Cap	LF	231	233	234	235		236
Culvert							
Culvert	LF	240	245	241	242	244	243
Bridge Rail							
Bridge Rail	LF	330*		331	332	334	333
Joint							
Strip Seal	LF	300					
Pourable	LF	301					
Compression	LF	302					
Assembly with Seal (Modular)	LF	303					
Open	LF	304					
Assembly without Seal	LF	305					
Other	LF	306					
Bearing							
Elastomeric	EA	310					
Movable (roller, sliding, etc.)	EA	311					
Enclosed/Concealed	EA	312					
Fixed	EA	313					
Pot	EA	314					
Disk	EA	315					
Other	EA	316					
Wearing Surfaces and Protective Coatings							
Wearing Surfaces	SF	510					
Steel Protective Coating	SF	515					
Concrete Protective Coating	SF	521					

*Element 330-Metal Bridge Rail may include steel or aluminum rails.

3

Element 520 - Concrete Reinforcing Steel Protective System (a.k.a. rebar protection) will not be collected by the FHWA.

EXAMPLES: TIMBER

APPENDIX B:

INSPECTION EXAMPLES

The examples provided show the evaluation and coding of bridge inspection data for timber, concrete, and steel bridges of varying complexity. The examples include the use of National Bridge Elements (NBEs) and Bridge Management Elements (BMEs) and the recording of defects. While it is an agency's choice of how to record defect codes, these examples were developed to demonstrate the use of the defect codes.

B1—TIMBER BRIDGE

The subject of this example is a four-span timber bridge crossing a small creek. The sketches in Figure B-1 show the bridge elements with relevant dimensions and note the locations of the defects described in Article B1.2.

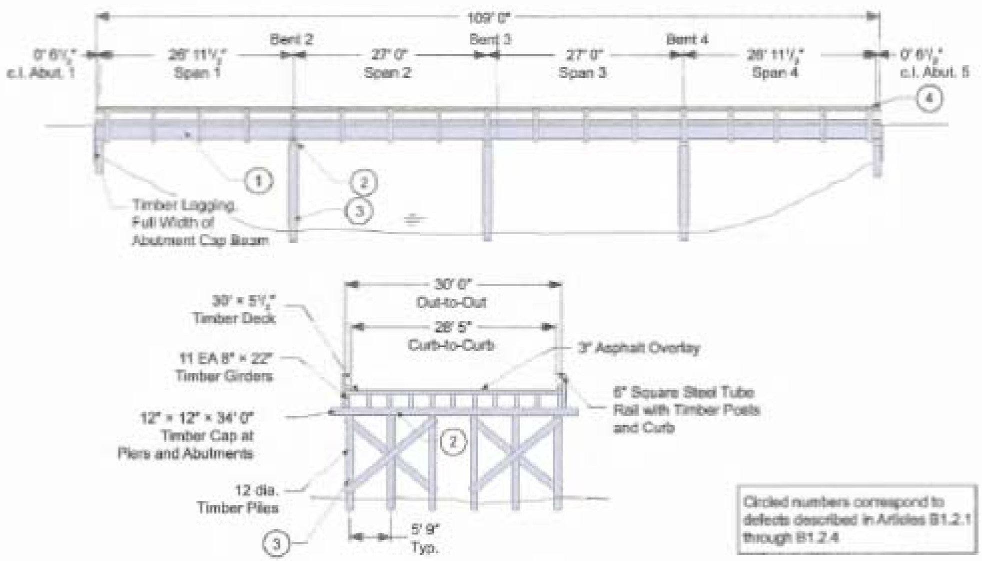


Figure B-1—Elevation and Typical Section of Bridge for Timber Bridge Example

B1.1—Element Quantities

B1.1.1—Deck

The timber deck has an asphalt wearing surface that runs curb to curb:

Timber Deck (Element 31) Quantity: 30 ft × 109 ft = 3,270 ft²
Wearing Surface (Element 510) Quantity: 28.42 ft × 109 ft = 3,097.78 ft² (round up to 3,098 ft²)

The metal bridge railing has timber posts and curb. The square steel tube rail elements are galvanized:

Metal Bridge Railing (Element 330) Quantity: 109 ft × (2 railing lines) = 218 ft
Steel Protective Coating (Element 515) Quantity: 0.50 ft × (4 sides) × 109 ft × (2 railing lines) = 436 ft²

B1.1.2—Superstructure

All four spans are composed of timber beams:

Timber Open Girder/Beam (Element 111) Quantity: 109 ft × (11 beams) = 1,199 ft

81.1.3-Substructure

As separate elements distribute vertical loads to the piles and retain the approach embankment, the vertical load-carrying elements will be considered similar to a bent and the timber abutment will consist of only the lagging retaining the approach embankment behind the abutment piles and cap beam:

Timber Abutment (Element 216) Quantity: 34ft x (2 abutments)= 68ft

The timber piles at the abutments and bents can be visually inspected to mud line:

Timber Pile (Element 228) Quantity: (6 piles per substructure unit) x (3 bents+ 2 abutments)= 30 piles

Vertical load is transferred to the piles at the abutments and bents by the timber bent caps:

Timber Pier Cap (Element 235) Quantity: (34ft per substructure unit) x (3 bents+ 2 abutments)= 170ft

81.2-Eiement Condition States

Aside from the defects described in Articles Bl.2.1 through Bl.2.4, all remaining element quantities are in good condition and are assigned to Condition State One. The following defects correspond to those labeled in Figure B-1.

81.2.1-Defect #1, Timber Open Girder/Beam (Element 111)

A 2-in. deep check (Defect #1150) extends the length of the right side exterior beam in Span 1, shown in Figure B-2. As it penetrates 25 percent (2 in. of the 8-in. member thickness), the length of this beam (27 ft.) is placed in Condition State 2. No other defects are present in the element.

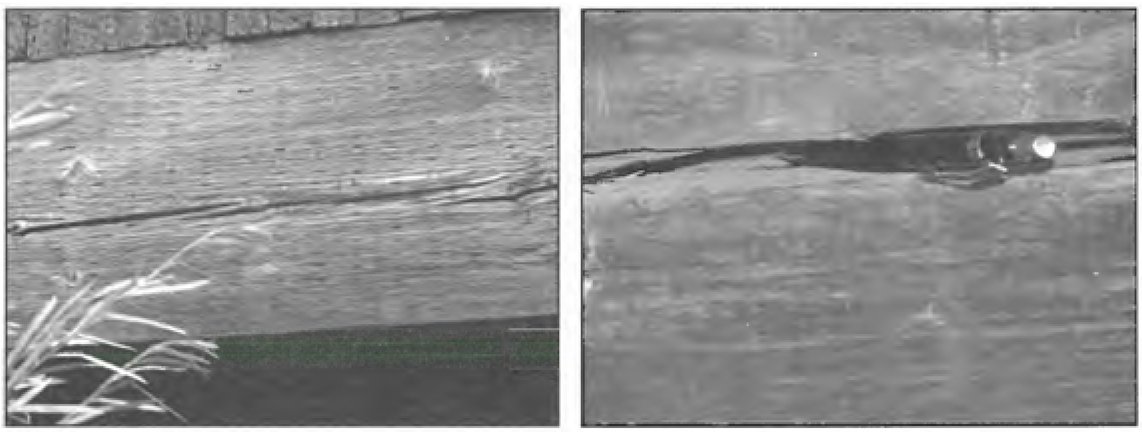


Figure B-2-2-in. Deep Check in Exterior Beam

81.2.2-Defect #2, Timber Pier Cap (Element 235)

A l-in. deep check (Defect #1150) extends the length of the bent cap at Bent 2 as shown in Figure B-3. As it penetrates 8 percent (1 in. of the 12-in. width of the member), the length of this beam (34ft) is placed in Condition State 2. No other defects are present in the element.

Figure B-3-1-in. Deep Check in Bent Cap at Bent 2

81.2.3-Defect #3, Timber Pile (Element 228)

A 7-in. deep check (Defect #1150) 3 ft long is present in the left exterior pile of Bent 2 as seen in Figure B-4. As it penetrates 58 percent (7 in. of the 12-in. member thickness), this condition meets the criteria for either Condition State 3 or Condition State 4. Per agency guidance, the severity of the check does not warrant structural review; this pile is placed in Condition State 3. Five other piles exhibit 1½-in. to 2-in. deep checks (not shown) and are placed in Condition State 2.

Figure B-4-7-in. Deep Check in Right Exterior Pile of Bent 2

81.2.4-Defect #4, Metal Bridge Railing (Element 330)

Two posts at Abutment 4 exhibit severe decay (Defect #1140) affecting 80 percent of the post section as see bib Figure B-5. Based on the severity and extent of the decay, this defect warrants structural review and the horizontal length of rail represented by the posts (2ft) is placed in Condition State 4.

Figure B-5-Decay in Timber Rail Posts

81.3-Element Quantity and Condition State Summary

The element quantities and defects described above are summarized as follows:

Element Number	Element Description	Unit of Measure	Total Quantity	Condition State 1	Condition State 2	Condition State 3	Condition State 4	Defect#*
31	Timber Deck	ft^2	3,270	3,270	0	0	0	
510	Wearing Surfaces	ft^2	3,098	3,098	0	0	0	
330	Metal Bridge Railing	ft	218	216	0	0	2	4
1140	*Decay/Section Loss*	*ft*	*2*	*0*	*0*	*0*	*2*	*4*
515	Steel Protective Coating	ft^2	436	436	0	0	0	
111	Timber Open Girder/Beam	ft	1,199	1,172	27	0	0	1
1150	*Check/Shake*	*ft*	*27*	*0*	*27*	*0*	*0*	*1*
228	Timber Pile	each	30	24	5	1	0	3
1150	*Check/Shake*	*each*	*6*	*0*	*5*	*1*	*0*	*3*
216	Timber Abutment	ft	68	68	0	0	0	
235	Timber Pier Cap	ft	170	136	34	0	0	2
1150	*Check/Shake*	*ft*	*34*	*0*	*34*	*0*	*0*	*2*

Notes:

* See Figure B-1 for defect locations.
Violet background: National Bridge Element
Blue background: Bridge Management Element
Italic type: Defect

EXAMPLE: Prestressed Concrete Girder Bridge

B2—PRESTRESSED CONCRETE GIRDER BRIDGE

The subject of this example is a four-span prestressed concrete girder bridge crossing a divided highway. The sketches in Figure B-6 show the bridge elements with relevant dimensions and note the locations of the defects described in Article B2.2.

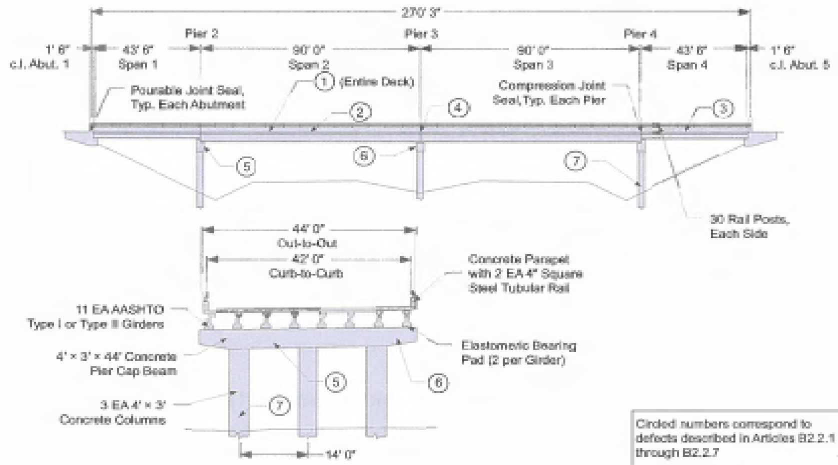


Figure B-6—Elevation and Typical Section of Bridge for Prestressed Concrete Girder Bridge Example

B2.1—Element Quantities

B2.1.1—Deck

The reinforced concrete deck has uncoated reinforcing steel and no protective overlay.

Reinforced Concrete Deck (Element 12) Quantity: 270 ft × 44 ft = 11,880 ft^2

As the redirective elements of the bridge railing consist of a combination of concrete and metal components, both the metal and reinforced concrete railing elements will be considered. The metal railing members are galvanized; estimate the surface area of each metal post as 5 ft^2:

Metal Bridge Railing (Element 330) Quantity: 270 ft × (2 railing lines) = 540 ft
Steel Protective Coating (Element 515) Quantity: [0.33 ft × (4 sides)] × (2 rails) × 270 ft + 5 ft^2 per post × 30 posts] × (2 railing lines) = 1,725.60 ft^2 (rounded up to 1,726 ft^2)
Reinforced Concrete Bridge Railing (Element 331) Quantity: 270 ft × (2 railing lines) = 540 ft

There is a deck joint at every substructure unit, extending out-to-out of the bridge deck, with pourable joint seals at the abutments and compression joint seals at the piers. There is no skew:

Pourable Joint Seal (Element 301) Quantity: 44 ft × (2 joints) = 88 ft
Compression Joint Seal (Element 302) Quantity: 44 ft × (3 joints) = 132 ft

B2.1.2—Superstructure

Since the prestressed concrete girders extend past the bearings and are embedded in the end and pier diaphragms, the length of the bridge minus the backwall thickness (1 ft at each end) provides a good estimate of the total length of each girder line:

Prestressed Concrete Open Girder (Element 109) Quantity: [270 ft – (2 × 1 ft)] × (8 girders) = 2,144 ft

Elastomeric bearings transfer load from the girders to the substructure:

Elastomeric Bearing (Element 310) Quantity: (2 bearings per girder) × (8 girders per span) × (4 spans) = 64 bearings

B2.1.3—Substructure

The reinforced concrete abutment distributes vertical load to the piles (not visible for inspection) and retains the approach embankment.

Reinforced Concrete Abutment (Element 215) Quantity: (44 ft per abutment) × (2 abutments) = 88 ft

Each reinforced concrete pier consists of a pier cap (Element 234) and three columns (Element 205):

Reinforced Concrete Column (Element 205) Quantity: (3 columns per pier) × (3 piers) = 9 columns
Reinforced Concrete Pier Cap (Element 234) Quantity: (44 ft per pier) × (3 piers) = 132 ft

B2.2—Element Condition States

Aside from the defects described in Articles B2.2.1 through B2.2.7, all remaining element quantities are in good condition and assigned to Condition State One. The following defects correspond to those labeled in Figure B-6.

B2.2.1—Defect #1, Reinforced Concrete Deck (Element 12)

Transverse, hairline cracks throughout at variable spacing greater than 3 ft throughout the top surface of the deck. Based on the cracks' widths (less than 0.012 in.) and density (greater than 3 ft), these areas meet the criteria for Condition State 1.

B2.2.2—Defect #2, Reinforced Concrete Deck (Element 12)

1-in. to 2-in. deep spalls with exposed rebar (with no section loss) and areas of distressed patches in both lanes near midspan of Span 2, shown in Figure B-7. The total area of spalls is 12 ft^2.; the total area of distressed patches is 100 ft^2. With no section loss, the exposed rebar (Defect #1090) meets the criteria for Condition State 2. As the spalls (Defect #1080) are more than 1 in. deep, all of these areas (112 ft^2 total) meet the criteria for Condition State 3, which controls.

Figure B-7—Spalls and Distressed Patches in Span 2 Deck

B2.2.3—Defect #3, Reinforced Concrete Deck (Element 12)

1-in. to 2-in. deep spalls with exposed rebar (with no section loss) and areas of distressed patches in both lanes near midspan of Span 4, shown in Figure B-8. The total area of spalls is 40 ft^2; the total area of distressed patches is 60 ft^2. With no section loss, the exposed rebar (Defect #1090) meets the criteria for Condition State 2. As the spalls (Defect #1080) are more than 1 in. deep and the patches are not sound, all of these areas (100 ft^2 total) meet the criteria for Condition State 3.

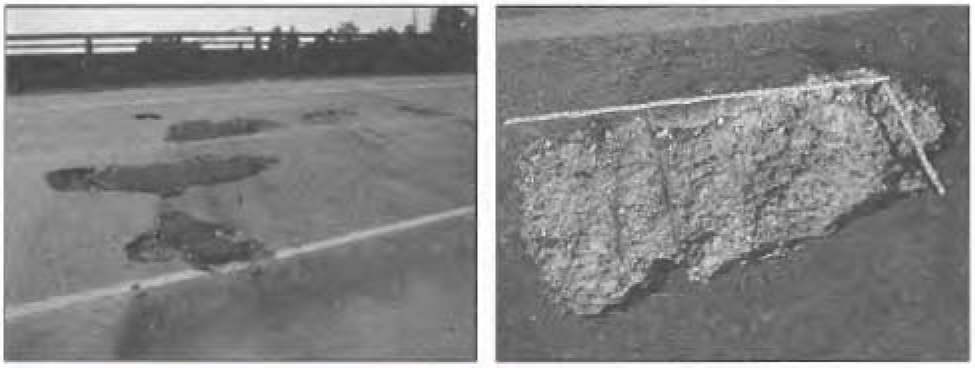


Figure B-8—Spalls and Distressed Patches in Span 4 Deck

B2.2.4—Defect #4, Compression Joint Seal (Element 302) and Reinforced Concrete Deck (Element 12)

Deep spalls with unsound concrete the full length (40 ft) of the deck 6 in. adjacent to the joint seal at Pier 3, shown in Figure B-9. The gland at this joint is also partially pulled out. For the joint element, the seal damage (Defect #2330) meets the criteria for Condition State 3 but the adjacent deck damage (Defect #2360) meets the criteria for Condition State 4, which controls. Due to their depth, the spalls (Defect #1080) in the concrete deck element in this area (40 ft × 1 ft = 40 ft^2) meet the criteria for Condition State 3.

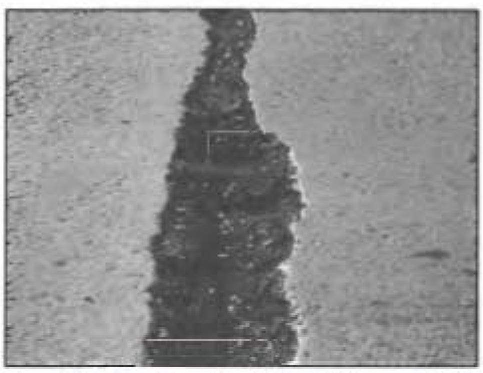


Figure B-9—Deep Spalls in the Deck Adjacent to the Joint Seal at Pier 3

B2.2.5—Defect #5, Reinforced Concrete Pier Cap (Element 234)

The underside of the Pier 2 cap has a spalled area 12 ft long and 2 in. deep with exposed rebar and rust staining, shown in Figure B-10. The depth of the spall (Defect #1080) meets the criteria to place this length of cap beam in Condition State 3. The section loss measured on the exposed rebar (Defect #1090) does not warrant a structural review of the cap beam and also meets the criteria for Condition State 3. Agency policy in this situation places a higher priority on the exposed rebar, making it the predominant defect.

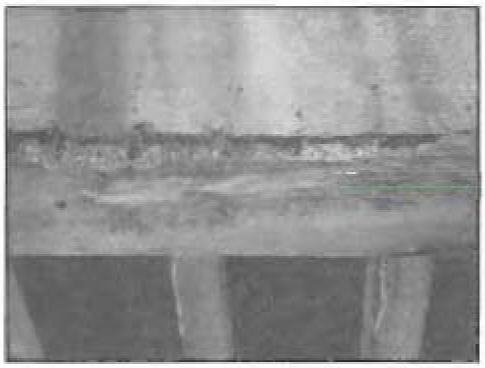


Figure B-10—Spall, Underside of Pier 2 Cap

B2.2.6—Defect #6, Reinforced Concrete Pier Cap (Element 234)

Both the right and left cantilevers of the Pier 3 cap exhibit 0.04-in. wide cracks, some with rust staining, shown in Figure B-11. This cracking extends for 2 ft on the left side and for 4 ft on the right. The widths of these cracks (Defect #1130) meet the criteria to place this quantity of the cap in Condition State 2; however, the presence of efflorescence (Defect #1120) with rust staining meets the criteria for Condition State 3, which controls.

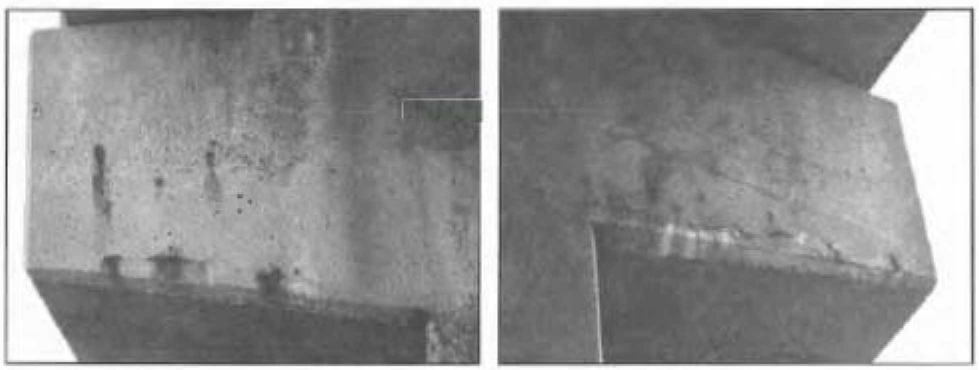


Figure B-11—0.04-in. Width Cracks with Rust Staining in the Cantilevers of the Pier 3 Cap

B2.2.7—Defect #7, Reinforced Concrete Column (Element 205)

The left column of Pier 4 has a $^{3}/_{16}$-in. wide × 11-ft long vertical crack, shown in Figure B-12. A previous structural review found that this crack does not affect the strength or serviceability of the element; thus, the width of this crack (Defect #1130) meets the criteria to place this column in Condition State 3.

Manual for Bridge Element Inspection

Figure B-12—$^{3}/_{16}$-in. Width Vertical Crack in Left Column of Pier 4

B2.3—ELEMENT QUANTITY AND CONDITION STATE SUMMARY

The element quantities and defects described above are summarized as follows:

Element Number	Element Description	Unit of Measure	Total Quantity	Condition State 1	Condition State 2	Condition State 3	Condition State 4	Defect #*
12	Reinforced Concrete Deck	ft^2	11,880	11,628	0	252	0	1,2,3,4
1080	*Delamination/Spall/ Patched Area*	*ft^2*	*252*	*0*	*0*	*252*	*0*	*2,3,4*
301	Pourable Joint Seal	ft	88	88	0	0	0	
302	Compression Joint Seal	ft	132	92	0	0	40	4
2360	*Adjacent Deck or Header*	*ft*	*40*	*0*	*0*	*0*	*40*	*4*
330	Metal Bridge Railing	ft	540	540	0	0	0	
515	Steel Protective Coating	ft^2	1,726	1,726	0	0	0	
331	Reinforced Concrete Bridge Railing	ft	540	540	0	0	0	
109	Prestressed Concrete Girder/Beam	ft	2,144	2,144	0	0	0	
310	Elastomeric Bearing	each	64	64	0	0	0	
215	Reinforced Concrete Abutment	ft	88	88	0	0	0	
205	Reinforced Concrete Column	each	9	8	0	1	0	7
1130	*Cracking (RC and Other)*	*each*	*1*	*0*	*0*	*1*	*0*	*7*
234	Reinforced Concrete Pier Cap	ft	132	114	0	18	0	5,6
1090	*Exposed Rebar*	*ft*	*12*	*0*	*0*	*12*	*0*	*5*
1120	*Efflorescence/Rust Staining*	*ft*	*6*	*0*	*0*	*6*	*0*	*6*

EXAMPLE: STEEL TRUSS

B3—STEEL TRUSS BRIDGE

The subject of this example is a two-span steel truss bridge crossing a river. The sketches in Figure B-13 show the bridge elements with relevant dimensions and note the locations of the defects described in Article B3.2.

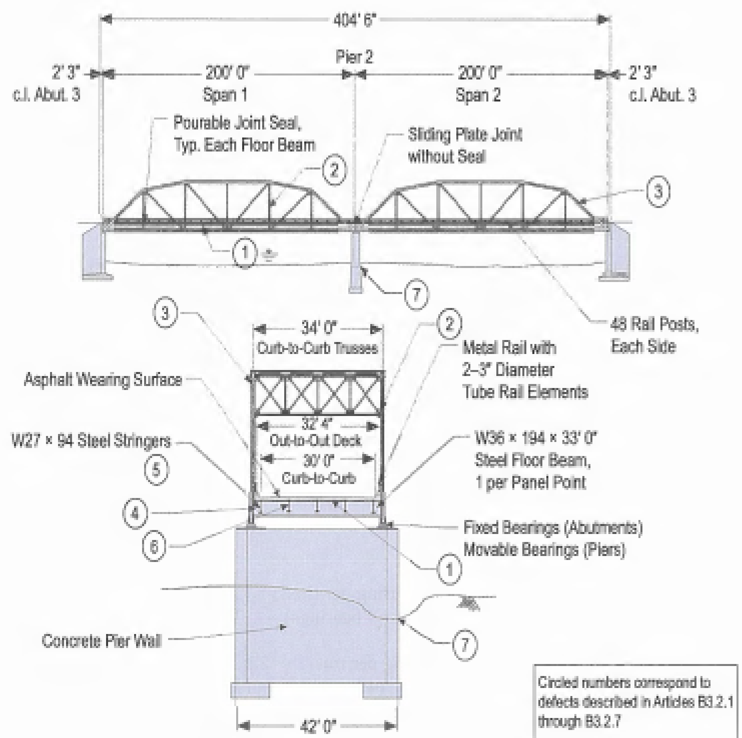


Figure B-13—Elevation and Typical Section of Bridge for Example B.3

B3.1—Element Quantities

B3.1.1—Deck

The reinforced concrete deck has uncoated reinforcing steel and an asphalt wearing surface overlay.

Reinforced Concrete Deck (Element 12) Quantity: 404.50 ft × 32.33 ft = 13,077.49 ft^2 (round up to 13,078 ft^2)
Wearing Surface (Element 510) Quantity: 404.50 ft × 30 ft = 12,135 ft^2

The metal railing has a concrete curb and metal posts. The metal railing members are painted; estimate the surface area of each metal post as 5 ft^2:

Metal Bridge Railing (Element 330) Quantity: 404.50 ft × (2 railing lines) = 809 ft
Steel Protective Coating (Element 515) Quantity: [3.1416 × 0.25 ft] × (2 rails) × 404.50 ft + 5 ft^2 per post × 48 posts] × (2 railing lines) = 1,750.78 ft^2 (round up to 1751 ft^2)

There are deck joints with pourable seals at 12 of the 14 floor beams. The sliding plate expansion joint at the pier does not have a seal. All joints extend from out-to-out of the deck. There is no skew:

Pourable Joint Seal (Element 301) Quantity: 32.33 ft × (12 joints) = 388 ft
Assembly Joint without Seal (Element 305) Quantity: 32.33 ft × (1 joint) = 32.33 ft (round up to 33 ft)

B3.1.2—Superstructure

The main superstructure elements are the steel truss, floor beams, and stringers. Each of these elements is painted:

Steel Truss (Element 120) Quantity: 200 ft × (2 trusses per span) × (2 spans) = 800 ft
Steel Protective Coating (Element 515) Quantity: Calculated from "as-built" plans; 18,696 ft^2

Steel Floor Beam (Element 152) Quantity: 33 ft × (7 floor beams per span) × (2 spans) = 462 ft
Steel Protective Coating (Element 515) Quantity: 33 ft × 8.9 ft^2/ft* × (14 floor beams) = 4,112 ft^2

Steel Stringer (Element 113) Quantity: 200 ft × (5 stringers) × (2 spans) = 2,000 ft
Steel Protective Coating (Element 515) Quantity: 200 ft × 6.8 ft^2/ft* x (5 stringers) × (2 spans) = 13,600 ft^2

* Surface area per foot length for W36 × 194 (floor beams) and W27 × 94 (stringers) steel sections are taken from the AISC *Steel Design Guide 19*, "Fire Resistance of Structural Steel Framing," Appendix A, and do not include the surface area of the top face of the top flange.

There is a gusset plate assembly at each truss connection composed of two gusset plates (one on each side). All of the assemblies are painted; estimate the painted surface area of each gusset plate as 16 ft^2:

Steel Gusset Plate (Element 162) Quantity: (12 plate assemblies per span) × (2 trusses) × (2 spans) = 48
Steel Protective Coating (Element 515) Quantity: (48 assemblies) × (2 plates per assembly) × (16 ft^2/plate) = 1,536 ft^2

Each truss is supported on one movable bearing and one fixed bearing. The bearings are painted; estimate the painted surface area of each bearing as 12 ft^2:

Movable Bearing (Element 311) Quantity: (1 bearing per truss) × (2 trusses per span) × (2 spans) = 4 bearings
Steel Protective Coating (Element 515) Quantity: (4 bearings) × (12 ft^2/bearing) = 48 ft^2

Fixed Bearing (Element 313) Quantity: (1 bearing per truss) × (2 trusses per span) × (2 spans) = 4 bearings
Steel Protective Coating (Element 515) Quantity: (4 bearings) × (12 ft^2/bearing) = 48 ft^2

B3.1.3—Substructure

The reinforced concrete abutment distributes vertical load to the spread footing foundation and retains the approach embankment. The abutments are the same width as the pier wall.

Reinforced Concrete Abutment (Element 215) Quantity: 42 ft × (2 abutments) = 84 ft

The trusses are also supported on a reinforced concrete pier wall:

Reinforced Concrete Pier Wall (Element 215) Quantity: 42 ft × (1 pier) = 42 ft

B3.2—Element Condition States

Aside from the defects described in Articles B3.2.1 through B3.2.7, all element quantities are in good condition and assigned to Condition State One. The following defects correspond to those labeled in Figure B-13.

B3.2.1—Defect #1, Reinforced Concrete Deck (Element 12)

Moderate efflorescence (Defect #1120) is noted in the two interior deck bays throughout the length of Span 1 (affected area: 15 ft × 200 ft = 3000 ft²), shown in Figure B-14. Based on the extent of the efflorescence build-up and the lack of rust staining, these areas meet the criteria for Condition State 2. Cracks (Defect #1130) measuring 0.015 in. wide spaced at 1 ft are also noted. The width and density of these cracks also meet the criteria for Condition State 2. Agency policy in this situation places a higher priority on the efflorescence, making it the predominant defect.

Figure B-14—Efflorescence on the Underside of the Deck in Span 1

B3.2.2—Defect #2, Steel Truss (Element 120)

There is new impact damage to the sway bracing at panel point 4 in the Span 1 truss, resulting in a 1-in. distortion (Defect #7000) in the right side L4-U4 vertical member as shown in Figure B-15. As the impact of this damage on the strength and serviceability of the truss is unknown, the length of the truss attributed to the vertical, measured parallel to the traveled way (1 ft) is placed in Condition State 4.

Figure B-15—Sway Bracing Impact Damage in Span 1

B3.2.3—Defect #3, Steel Truss (Element 120), Steel Gusset Plate (Element 162), and Steel Protective Coating (Element 515)

Freckle rust throughout the length of both spans, both trusses as shown in Figure B-16. As no section loss is measured, this corrosion (Defect #1000) results in the entire quantity of the steel truss and gusset plate elements being assigned to Condition State 2. The paint system throughout is chalking (Defect #3410), exhibiting loss of pigment, and meeting the criteria for Condition State 3. The areas of paint where freckle rust is noted (estimated at 5 percent of the painted area, or 18,696 ft^2 × 0.05 = 935 ft^2 of the trusses and 1,536 ft^2 × 0.05 = 77 ft^2 of the gusset plates) have failed (Defect #3440), meeting the criteria for Condition State 4.

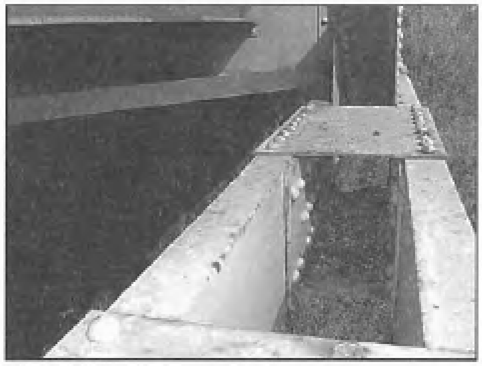


Figure B-16—Freckle Rust, Typical, Both Trusses, Both Spans

B3.2.4—Defect #4, Steel Floor Beam (Element 152) and Steel Protective Coating (Element 515)

Freckle rust throughout the length of all floor beams; thus, the quantity of the steel floor beam element not showing further corrosion is assigned to Condition State 2. There is corrosion (Defect #1000) with less than 10 percent section loss in the top flange at 20 of the 28 beam ends, shown in Figure B-17, which meets the criteria for Condition State 3. Each affected area will be considered to represent 2 ft of floor beam length (20 × 2 ft = 40 ft total). The paint system in these areas (approximately 2 ft^2 per location, 20 × 2 ft^2 = 40 ft^2 total) has failed (Defect #3440) and is assigned to Condition State 4. The paint system throughout the rest of the beams is chalking (Defect #3410), exhibiting loss of pigment and meeting the criteria for Condition State 3. The areas of paint where freckle rust is noted (estimated at 5 percent of the painted area, or 4,112 ft^2 × 0.05 = 206 ft^2) has also failed (Defect #3440), meeting the criteria for Condition State 4.

Figure B-17—Corrosion at Floor Beam Ends

B3.2.5—Defect #5, Steel Stringer (Element 113)

Freckle rust present near the floor beam connections; total length affected is 50 ft. As no section loss is evident, the corrosion (Defect #1000) in these areas meets the criteria for Condition State 2. In these areas, the paint is chalking (Defect #3410), exhibiting loss of pigment and meeting the criteria for Condition State 3 (total affected area is 50 ft × 6.8 ft^2/ft = 340 ft^2). The areas of paint where freckle rust is noted (estimated at 5 percent of the affected area, or 340 ft^2 × 0.05 = 17 ft^2) have failed (Defect #3440), meeting the criteria for Condition State 4.

B3.2.6—Defect #6, Steel Stringer (Element 113)

Broken and missing rivets in 8 stringer-to-floor beam connections (Defect #1020), shown in Figure B-18. Each affected connection will be considered to represent 1 ft of stringer length, or 8 × 1 ft = 8 ft total. This condition led the inspector to assign these quantities to Condition State 4 in the field. However, a structural review of the floor system demonstrates that, despite the missing fasteners, the bridge can still carry legal loads and, per agency policy, these quantities are reassigned to Condition State 3.

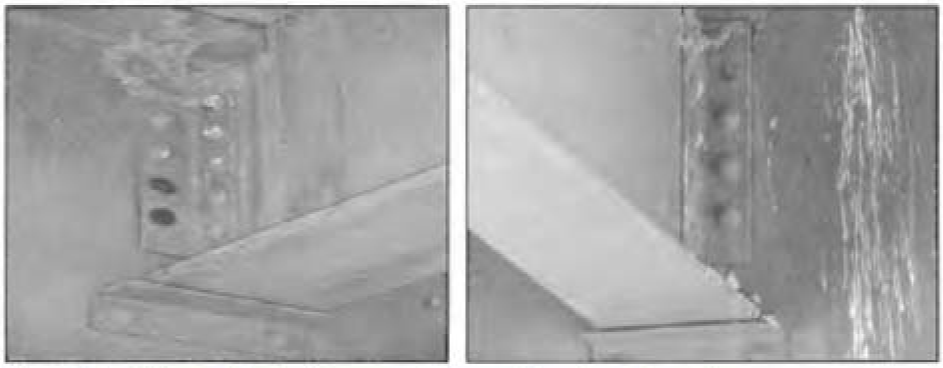


Figure B-18—Missing and Broken Fasteners at Stringer-to-Floor Beam Connections

B3.2.7—Defect #7, Pier Wall (Element 210)

There is a small scour hole (Defect #6000) extending 10 ft in from the upstream end of the pier wall as shown in Figure B-19. The measured scour is within the tolerable limits established by the bridge's scour evaluation; thus, the affected length meets the criteria for Condition State 2.

Figure B-19—Scour Hole at the Upstream End of the Pier Wall

B3.3—Element Quantity and Condition State Summary

The element quantities and defects described above are summarized as follows:

Element Number	Element Description	Unit of Measure	Total Quantity	Condition State 1	Condition State 2	Condition State 3	Condition State 4	Defect #*
12	Reinforced Concrete Deck	ft²	13,079	10,079	3,000	0	0	1
1120	*Efflorescence/Rust Staining*	*ft²*	*3,000*	*0*	*3,000*	*0*	*0*	*1*
510	Wearing Surface	ft²	12,135	12,135	0	0	0	
330	Metal Bridge Railing	ft	809	809	0	0	0	
515	Steel Protective Coating	ft²	1,751	1,751	0	0	0	
301	Pourable Joint Seal	ft	388	388	0	0	0	
305	Assembly Joint without Seal	ft	33	33	0	0	0	
120	Steel Truss	ft	800	0	799	0	1	2,3
1000	*Corrosion*	*ft*	*800*	*0*	*799*	*0*	*0*	*3*
7000	*Damage*	*ft*	*1*	*0*	*0*	*0*	*1*	*2*
515	Steel Protective Coating	ft²	18,696	0	0	17,761	935	3
3410	*Chalking*	*ft²*	*17,761*	*0*	*0*	*17,761*	*0*	*3*
3440	*Effectiveness*	*ft²*	*935*	*0*	*0*	*0*	*935*	*3*
152	Steel Floor Beam	ft	462	0	442	20	0	4
1000	*Corrosion*	*ft*	*462*	*0*	*442*	*20*	*0*	*4*
515	Steel Protective Coating	ft²	4,112	0	0	3,866	246	4
3410	*Chalking*	*ft²*	*3,866*	*0*	*0*	*3,866*	*0*	*4*
3440	*Effectiveness*	*ft²*	*246*	*0*	*0*	*0*	*246*	*4*
113	Steel Stringer	ft	2,000	1,942	50	8	0	5,6
1000	*Corrosion*	*ft*	*50*	*0*	*50*	*0*	*0*	*5*
1020	*Connections*	*ft*	*8*	*0*	*0*	*8*	*0*	*6*
515	Steel Protective Coating	ft²	13,600	13,260	0	323	17	5
3410	*Chalking*	*ft²*	*323*	*0*	*0*	*323*	*0*	*5*
3440	*Effectiveness*	*ft²*	*17*	*0*	*0*	*0*	*17*	*5*
162	Steel Gusset Plate	each	48	0	48	0	0	3
515	Steel Protective Coating	ft²	1,536	0	0	1,459	77	3
3410	*Chalking*	*ft²*	*1,459*	*0*	*0*	*1,459*	*0*	*3*
3440	*Effectiveness*	*ft²*	*77*	*0*	*0*	*0*	*77*	*3*
311	Movable Bearing	each	4	4	0	0	0	
515	Steel Protective Coating	ft²	48	48	0	0	0	

Manual for Bridge Element Inspection B-17

Element Number	Element Description	Unit of Measure	Total Quantity	Condition State 1	Condition State 2	Condition State 3	Condition State 4	Defect #*
313	Fixed Bearing	each	4	4	0	0	0	
515	Steel Protective Coating	ft^2	48	48	0	0	0	
215	Reinforced Concrete Abutment	ft	84	84	0	0	0	
210	Reinforced Concrete Pier Wall	ft	42	32	10	0	0	7
6000	*Scour*	*ft*	*10*	*0*	*10*	*0*	*0*	*7*

Notes:

* See Figure B-13 for defect locations
Violet background: National Bridge Element
Blue background: Bridge Management Element
Italic type: Defect

EXAMPLE: Guidance on Condition State 4

KYTC Procedures for AASHTO Condition State 4 (Severe):
The granularity of the defect details is typically not specified with defect descriptive language for Condition State 4, as this state is reserved for severe conditions that are beyond the specific defects defined for Condition States 1 through 3. Elements with a portion or all of the quantity in Condition State 4 will often have load capacity implications warranting a structural review. Within the Manual for Bridge Element Inspection, the term "structural review" is defined as a review by a person qualified to evaluate the field observed conditions and make a determination of the impacts of the conditions on the performance of the element. Structural reviews may include a review of the field inspection notes and photographs, review of as-built/design plans, or analysis as deemed appropriate to evaluate the performance of the element. KYTC may establish additional guidance to aid the inspector in determining the field circumstances where structural reviews are warranted, taking into consideration the education, training, and experience of the inspection staff.

Condition State 4
The condition warrants a structural review to determine the effect on strength or serviceability of the element or bridge; OR a structural review has been completed and the defects impact strength or serviceability of the element or bridge.

Action: All element or defect quantities placed in condition state 4 will require immediate review.

> **1st line review:** will be required and can be performed by a Qualified Team Leader (at the discretion of the District Bridge Engineer), or District Bridge Engineer.
>
> **2nd Line review**: if needed can be performed by Central Office Load Rating Staff, Chief Bridge Inspection Engineer, Chief Bridge Inspector, Scour Engineer or the TEBM for Bridge Preservation.

Definitions

> **Strength**: any material or property that helps maintains the structural integrity of the structure from failure.
>
> > Example: (broken prestressed tendons, severe steel deterioration, shear cracking that exceeds the limits of condition state 3, loss of bearing capacity, etc).
>
> **Serviceability**: any defect that would impede traffic but would not cause immediate failure of the structure.
>
> > Example: (damaged railing, full depth potholes, settlement, etc).
>
> **Severe**: an element which exhibits an effect on strength or serviceability that warrants an immediate plan of action or repairs. Example: (repair plan, load rating analysis, scour analysis, or scheduled monitoring, etc).

ELEMENT ENVIRONMENT CODING

CODING	CORRESPONDING CONDITION
1	**BENIGN** – Neither environmental factors nor operating practices are likely to significantly change the condition of the element over time nor have their effects been mitigated by past non-maintenance actions or the presence of highly effective protective systems. (i.e. The element is not likely to deteriorate much over time.)
2	**LOW** – Environmental factors and/or operating practices either do not adversely influence the condition of the element or their effects are substantially lessened by the application of effective protective systems. (i.e. The element is likely to deteriorate only slowly overtime.)
3	**MODERATE** – Any change in the condition of the element is likely to be quite normal as measured against those environmental factors and/or operating practices that are considered typical by the agency. (i.e. The element will likely have a normal rate of deterioration.)
4	**SEVERE** – Environmental factors and/or operating practices contribute to the rapid decline in the condition of the element. Protective systems are not in place or are ineffective. (i.e. The element is likely to deteriorate rapidly due to conditions at the bridge site.)

9000 – Exhibits

9100 Sample Letters (note that the italicized text is to be changed as necessary)

9101 Posting Memo to District
9102 Closure Memo to District
9103 Posting Memo to County
9104 Closure Memo to County
9105 Countywide Postings Memo to County (2 pages)
9106 CBMNIR notification (also MAIN-9007)
9107 Sample Greeting letter for non-state owned structures
9108 Posting Compliance Forms (2 pages)

9200 Inventory

9201 Numbering of Bridge Components

9300 Inspection

9301 Categorization for Prioritizing In-Depth Inspection
9302 Equipment List for Bridge Inspections (2 pages)
9303 Form TC 71-132, "Consultant Bridge Inspection Field Review Report" (also MAIN-9009, eform)
9305 Form TC 71-5, CBMNIR Form (also MAIN-9010, eform)
9306 Contract Bridge Inspection Performance Evaluations

9400 Load Ratings

9402 Analysis Trucks (5 pages)
KYTC Types 1-4
AASHTO H and HS
AASHTO SU4-SU7
KYTC Annual Permits
9403 Posting Sign Types
9405 Bridge Information Sheets – Steel or Timber Beams
9406 Bridge Information Sheets – Multi-Box Beams (PCDU)
9407 Bridge Information Sheets – Reinforced Concrete T-Beams (RCDG)

9500 Scour

9501 Scour Critical Bridge - Plan of Action (5 pages)

Sample Letter – Posting Memo to District Exhibit 9101

Memo To: *Matt Bullock, P.E.*
Chief District Engineer
District Five

From: *Anne Lynch Irish, P.E.*
Chief Load Rating Engineer
Division of Maintenance

Date: *October 19, 2010*

Subject: *Bridge Posting*
Bullitt County
KY 61 over Barley Creek

After review of the condition and analysis or changes in the weight carrying capacity of the subject structure by the bridge preservation analysis staff, this office *has determined* that the posting level for the following bridge should be as follows:

015B00013N ***Post the structure at the following weight limits due to the load rating of the concrete beams in poor condition:***
Type 1 Truck = 18 tons
Type 2 Truck = 20 tons
Type 3 Truck = 24 tons

Please notify the proper officials of this posting change. Should you have any questions, please advise.

ALI

cc: Posting Memo File
Mohamad Abdol
Royce Meredith
Darrell Dudgeon
Eddie House
Terry King
Nathan Weldy

Sample Letter – Closure Memo to District Exhibit 9102

Memo To: *Bart Bryant, P.E.*
Chief District Engineer
District Nine

From: *Anne Lynch Irish, P.E.*
Chief Load Rating Engineer
Division of Maintenance

Date: *January 19, 2010*

Subject: *Bridge Posting*
Carter County
Harvey Branch Road (CR1634) over Buffalo Creek

After review of the condition and analysis or changes in the weight carrying capacity of the subject structure by the bridge preservation analysis staff, this office *concurs* that the posting level for the following bridge should be as follows:

022C00059N ***Close and barricade the structure to all traffic due to the critical condition of the timber substructure (piling and caps).***

Please notify the proper officials of this posting change. Should you have any questions, please advise.

ALI

cc: Posting Memo File
Daran Razor
Joe Callahan
Rick Rogers
Alex Greiner

Sample Letter – Posting Memo to County Exhibit 9103

September 10, 2010

Judge *Steve Applegate*
Lewis County Judge/Executive
Lewis County Courthouse
Vanceburg, Kentucky *41179*

Dear Judge *Applegate*:

Upon completion of a routine inspection of bridge *068C00062N (Lower Kinney Road (CR 1102) over Mill Creek - 0.9 mi south of jct. KY 9/AA Hwy)*, our Central Office Load Rating Engineer has determined that the posting level for the bridge should be reduced as follows:

068C00062N ***Post the structure at 8 tons for all traffic due to the load rating of the timber deck.***

Furthermore, the steel I-beams are in poor condition and need to be replaced along with the deck. Aside from some undermining and light cracking, the abutments appear to be in satisfactory condition and further assessment should be considered for reuse with respect to any plans of bridge rehabilitation. A copy of the inspection report is attached along with a map showing the location of the structure.

For your county to be eligible for Federal Bridge Replacement and Rehabilitation funds for the coming year, the bridge that is listed must be signed for the weight limits shown. Upon receipt of this letter, your county has 30 days to post or barricade the required structure and return a signed copy of the attached Compliance Form to this office.

If you have any questions, please contact *Rick Rogers, Alex Greiner, or myself at 606-845-2551.*

Sincerely,

Joe Callahan, P.E.
Structures Section Supervisor

Attachments

cc: Central Office TEBM for Bridge Preservation
District School Superintendent
Railroad(s)

Sample Letter – Closure Memo to County Exhibit 9104

September 18, 2010

Judge *Steve Pearlman*
Caldwell County Judge/Executive
Caldwell County Courthouse
Princeton, Kentucky *12345*

Dear Judge *Pearlman*:

Upon completion of a routine inspection of bridge *017C00001N (Lower Kinney Road (CR 1102) over Mill Creek - 0.9 mi south of jct. KY 9/AA Hwy),* our Central Office Load Rating Engineer has determined that the posting level for the bridge should be reduced as follows:

017C00006N ***Close and barricade the structure to all traffic due to the failure of the timber piling substructure and the critical condition of the steel beam superstructure.***

Furthermore, the steel I-beams are beginning to buckle and have shifted off of their bearing supports. The timber piles in the intermediate substructures (piers) is rotted and shifted out of alignment with the timber cap to be no longer in bearing. Aside from some undermining and light cracking, the abutments appear to be in satisfactory condition. A copy of the inspection report is attached along with a map showing the location of the structure.

For your county to be eligible for Federal Bridge Replacement and Rehabilitation funds for the coming year, the bridge that is listed must be properly closed and barricaded. Upon receipt of this letter, your county has 14 days to barricade the required structure and return a signed copy of the attached Compliance Form to this office.

If you have any questions, please contact *me* at *270-824-7080*.

Sincerely,

Brad Houck, P.E.
Structures Section Supervisor

Attachments

cc: Central Office TEBM for Bridge Preservation
District School Superintendent
Railroad(s)

Sample Letter - Countywide Posting Memo to County page 1 - Exhibit 9105

November 20, 2010

Honorable *Ralph Johnson*
ABC County Judge/Executive
ABC County Courthouse
Post Office Box 123
Somewhere, Kentucky *45678*

Dear Judge *Johnson*:

Bridge inspections in *ABC* County were completed in *Month* of *2010*. Enclosed are copies of our inspection reports for these structures, with recommended posting, closure, maintenance, and/or repairs, and an updated location map.

Critical Needs – these structures require immediate attention and/or indicate changes that have occurred since the previous report**:**

CR-121-6018-C00002 Smith Road over Baxter Creek
Timber deck planks which are rotting, splitting and sagging need to be replaced.

Signing Needs – these structures have improper (substandard) or missing signage:

CR-121-2153-R00617 CSX Railroad over Elm Street in Nonesuch
Missing vertical clearance sign for the southbound lane.

Posting Status – these structures have weight limits below 40 tons:

Bridge ID Location	Posting Recommendation	Posting Status
CR-121-6121-C00011 *Red Road over Wildcat Lane*	*13 ton*	*posted correctly*
CR-121-9999-C00029 *15th Street over CSX Railroad*	*CLOSE*	*barricaded correctly*
CR-121-1234-C00042 *Blue Street over Cardinal Creek*	*5 ton*	*not posted*

Before crossing any of these structures, the driver of any vehicle is responsible for knowing the vehicle's gross weight. This includes school buses, which have become larger and heavier. It is the responsibility of both the bus driver and the district school transportation director to ensure the bus's gross weight does not exceed the weight limit of these structures.

Sample Letter - Countywide Posting Memo to County page 2 - Exhibit 9105

November 20, 2010

to Honorable *Ralph Johnson, ABC* County Judge/Executive
ABC County bridge inspections, page *2*

In order for your county to be eligible for Federal Bridge Replacement and Rehabilitation Funds for the coming year, the structures listed as recommended posted must be signed for the weight limits shown. Those listed as recommended closed must be physically barricaded. All signs and barricades must conform to the Manual on Uniform Traffic Control Devices. Upon receipt of this letter your county has **30 days** to post or barricade the required structures and return a signed copy of the attached Compliance Form to this office. Counties that are found to be out of compliance will be made ineligible for Federal funding.

If you have any questions, please contact the District Bridge Engineer, *John Ledford at 859-123-4567 extension 890.*

Sincerely,
William J. Chief, P.E.
Executive Director

John Ledford

John Ledford, P.E.
District *13* Bridge Engineer

Enclosures

cc: Central Office TEBM for Bridge Preservation
School Superintendent(s)
Railroad(s)

Sample Letter – CBMNIR Notification Exhibit 9106-A

November 20, 2010

Honorable *Ralph Johnson*
ABC County Judge/Executive
ABC County Courthouse
Post Office Box 123
Somewhere, Kentucky *45678*

Dear Judge *Johnson*:

Subject: Bridge # *123C00456N, Buffalo Road over Bison Creek*

This letter confirms the *telephone* contact with *Mr. Robert Smith, ABC County Road Superintendent, on November 19, 2010*, about the subject structure. The structure's recent NBI inspection revealed *a* critical problem *(advanced scour)* that requires immediate attention. Attached are the NBIS inspection report and the department's Critical Bridge Maintenance Needs Inspection Report for this structure which describe the problem.

(Discuss the problems. Recommend repairs.)

If these actions are not taken the structure should be closed to traffic.

Please notify the Department **within 3 days** of the course of action you chose to take.

If you have any questions, please contact the District Bridge Engineer, *John Ledford at 859-123-4567 extension 890.*

Sincerely,
William J. Chief, P.E.
Executive Director

John Ledford

John Ledford, P.E.
District *13* Bridge Engineer

Enclosures

cc: Central Office TEBM for Bridge Preservation
School Superintendent
Railroad(s)

Sample Letter – County Greeting page 1 - Exhibit 9106-B

May 13, 2011

Judge New Person
Any County Judge Executive
P.O. Box 123
Any City, Kentucky 12345

Dear Judge New Person,

After the collapse of the 'Silver Bridge' over the Ohio River at Point Pleasant, West Virginia, in 1967, Congress enacted the National Bridge Inspection Standards. This resulted in a federal mandate for all bridges on public roads to be inventoried, load rated, and inspected. A bridge is defined as a structure having an opening greater than 20 feet in length when measured along the center line of the road.

The Kentucky Transportation Cabinet (KYTC) has accepted this responsibility and does this at no cost to the bridge owner. Currently the bridge inventory is stored in a software program – AASHTOWare Bridge Management (BrM) - which is used by most states. The load rating of the bridges is handled by KYTC Central Office in Frankfort. Inspections are conducted by KYTC's 12 district offices. Every bridge is inspected at least once every two years by a qualified team leader/bridge inspector. Bridges that have a posted weight limit determined by Central Office are inspected at least once a year.

After all scheduled bridges in a county have been inspected and the data is entered into BrM, copies of the inspection reports are sent to the bridge owner. Typically the bridge owner is the state or county or city depending on who maintains the road that the bridge serves. A summary of the recommended actions needed on each bridge is also sent. These recommended actions may include posting a bridge for a weight limit or even closing and barricading a bridge to all vehicular traffic. The letter will be accompanied by a Statement of Compliance which needs to be signed by the county judge executive after all postings are completed in the field. The signed Statement of Compliance will then be sent to the district office, where the bridge engineer or inspectors will verify these postings.

As long as the bridge owner complies with KYTC recommendations concerning posting a bridge for a weight limit and/or closing and barricading a bridge to all traffic, the bridge owner is considered to be in "compliance" and replacement of the bridge is eligible for federal bridge funds. Every two years the Kentucky Highway Plan is updated with additional road construction projects. These projects can include county bridge replacements. The Highway Plan must be

Sample Letter – County Greeting Letter page 2 - Exhibit 9106-B

submitted to the legislature for approval. Once a county owned bridge is accepted into the Highway Plan the bridge owner must remain in compliance. Otherwise the designated funds will be withheld from the bridge replacement project.

KYTC believes in developing and maintaining a good working relationship with bridge owners. When a bridge requires a posted weight limit or a bridge closure KYTC will send a certified letter to the owner stating the required action. KYTC will follow this with a phone call, which may include an invitation to visit the bridge to point out KYTC's concerns. The bridge owner will then have 30 days to make the needed repairs or post the bridge or close the bridge. If the required action is not completed within 30 days the bridge owner is considered not in compliance and the project is ineligible for federal bridge replacement funds.

KYTC's goal is to ensure a safe roadway network. To accomplish this it is vital to have the cooperation of the bridge owners. We look forward to working with you and your staff.

Sincerely,

Bridge Engineer's Name, P.E.
District _ Structures Section Supervisor

Sample Form - Fracture Critical Inspection Access Procedures Exhibit 9107

STRUCTURE ID: ____________ COUNTY: ____________

Kentucky Transportation Cabinet

Fracture Critical Inspection Access Procedures

- ☐ Rope Access
- ☐ Snooper
- ☐ Work Platform
- ☐ Traffic Control
- ☐ Ladder
- ☐ Walk Under
- ☐ Man lift
- ☐ Bucket Truck

Minimum Number of Inspectors Required: ____________

Notes/ Special Details:

Sample Form – Posting Compliance page 1 – Exhibit 9108

STATEMENT OF COMPLIANCE WITH
NATIONAL BRIDGE INSPECTION STANDARDS
BRIDGE POSTING REQUIREMENTS

______________________ COUNTY or CITY

This certifies that ______________________ County or City has posted ALL County- or City-maintained bridge structures with safe load capacities of less than 40 tons in accordance with the National Bridge Inspection Standards.

____
COUNTY JUDGE/EXECUTIVE or MAYOR

____
DATE

All County- or City-maintained bridge structures with safe load capacity ratings of less than 40 tons, in ____________________ County or City have been posted as required by the National Bridge Inspection Standards.

____________________________________ ____________________________
DISTRICT BRIDGE ENGINEER DATE

____________________________________ ____________________________
CHIEF DISTRICT ENGINEER DATE

DISTRICT ____

Sample Form – Posting Compliance page 2 – Exhibit 9108

STATEMENT OF COMPLIANCE WITH
NATIONAL BRIDGE INSPECTION STANDARDS
BRIDGE POSTING REQUIREMENTS

Posting Compliance for County/City Without Structures Which Require Posting

COUNTY _____________

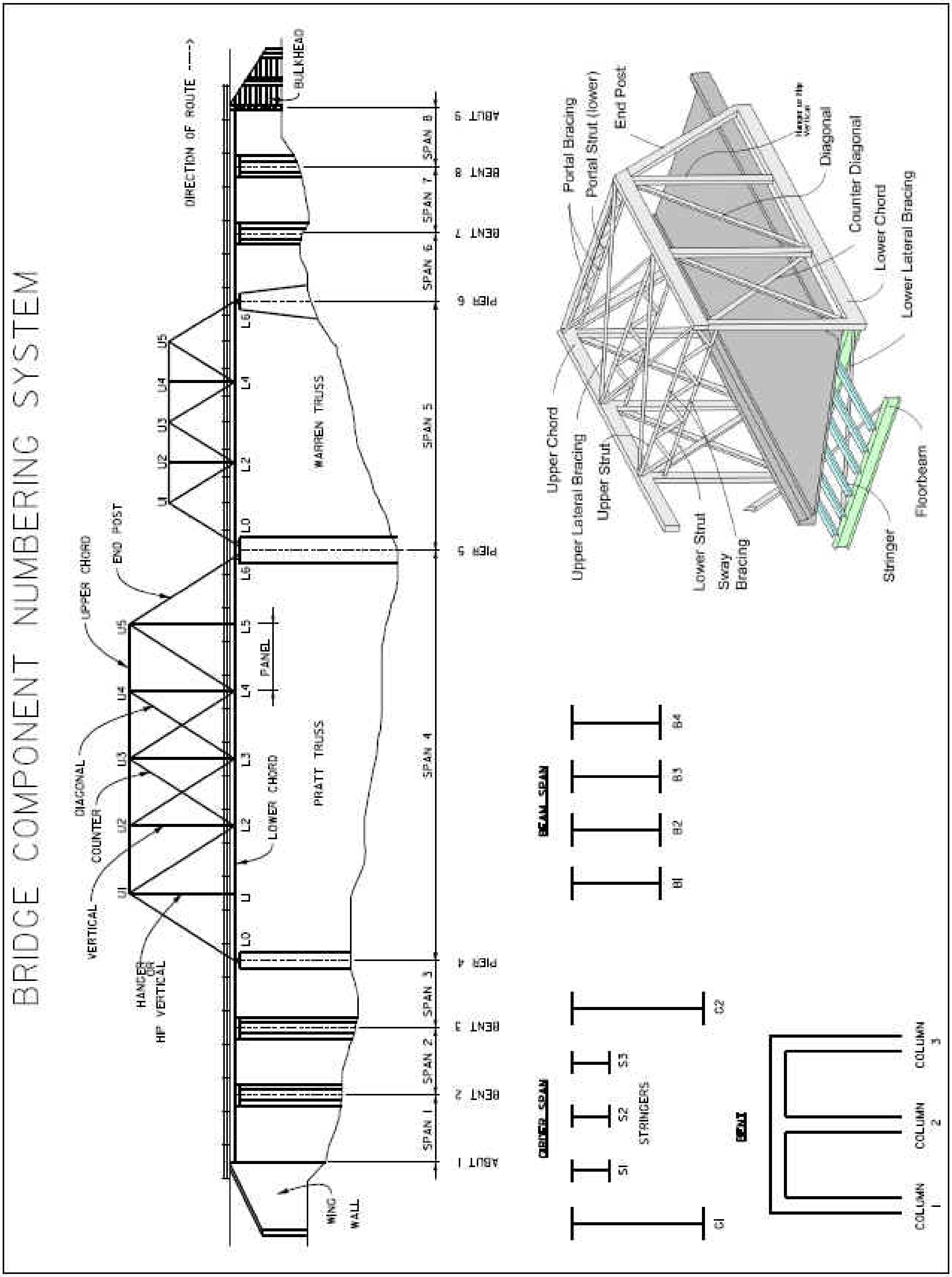
OR CITY _____________

This certifies that as of_ *add date*, _____________County/City has no structures which require posting in accordance with the National Bridge Inspection Standards.

___________________________________	___________________________
DISTRICT BRIDGE ENGINEER	DATE
___________________________________	___________________________
CHIEF DISTRICT ENGINEER	DATE

DISTRICT ____

Numbering of Bridge Components **Exhibit 9201**



Categorization for Prioritizing In-Depth Inspection Exhibit 9301

CATEGORIES AND RECOMMENDED INTERVALS			
CATEGORY	**DESCRIPTION**	**TYPE INSPECTION**	**FREQUENCY**
A	Major Trusses, Suspension Bridges, Tied Arches and Complex Structures	In-Depth	120 months
		Fracture Critical	24 months
		Routine	24 months
B.1	Non-Redundant Girder Systems		
	A. Welded Plate Girder	In-Depth	72-96 months
		Fracture Critical	24 months
		Routine	24 months
	B. Riveted Plate Girder	In-Depth	120 months
		Fracture Critical	24 months
		Routine	24 months
B.2	All Trusses up to 360'	In-Depth	96 months
		Fracture Critical	24 months
		Routine	24 months
B.3	Redundant Continuous Steel Girder/Beam Systems	In-Depth	72-96 months
		Routine	24 months
B.4	Redundant Simple Steel Girder/Beam Systems	In-Depth	72-96 months
		Routine	24 months
B.5	All Timber Superstructures and Substructures	In-Depth	24 months
		Routine	24 months
B.6	Prestressed Concrete Box Beams (side by side; top flange acting as deck)	In-Depth	*
		Routine	24 months
		*Dependent on Trucking Classification of Roadway	
B.7	Prestressed Concrete Box Beams (side by side or spread with reinforced concrete deck)	Extended Wt. Coal	12-24 months
		AAA	24 months
		AA	48 months
		A and County	72 months
B.8	Prestressed Concrete I-Beams	In-Depth	*
		Routine	24 months
		*Dependent on Trucking Classification of Roadway	
		Extended Wt. Coal	72 months
		AAA	72-96 months
		AA	96 months
		A and County	120+ months
B.9	All other Concrete Structures	In-Depth	N/A
		Routine	24 months

Equipment List for Bridge Inspections page 1 - Exhibit 9302

The following items are basic tools that each inspection team shall have available for use at all times:

	TOOL	PURPOSE
CLEANING	Wisk Broom	Used for removing loose dirt and debris
	Wire Brush	Used for removing loose paint and corrosion from steel elements
	Flat Bladed Screwdriver	Used for general cleaning and probing
	Hand Shovel	Used for removing dirt and debris from bearing areas
	Machete or Brush Axe	Used to clear vegetation to gain access to inspect the bridge.
INSPECTION	Pocket Knife	Used for general cutting and probing
	Chipping Hammer	Used for sounding concrete and timber members. Also used on steel members to loosen corrosion and check fasteners.
	Plumb Bob, Level and Tape Measure	Used for checking vertical alignment
	Measuring Rod, Waders, Sounding Rods and Weighted Line	Used for vertical clearance measurement, to probe for scour and to measure stream channel profiles.
	Chain Drags	Used for checking concrete decks for delamination
VISUAL AID	Binoculars	Used to preview areas prior to inspection and for examination of bridge elements at a distance.
	Flashlight	Used to light darkened areas for improved visual inspection.
	Magnifying Glass	Used for close examination of cracks and areas prone to cracking
	Hand Mirror	Used to view and inspect areas that cannot be reached by direct visual inspection.
MEASURING	6 Ft. Pocket Tape	Used to measure defects and element and joint dimensions.
	100 Ft. Tape	Used for measuring distances and larger bridge dimensions.
	Calipers	Used to measure section thickness and/or loss of section of steel elements.
	Thermometer	Used to measure air temperature at the time of the bridge inspection.
	4 Ft. Carpenter’s level	Used to measure approach pavement settlement and general plumb of bridge elements.
	Distometer	Used to measure distances that aren’t within arm’s reach with a laser.

Equipment List for Bridge Inspections page 2 - Exhibit 9302

	TOOL	PURPOSE
DOCUMEN-TATION	Inspection Forms, clipboard, pencils	Used for recording inspection results.
	Straight edge or ruler	Used for drawing sketches and straight lines.
	Digital Camera	Used to document the bridge via photographs.
	Chalk, Markers, Spray Paint with Letter Templates	Used to mark the bridge with ID Number and to apply reference marks.
MISCELLANEOUS	Penetrating Oil (WD-40, etc.)	Aids removal of fasteners, lock nuts, pin caps when necessary for inspection.
	First Aid Kit	Used to apply first aid as necessary for cuts, scrapes, stings, etc.
	*Safety Helmets, Safety Vests, Safety Glasses	Safety equipment used to protect the bridge inspector.
	Ladder	Used to gain access to high areas so that they can be properly inspected.

*Safety Helmets shall be used during all rope access and snooper bucket activity.

In addition to the above basic equipment, the inspection team shall have access to other special equipment that may be used as necessary. This equipment need not be carried to every inspection site but rather shall be available to the inspection team from the district inspection office or regional office. This special equipment is listed below:

	TOOL	PURPOSE
SPECIAL PURPOSE EQUIPMENT	Reach All, Bucket Truck	Used to inspect large, high structures
	Traffic Control Equipment	Used on high traffic bridges to protect the inspection team during the inspection.
	Boat with motor and life vests	Used to inspect structures over larger streams with deep water
	Sonar Depth Finder	Used to measure extent of scour area.
	Increment borer, Timber decay detecting drill	Used to probe timber members for suspected areas of decay.
	Survey Equipment (Transit, etc.)	Used on larger structures with areas of suspected scour to establish groundline profiles and elevations.
	Ropes, harness and climbing equipment	Used to gain access to the bridge for inspection.
	Dye Penetrant	Used to identify the extent of cracks in steel members.
	Underwater Video Camera with telescoping rod	Used to conduct a visual examination of underwater bridge elements as part of an underwater inspection.

Consultant Bridge Inspection Field Review Report Exhibit 9303

Consultant Bridge Inspection Field Review Report: TC 71-132 **MAIN-9009**

KENTUCKY TRANSPORTATION CABINET
Division of Maintenance

TC 71-132E
07/2008

CONSULTANT BRIDGE INSPECTION FIELD REVIEW REPORT

Project ______________________________

Consultant ______________________

Date __________ Time (on job) __________ Time (off job) __________ ___ ET ___ CT

Weather Conditions ______________________________

TRAFFIC CONTROL

Standard Drawing Number ____________________

Are signs in place, properly spaced, and in good condition? ___ Yes ___ No

Is cone taper correct and flagman/arrow being used properly? (When guard rail tapers into bridge end and arrow is used, cone taper should be completed 250 feet before bridge end.) ___ Yes ___ No

Comments

INSPECTION TEAM

Name ____________________ Number ____________________
Chief Inspector (on job) Crew Members (on job)

GENERAL COMMENTS

Describe inspection work, equipment, and progress.

Name ____________________
Reviewer

CBMNIR, TC 71-5 Exhibit 9305

Kentucky Transportation Cabinet
Department of Highways
Division of Maintenance

Rev. 11/24/2014

CRITICAL BRIDGE MAINTENANCE NEEDS INSPECTION REPORT

Bridge ID: ____________ **Inspector:** ____________ **Date:** ____________

Mile point: ____________ **Long/Lat:** ____________

A CRITICAL BRIDGE MAINTENANCE NEED is "Any existing localized condition which immediately threatens the structural integrity of a structure to the extent that load restrictions or closure is warranted; or any condition which immediately threatens the traveling public's safety".

CODE	DESCRIPTION OF CRITICAL ITEM	RECOMMENDED MAINTENANCE ACTION	DATE COMPLETED
1	Cracks, severe section loss, or other defect in load-carrying member .		
2	Loss of load bearing capability due to loss of bearing support, severe misalignment of bearing devices, or settlement of substructure units		
3	Scour or undermining of substructure foundations		
4	Impact damage to structural members		
5	Severe drift accumulation		
6	Severe misalignment of structural members		
7	**Severe** impact due to differences in elevation between approach roadway		
8	Severe deck drainage deficiencies (hydroplaning probable)		
9	Loose expansion devices		
99	Other (explain):		

COMMENTS:

District Bridge Engineer Signature/ Date

INSTRUCTIONS

- The Inspector identifies the critical problem by circling the appropriate code.
- The Bridge Engineer reviews for concurrence and enters the code for Recommended Maintenance Action.
- Send signed, scanned copy to Central Office (D. Steele, J. Rogers, R. Rogers and A. Irish) immediately.
- Upload electronic copy to Media Tab.

RECOMMENDED MAINTENANCE ACTIONS
1 - Schedule State Forces repair
2 - Schedule Contract repair
3 - Reduce load capacity
4 - Monitor closely
5 - Close Structure
6 - Notify Owner of Non-state owned bridge

NOTE: Corresponding NBI Inspection Report items must be rated a "3" or less OR; Element level condition rating assigned to lowest condition rating for codes 1, 2, 4 and 6; and NBI rating of 4 or less OR; Element level in condition state 4 for codes 3 and 5.

Contract Bridge Inspection – Performance Evaluation Exhibit 9306

Kentucky Transportation Cabinet
Department of Highways
Division of Maintenance
CONTRACT BRIDGE INSPECTION - PERFORMANCE EVALUATION

Name and Address of Contractor:	Contract Number:

Office Responsible for

Administrator of Contract	Person responsible for work Assignment/Project Manager:

Contract Data

Assignment Date:	Number of Inspections assigned:	Number of inspections completed:	Completion Date:

Man Hours

Estimated Hours Negotiated:	Actual Hours Billed:

PERFORMANCE

EXCELLENT (4)	GOOD (3)	FAIR (2)	POOR (1)	POINTS
MANAGEMENT				
☐ Aware of all activities, equipped team well, and always cooperative.	☐ Aware of most activities, equipped team adequately, and/or usually cooperative.	☐ Unaware of many activities, some team needs unmet, and/or often uncooperative.	☐ Unaware of most activities, team inadequately equipped, and/or very uncooperative.	
INSPECTION TEAM				
☐ Very knowledgeable of NBIS and KYTC inspection procedure	☐ Adequately knowledgeable of NBIS and KYTC inspection procedure	☐ Occasional conflict with NBIS or KYTC procedure resulting in improper/rejected reports	☐ Frequent conflict with NBIS or KYTC procedure resulting in improper/rejected reports	
TIMELINESS OF REPORTING				
☐ Report pdi always submitted within week of inspections	☐ Report pdi usually submitted within week of inspections, no submittals beyond 30 day limit	☐ Report pdi seldom submitted within week of inspections, no submittals beyond 30 day limit	☐ Report pdi never submitted within week of inspections, or submittal beyond 30 day limit	
REPORT QUALITY				
☐ All reports complete and accurate, with excellent notes and pictures in proper format	☐ Reports complete and accurate, occasional vague notes; adequate pictures in proper format	☐ Frequent vague notes; inadequate pictures in proper format, to document deficiencies	☐ Frequent vague notes or inadequate pictures to document deficiencies, pictures not in proper format	
NEGOTIATION/BILLING				
☐ Good faith estimates were easlily agreed upon and actual hours billed were at or below estimates	☐ Good faith estimates were agreed upon with reasonable negotiation, or actual hours billed were at or slightly above	☐ Good faith estimates were agreed upon with labored negotiation, or actual billed hours reasonably higher than	☐ Good faith estimates could not be agreed upon without third party intervention, or actual billed hours unexpectedly higher	
COMMUNICATION				
☐ Severe deficiencies found or inspection concerns immediately reported to District Bridge Engineer	☐ Severe deficiencies found or inspection concerns reported to District Bridge Engineer in timely manner	☐ Timeliness of reporting severe deficiencies found or inspection concerns to District Bridge Engineer needs improving	☐ Severe deficiencies found or inspection concern were not reported to District Bridge Engineer	
			Total Rating Points =	

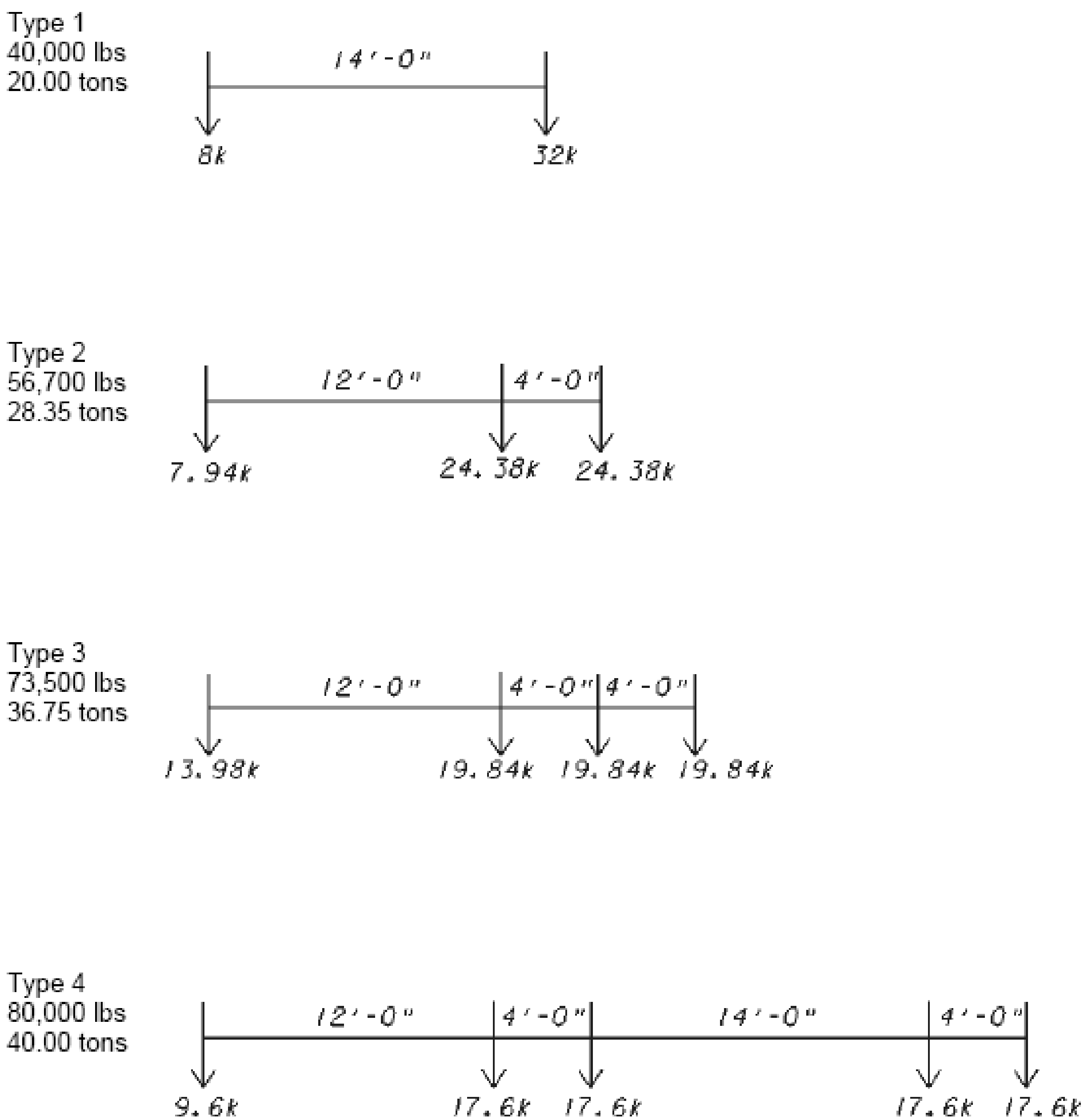
COMMENTS

RATED BY NAME AND TITLE

SIGNATURE & DATE

Analysis Trucks, KYTC Truck Types 1-4 page 1 - Exhibit 9402

LARS STANDARD TRUCKS*



*Trucks 1, 2, 3 and 4 describe Kentucky's load rating trucks and are built into the LARS/Bridge Modeler Program

Analysis Trucks, AASHTO H Trucks page 2 - Exhibit 9402

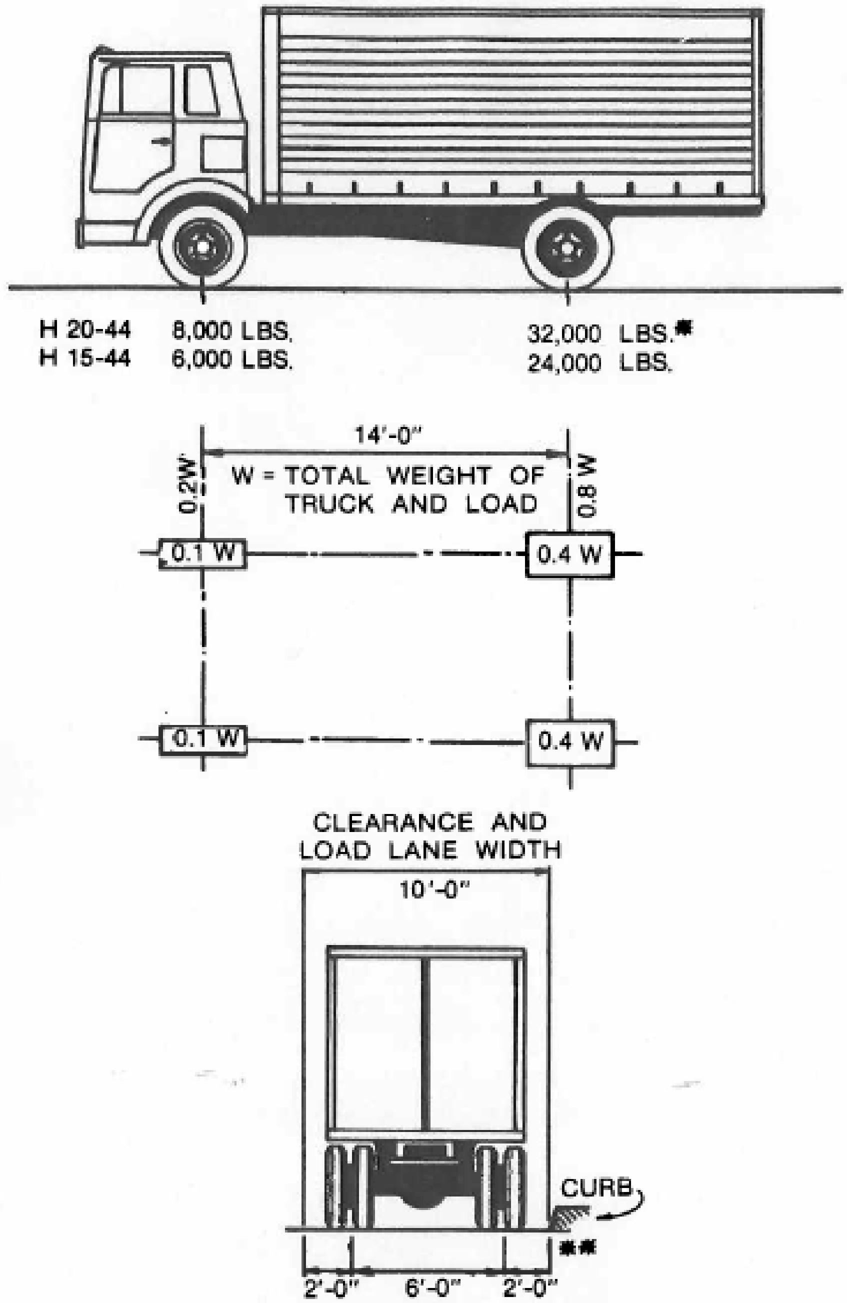


FIGURE 3.7.6A Standard H Trucks

*In the design of timber floors and orthotropic steel decks (excluding transverse beams) for H 20 Loading, one axle load of 24,000 pounds or two axle loads of 16,000 pounds each spaced 4 feet apart may be used, whichever produces the greater stress, instead of the 32,000-pound axle shown.

**For slab design, the center line of wheels shall be assumed to be 1 foot from face of curb. (See Article 3.24.2.)

Analysis Trucks, AASHTO HS Trucks page 3 - Exhibit 9402

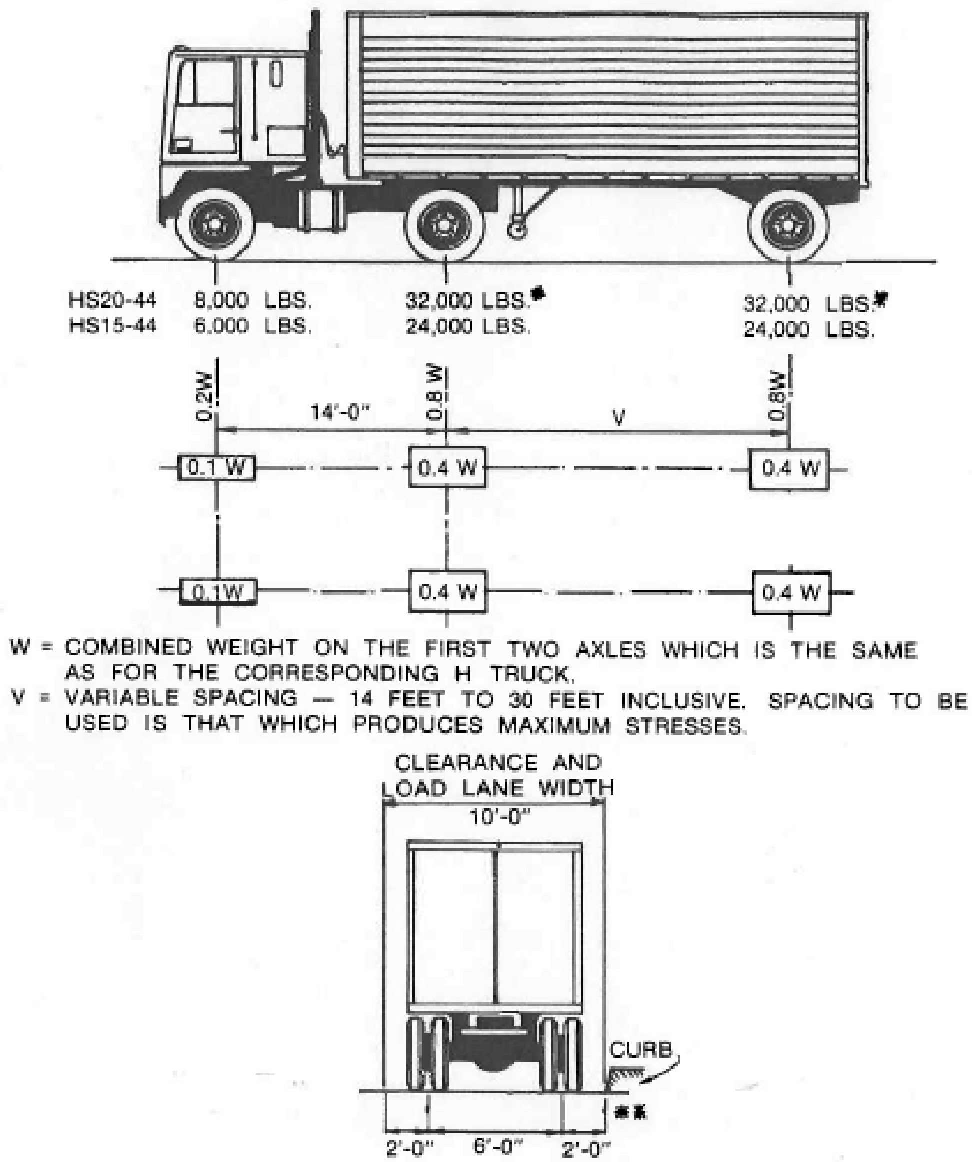


FIGURE 3.7.7A Standard HS Trucks

*In the design of timber floors and orthotropic steel decks (excluding transverse beams) for H 20 Loading, one axle load of 24,000 pounds or two axle loads of 16,000 pounds each, spaced 4 feet apart may be used, whichever produces the greater stress, instead of the 32,000-pound axle shown.

**For slab design, the center line of wheels shall be assumed to be 1 foot from face of curb. (See Article 3.24.2.)

Analysis Trucks, AASHTO SU4-SU7 Trucks page 4 - Exhibit 9402

+

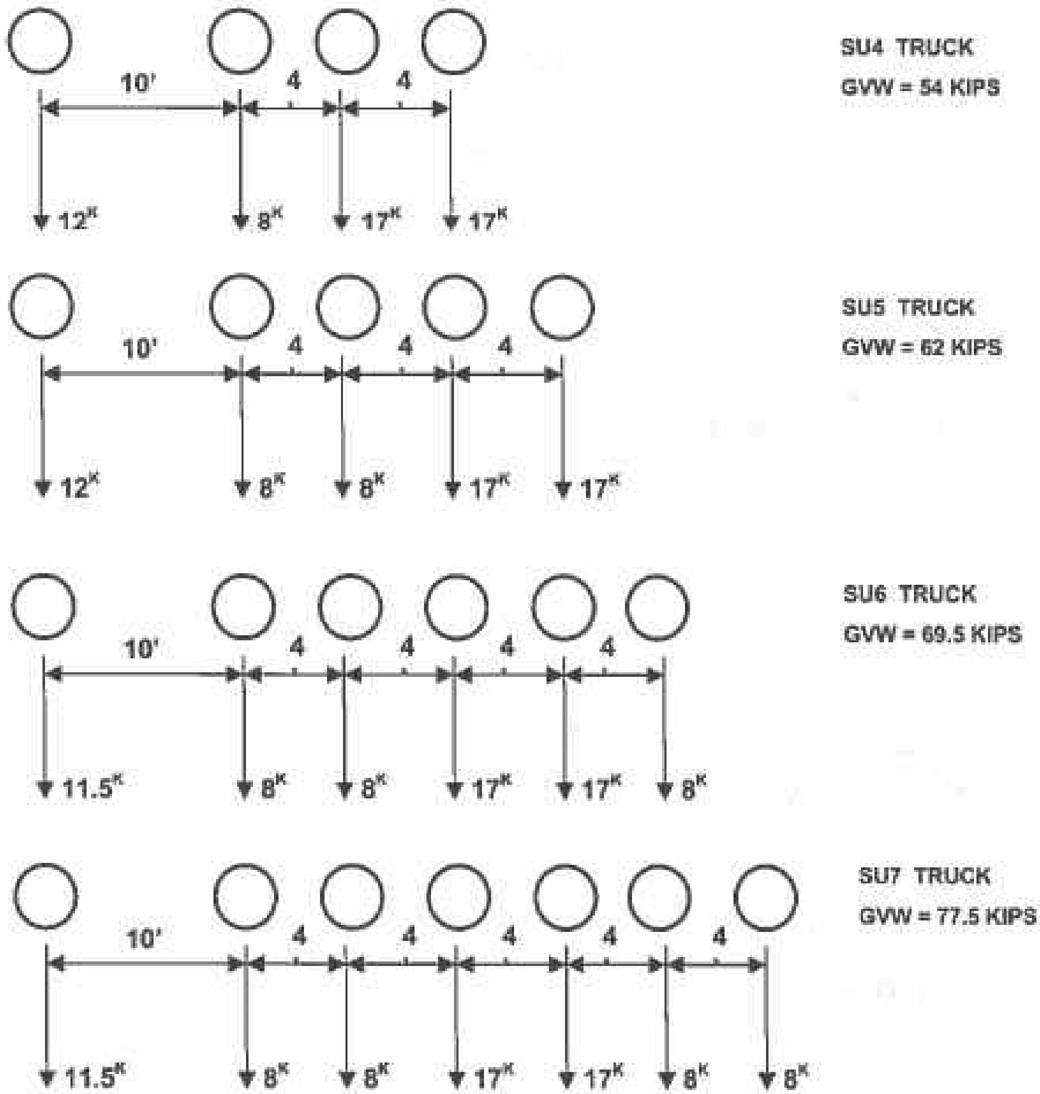
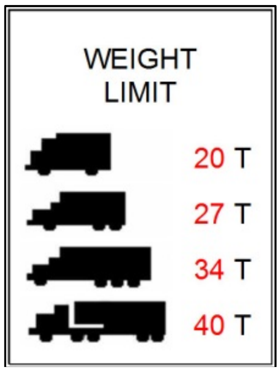
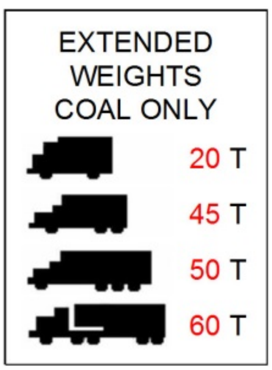
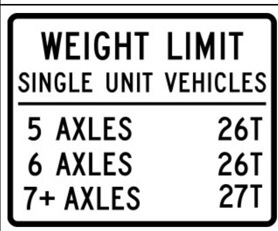


Figure 6B.9.2-2—Bridge Posting Loads for Single Unit Trucks that Meet Formula B

Analysis Trucks, KYTC Annual Permits page 5 - Exhibit 9402

in development

Posting Sign Types **Exhibit 9403**

R12-1		The Weight Limit sign carrying the legend: WEIGHT LIMIT XX TONS may be used to indicate vehicle weight restrictions including load.
R12-5		Posting of specific load limits may be accomplished by use of the Weight Limit symbol sign. A sign containing the legend WEIGHT LIMIT on the top two lines, and showing 4 different truck symbols and their respective weight limits for which restrictions apply may be used, with the weight limits shown to the right of each symbol as XX T.
R12-5		Use this sign to post a bridge with a load carrying capacity equal to greater than the legal load limits for the Trucking Highway as designated by A, AA, AAA or C <u>but less than</u> or equal to the legal loads for Extended Weight vehicles.
R12-4		Use this sign to post a bridge for SU5, SU6 and/or SU7.
R12-4		Use this sign to restrict Annual Permit holders from legally crossing the bridge. in development

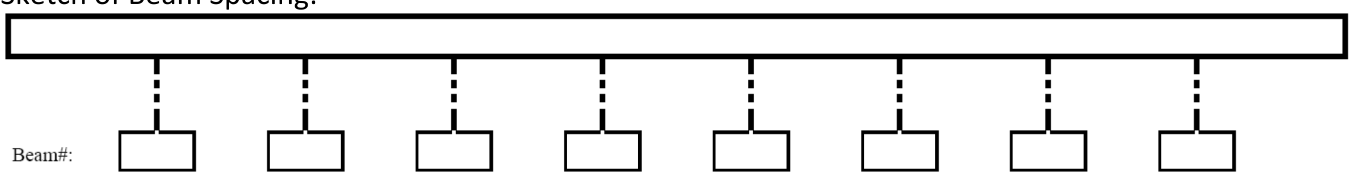
Bridge Information Sheet – Steel or Timber Beams — Exhibit 9405

Date:______________________ Bridge #:___________________

Deck Type:
Thickness:
Asphalt Surface: Y or N
Thickness:
Deck Width (Curb to Curb):
Runners:
Curb Dimensions:
Posted for Weight Limits: Y or N
Guardrail: Y or N

Curb Sketch and Extra Notes:

Superstructure:
Number of Beams:
Sketch of Beam Spacing:

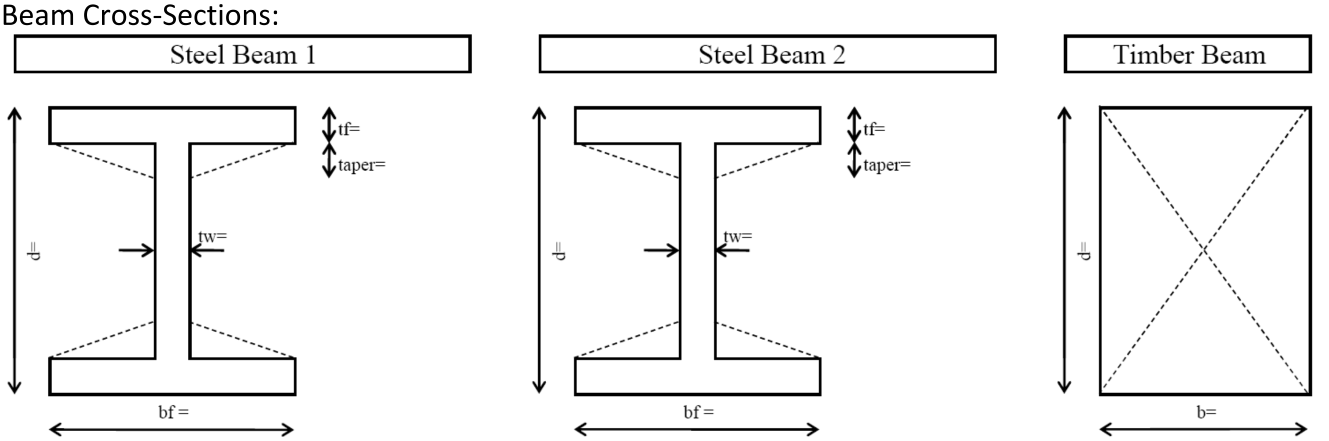


Beam Length for each span: Out to Out:
Clear:
C-C Bearing:

F_Y:
Are flanges tapered: Y or N
Are beams stamped: Y or N
Are there any nailers: Y or N

Lateral Bracing: Y or N
Location: Top Bottom
Size:
Type:

Beam Cross-Sections:



Bridge Information Sheet – Multi-Box Beams (PCDU) Exhibit 9406

Date:______________________ Bridge #:___________________

Deck Information:

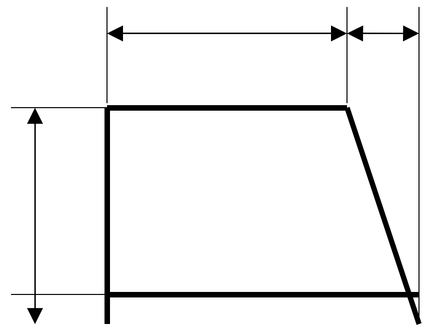
Asphalt Surface: Y or N
Thickness:

Curb: Y or N
Dimensions:

Posted for Weight Limits: Y or N
Limits:

Guardrail: Y or N

Curb Sketch:



Superstructure:

Number of Beams:

Beam Width =

Beam Depth =

Beam Length for each span:
Out to Out =
Clear =
C-C Bearing =

Lateral tensioning rods in place: Y or N

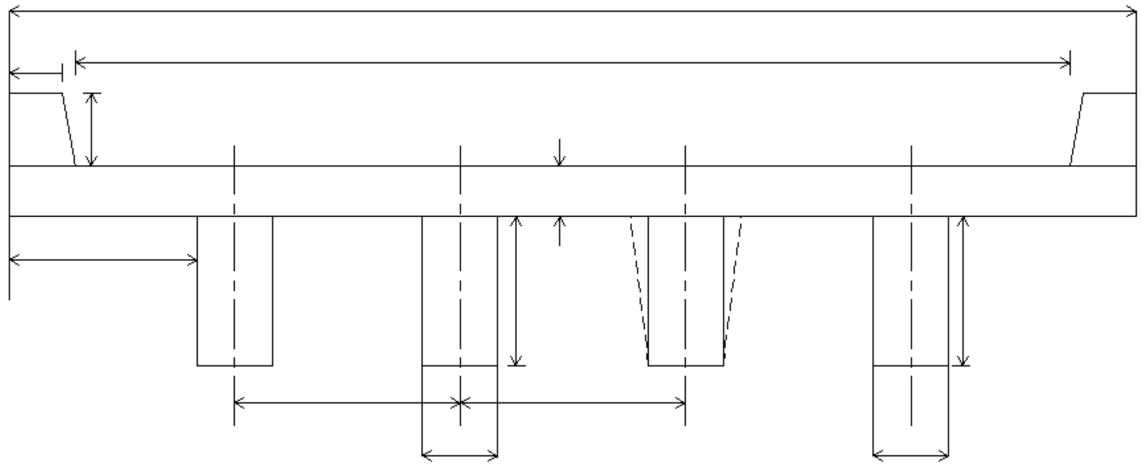
Stamp on fascia beam or wingwall: Y or N
What is stamped:

Any notable defects in beams or substructure: Y or N
List defects:

Extra Notes:

Bridge Information Sheet – Reinf. Concrete T-Beams (RCDG) Exhibit 9407

Date:______________________ Bridge #:___________________



Deck Information:

Asphalt Surface: Y or N
Thickness:

Posted for Weight Limits: Y or N
Limits:

Guardrail: Y or N

Superstructure:

Number of Beams:

Are the beams tapered?

Beam Length for each span:
Out to Out =
Clear =
C-C Bearing =

Stamp on fascia beam or wingwall: Y or N
What is stamped?

Is the bridge skewed?

Extra Notes/Drawings:

Scour Risk Calculation Field Sheet page 1 - Exhibit 9501

SCOUR RISK CALCULATION FIELD SHEET

BRIDGE ID: ________________________ DATE: __________________

BRIDGE INFORMATION

LOCAL MAX SCOUR: ________ FEET APROX. SKEW TO FLOW: ________ DEGREES
CONTRACTION SCOUR: Y N % DEBRIS BLOCKAGE: ________ %

CHANNEL INFORMATION

MIGRATION: Y N
BED MATERIAL: SILT SAND GRAVEL CLAY COBBLE BEDROCK

CHANNEL EROSION/PROTECTION INFORMATION

UPSTREAM LEFT

EVIDENCE OF EROSION: Y N

VEGATATIVE COVER: ________ %

EROSION CONTROL SYSTEM:
N/A GOOD FAIR POOR

SINUOSITY RATING: STRAIGHT
SINUOUS
MEANDERING
HIGHLY MEANDERING

UPSTREAM RIGHT

EVIDENCE OF EROSION: Y N

VEGATATIVE COVER: ________ %

EROSION CONTROL SYSTEM:
N/A GOOD FAIR POOR

SINUOSITY RATING: STRAIGHT
SINUOUS
MEANDERING
HIGHLY MEANDERING

BRIDGE REACH LEFT

EVIDENCE OF EROSION: Y N

VEGATATIVE COVER: ________ %

EROSION CONTROL SYSTEM:
N/A GOOD FAIR POOR

SINUOSITY RATING: STRAIGHT
SINUOUS
MEANDERING
HIGHLY MEANDERING

BRIDGE REACH RIGHT

EVIDENCE OF EROSION: Y N

VEGATATIVE COVER: ________ %

EROSION CONTROL SYSTEM:
N/A GOOD FAIR POOR

SINUOSITY RATING: STRAIGHT
SINUOUS
MEANDERING
HIGHLY MEANDERING

Scour Risk Calculation Field Sheet page 2 - Exhibit 9501

SCOUR RISK CALCULATION FIELD SHEET

BRIDGE ID: ____________________ DATE: ________________

FLOODPLAIN INFORMATION

UPSTREAM LEFT FLOODPLAIN

EVIDENCE OF OVER-TOPPING: Y N

LATERAL/TRIBUTARY INFLOW: Y N

VEGETATIVE COVER: WOODS OR BRUSH
GRASS
BARE, ROW CROPS, PAVED OR OTHER

OBSTRUCTIONS PRESENT: Y N

FLOODPLAIN: LITTLE/NONE
NARROW
WIDE

NATURAL LEVEE: Y N

APPARENT INCISION: Y N

UPSTREAM RIGHT FLOODPLAIN

EVIDENCE OF OVER-TOPPING: Y N

LATERAL/TRIBUTARY INFLOW: Y N

VEGETATIVE COVER: WOODS OR BRUSH
GRASS
BARE, ROW CROPS, PAVED OR OTHER

OBSTRUCTIONS PRESENT: Y N

FLOODPLAIN: LITTLE/NONE
NARROW
WIDE

NATURAL LEVEE: Y N

APPARENT INCISION: Y N

INSPECTOR INFORMATION

RISK OPINION: UNKNOWN LOW MEDIUM HIGH NEEDS ATTENTION

INSPECTOR NAME: ______________________________

Scour Risk Calculation Excel Sheet page 1 - Exhibit 9502

Scour Risk Assessment		
Factors	**Individual Score**	**Total Score**
a. Element Skew to Flow	20	70
b. Local Scour	1	40
c.Debris	10	80
d. Channel Erosion/Protection		36
Bank Erosion	1	
Vegetative Cover	2	
Erosion Control Condition	2	
Sinuosity	1	
e. Contraction Scour	50	50
f. Channel Migration	0	0
g. Flood Plan Descriptions		44
Evidence of Flow	12	
Lateral Inflow	12	
Vegetative Cover	2	
Obstructions Present	4	
Floodplain Width	2	
Natural Levees	2	
Incision	2	
h. Bed Material	2	20
		340 High Risk

Scour Critical Bridge – Plan of Action page 1 - Exhibit 9503

SCOUR CRITICAL BRIDGE - PLAN OF ACTION

1. GENERAL INFORMATION

Structure number: _____	City, County, State: _____	Waterway: _____
Structure name: _____	State highway or facility carried: _____	Owner: _____
Year built: _____	Year rebuilt: _____	Bridge replacement plans (if scheduled): _____ Anticipated opening date: _____

Structure type: ☐ Bridge ☐ Culvert
Structure size and description: _____

Foundations: ☐ Known, type: _____ Depth: _____ ☐ Unknown

Subsurface soil information (*check all that apply*): ☐ Non-cohesive ☐ Cohesive ☐ Rock

Bridge ADT: _____	Year/ADT: _____	% Trucks: _____

Does the bridge provide service to emergency facilities and/or an evacuation route (Y/N)? ____
If so, describe: _____

2. RESPONSIBILITY FOR POA

Author(s) of POA (name, title, agency/organization, telephone, pager, email):
____

Date: _____

Concurrences on POA (name, title, agency/organization, telephone, pager, email):
____

POA updated by (name, title, agency, organization): _____ Date of update: ___
Items update: _____

POA to be updated every _____ months by (name, title, agency/organization):_____
Date of next update:_____

3. SCOUR VULNERABILITY

a. Current Item 113 Code: ☐ 3 ☐ 2 ☐ 1 Other: _____

b. Source of Scour Critical Code: ☐ Observed ☐ Assessment ☐ Calculated Other: _____

c. Scour Evaluation Summary: _____

d. Scour History: _____

Scour Critical Bridge – Plan of Action page 2 - Exhibit 9503

4. RECOMMENDED ACTION(S) (see Sections 6 and 7)

	Recommended		Implemented	
a. Increased Inspection Frequency	☐ Yes	☐ No	☐ Yes	☐ No
b. Fixed Monitoring Device(s)	☐ Yes	☐ No	☐ Yes	☐ No
c. Flood Monitoring Program	☐ Yes	☐ No	☐ Yes	☐ No
d. Hydraulic/Structural Countermeasures	☐ Yes	☐ No	☐ Yes	☐ No

5. NBI CODING INFORMATION

		Current	Previous
Inspection date			
Item 113	Scour Critical		
Item 60	Substructure		
Item 61	Channel & Channel Protection		
Item 71	Waterway Adequacy		
Comments: (drift, scour holes, etc. - depict in sketches in Section 10)		____	____

6. MONITORING PROGRAM

☐ **Regular Inspection Program** ☐ w/surveyed cross sections
Items to Watch: _____

☐ **Increased Inspection Frequency of __ mo.** ☐ w/surveyed cross sections
Items to Watch: _____

☐ **Underwater Inspection Required**
Items to Watch: _____

☐ **Increased Underwater Inspection Frequency of __ mo.**
Items to Watch: _____

☐ **Fixed Monitoring Device(s)**
Type of Instrument: _____
Installation location(s): _____
Sample Interval: ☐ 30 min. ☐ 1 hr. ☐ 6 hrs. ☐ 12 hrs. ☐ Other: _____
Frequency of data download and review: ☐ Daily ☐ Weekly ☐ Monthly ☐ Other _____
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevations(s) for each pier/abutment:_____
Survey ties: _____
Criteria of termination for fixed monitoring: _____

Scour Critical Bridge – Plan of Action page 3 - Exhibit 9503

☐ **Flood Monitoring Program**
Type: ☐ Visual inspection
☐ Instrument (*check all that apply*):
☐ Portable ☐ Geophysical ☐ Sonar ☐ Other: _____
Flood monitoring required: ☐ Yes ☐ No
Flood monitoring event defined by (*check all that apply*):
☐ Discharge _____ ☐ Stage _____
☐ Elev. measured from _____ ☐ Rainfall _____ (in/mm) per _____ (hour)
☐ Flood forecasting information: _____
☐ Flood warning system: _____
Frequency of flood monitoring: ☐1 hr. ☐3 hrs. ☐6 hrs. ☐ Other: _____
Post-flood monitoring required: ☐ No ☐Yes, within _____ days
Frequency of post-flood monitoring: ☐Daily ☐Weekly ☐Monthly ☐Other: _____
Criteria for termination of flood monitoring: _____
Criteria for termination of post-flood monitoring: _____
Scour alert elevation(s) for each pier/abutment: _____
Scour critical elevation(s) for each pier/abutment: _____

Note: Additional details for action(s) required may be included in Section 8.
Action(s) required if scour alert elevation detected (*include notification and closure procedures*): _____
Action(s) required if scour critical elevation detected (*include notification and closure procedures*): _____

Agency and department responsible for monitoring: _____

Contact person (*include name, title, telephone, pager, e-mail*): _____

7. COUNTERMEASURE RECOMMENDATIONS

Prioritize alternatives below. Include information on any hydraulic, structural or monitoring countermeasures.

☐ **Only monitoring required (see Section 6 and Section 10 – Attachment F)**
Estimated cost $_____

☐ **Structural/hydraulic countermeasures considered (see Section 10, Attachment F):**

Priority Ranking	Estimated cost
(1) _____	$ _____
(2) _____	$ _____
(3) _____	$ _____
(4) _____	$ _____
(5) _____	$ _____

Basis for the selection of the preferred scour countermeasure: _____

Countermeasure implementation project type:
☐ Proposed Construction Project ☐ Maintenance Project
☐ Programmed Construction - Project Lead Agency:
☐ Bridge Bureau ☐ Road Design ☐ Other _____

Agency and department responsible for countermeasure program (if different from Section 6 contact for monitoring): _____

Scour Critical Bridge – Plan of Action page 4 - Exhibit 9503

Contact person (*include name, title, telephone, pager, e-mail*): _____

Target design completion date: _____

Target construction completion date: _____

Countermeasures already completed: _____

8. BRIDGE CLOSURE PLAN

Scour monitoring criteria for consideration of bridge closure:

- ☐ Water surface elevation reaches _____ at _____
- ☐ Overtopping road or structure
- ☐ Scour measurement results / Monitoring device (See Section 6)
- ☐ Observed structure movement / Settlement
- ☐ Discharge: _____ cfs/cms
- ☐ Flood forecast: _____
- ☐ Other: ☐ Debris accumulation ☐ Movement of riprap/other armor protection
  ☐ Loss of road embankment

Emergency repair plans (*include source(s), contact(s), cost, installation directions*): _____

Agency and department responsible for closure: _____

Contact persons (name, title, agency/organization, telephone, pager, email): _____

Criteria for re-opening the bridge: _____

Agency and person responsible for re-opening the bridge after inspection: _____

9. DETOUR ROUTE

Detour route description (route number, from/to, distance from bridge, etc.) - Include map in Section 10, Attachment E.

Bridges on Detour Route:

Bridge Number	Waterway	Sufficiency Rating/ Load Limitations	Item 113 Code

Traffic control equipment (detour signing and barriers) and location(s): _____

Additional considerations or critical issues (susceptibility to overtopping, limited waterway adequacy, lane restrictions, etc.) : _____

Scour Critical Bridge – Plan of Action page 5 - Exhibit 9503

News release, other public notice (include authorized person(s), information to be provided and limitations): _____

10. ATTACHMENTS

Please indicate which materials are being submitted with this POA:

- ☐ Attachment A: Boring logs and/or other subsurface information
- ☐ Attachment B: Cross sections from current and previous inspection reports
- ☐ Attachment C: Bridge elevation showing existing streambed, foundation depth(s) and observed and/or calculated scour depths
- ☐ Attachment D: Plan view showing location of scour holes, debris, etc.
- ☐ Attachment E: Map showing detour route(s)
- ☐ Attachment F: Supporting documentation, calculations, estimates and conceptual designs for scour countermeasures.
- ☐ Attachment G: Photos
- ☐ Attachment H: Other information: _____

Appendix A – Post Earthquake Investigation Field Manual

Published by the Kentucky Transportation Center for KYTC, 2005.

Appendix B – Federal Register

The Federal Highway Administration (FHWA) published in the December 14, 2004, Federal Register, the 2005 final Rule revising the NBIS. It can be found here:
http://www.gpo.gov/fdsys/pkg/FR-2004-12-14/pdf/FR-2004-12-14.pdf

Pages 74419-74436 are the "Final Rule," discussing the rule-making back-story of the Code.
Pages 74436-74439 are the code itself, "Part 650 – Subpart C".

Outline of the Regulation

- Code of Federal Regulations
  - Title 23 – Highways
    - Chapter 1 – FHWA, DOT
      - PART 650—Bridges, Structures, and Hydraulics
        - Subpart C – National Bridge Inspection Standards
          - Section 650.301 Purpose
          - Section 650.303 Applicability
          - Section 650.305 Definitions
          - Section 650.307 Bridge Inspection Organization
          - Section 650.309 Qualifications of Personnel
          - Section 650.311 Inspection Frequency
          - Section 650.313 Inspection Procedures
          - Section 650.315 Inventory
          - Section 650.317 Reference Manuals