

## Chapter 10

# Structure Maintenance Program

### 10.0 Introduction

#### Description

Maintenance plays an essential and integral role in the long-term life of highway structures. Structures left to deteriorate without timely maintenance treatment will likely require more costly treatments sooner than those properly maintained. Structure maintenance can be broken down into two distinct, but equally important categories, preventative maintenance and repair.

Preventative maintenance includes any type of work on a structure that is performed regularly or scheduled on an as needed basis, and that is meant to preserve the structure in as close to the original constructed condition as possible. This type of maintenance is meant to stop or slow down the deterioration of the structure in order to reduce the number of, and increase the time between, major repairs, rehabilitation, or replacement of the structure. Specific types of preventative maintenance may include:

- Cleaning drains, decks, joints, bearings, caps, and girder flanges of dirt, sanding material, and bird droppings.
- Sealing decks
- Removing drift buildup on a pier

Repairs include any type of work on the structure that is meant to maintain or replace the structure's load carrying capacity or to remove a safety hazard. Specific types of repairs may include:

- Replacing damaged bridge rail
- Replacing rotten or broken timber beams and caps
- Repairing vehicular impact damage to beams or columns
- Repairing spalls in bridge decks
- Repairing damaged guard angles or joints in bridge decks

#### Bridge Inspection Program

Bridges are designed and constructed in accordance with MDT and AASHTO specifications. This is accomplished through application of stringent design criteria and construction specifications. Nevertheless, structural elements deteriorate over time and may eventually present a hazard to bridge users. A systematic program of bridge inspection is necessary to detect structural problems and minimize the probability of a structural failure.

At MDT, there are two bridge inspection programs:

1. District bridge inspections that meet the National Bridge Inspection Standards (NBIS). Congress enacted legislation requiring the establishment of national standards. Through the Federal Highway Administration (FHWA), specific criteria known as the NBIS were established.

Inspections meeting the NBIS standards are performed every two years, are very detailed and track deterioration of specific individual elements. The NBIS inspectors must meet certain minimum training and experience requirements before being qualified as an NBIS inspector.

All bridge deficiencies, large or small, discovered during the NBIS inspections are recorded in the inspection comments for each element and in the “Inspection Work Candidates” recommendation (see the MDT Maintenance Bridge Inspection Manual (MBIM) for details on obtaining a comprehensive Work Candidates report for all bridges in a division) section of the inspection report. Also, any serious bridge deficiencies in need of immediate attention are promptly reported directly to the responsible Maintenance Division and the Bridge Maintenance Engineer by the NBIS inspector.

The NBIS reports for each bridge should be reviewed as they are received and any deficiencies should be brought to the attention of the affected section for repair.

2. Inspections performed by MDT Maintenance personnel. These Routine Maintenance Bridge Inspections are an “in-house” MDT program (not federally mandated or funded) and are performed every six months. They are not meant to be very detailed, but to be very quick and simple, focusing only on major bridge components and any major changes in their condition since the last NBIS Inspection. Routine Maintenance Bridge Inspections should include monitoring the following items for deficiencies.
  - Impact damage from vehicle accidents or high loads.
  - Failed, crushed, or cracked timber girders or caps.
  - Any crack in a steel beam or very large cracks in concrete beams.
  - Scouring around piers or abutments.
  - Abnormal looseness or vibrating of trusses.
  - Spalls or deterioration in bridge decks and joints.
  - Material/debris accumulation around piers and abutments
  - Removing trees or brush growing under or close to structures.
  - Plugged or partially plugged deck drains.
  - Damaged or missing bridge rail, curbs, or wingwalls.
  - Loose bolts or other fasteners.
  - Vegetation that limits sight distance.
  - Bearings – material buildup or out of place.

- Cleaning and removal of incompressible material (dirt, sand, etc...) from joints.
- Other items as noted in the MDT Maintenance Bridge Inspection Manual.

Serious deficiencies requiring emergency attention that are discovered during the Maintenance Bridge Inspections (or at any other time) are reported to the Bridge Maintenance Engineer and the District Bridge Inspection Coordinator through the Area office.

See the MBIM for specific information on the Routine Maintenance Bridge Inspections.

### **Purpose**

MDT's goal is to maintain bridges in a manner that provides a safe roadway, preserves and extends the state's investment, maintains the functional condition, and retards future deterioration by providing the appropriate preventative maintenance treatments. The Department's objective is to maintain structures to, as near as possible, the standards to which they were constructed.

### **Timing of Maintenance**

Deficiencies found during inspections (NBIS or Maintenance) should be prioritized and corrected in a timely manner. Assistance from the Bridge Maintenance Engineer is available for prioritizing and planning bridge repairs.

### **Approvals**

A number of environmental and access permits must be addressed and obtained for bridge inspection, maintenance, and/or repairs (i.e. railroads, adjoining landowners, and environmental permits). Because of load carrying capacity, inspection, and accelerated deterioration concerns, only the Bridge Bureau can approve asphalt overlays on structures.

### **Documentation**

Documentation of Maintenance Bridge Inspections should be in accordance with the MDT Maintenance Bridge Inspection Manual. All bridge maintenance, repair, and inspection activities should be in accordance with activity reporting outlined in the Maintenance Management Systems Manual.

### **Resources**

Bridge Inspection Manual  
MDT Maintenance Bridge Inspection Manual

Bridge Inspection Reports  
MDT Environmental Best Practices  
Maintenance Management System Manual

## **10.1 Maintenance and Repair of Structures (MMS 4101-4113)**

### **Activity Description**

This activity is the restoration and/or repair of structures. Maintenance and repair of structures may include, but are not limited to, the following activities:

- Repairing damage or deterioration in various bridge components.
- Removing debris and drift adjacent to piers.
- Cleaning drains, decks, joint, or bearings.
- Cleaning and painting timber bridges rails.
- Tightening or replacing bolts and nuts.
- Repairing concrete bridge deck surface.
- Replacing/repairing joint material and joint headers.
- Repairing or replacing bridge rail, curb, or posts.
- Adjusting the height of a bridge after settlement.
- Repairing and replacing timber girders, caps, decks, and/or piles.
- Repairing vehicle impact damage to beams and columns.

### **Vertical Clearance Signs**

Installing or updating vertical clearance signs is also considered a structure maintenance activity. The updating and placing of vertical clearance signs should be performed in accordance with the Low Clearance Signs on Bridges memo dated June 19, 2009. Vertical clearance data for each structure is available in the NBIS inspection reports.

### **Purpose**

Maintenance of structures is necessary for the public safety, structural integrity, and protection of the state's capital investment.

### **Timing of Maintenance**

With different maintenance and repair strategies required, the timing of individual maintenance tasks varies:

- Cleaning deck drains is performed when temperatures are above freezing, since water is normally used for this work.
- Cleaning of bridge decks is done by pick up broom during the spring. (Do not dump materials into waterways).
- Patching or repairing concrete areas is performed when weather conditions permit cleaning, preparing, and placement of concrete or concrete patching material.

- Removing debris and drift material deposited around piers should be completed as soon as possible.
- Repairing structural damage is performed as soon as practical, consistent with the severity of the damage.

### **Specialized Equipment**

Following is a partial list of some of the more common pieces of equipment needed for bridge repairs. The Bridge Maintenance Engineer also has an inventory of specialty bridge repair equipment that is available.

- Bucket Truck
- “Snooper” type man-lift truck
- Pick up broom/vacuum truck
- Attenuator mounted truck
- Backhoe/Loader
- 15 lb class chipping hammer
- Concrete saw
- Sandblaster
- Air compressor
- Generator
- Circular saw
- Drills (hammer, mixing, and/or regular)

### **Materials**

Following is a partial list of commonly used bridge repair materials. Contact the Bridge Maintenance Engineer for questions on choosing and ordering materials for specific repairs.

- Rapid setting repair concrete
- Portland cement concrete
- Curing compound
- Reinforcing steel
- Epoxy adhesive
- Primer and paint products
- Miscellaneous hardware including various bolts, washers and nuts
- Miscellaneous forming materials including lumber, screws, and nails

**Ordering** – Planned repairs are reviewed and an estimate of materials prepared. Arrangement for purchasing materials is made prior to scheduling of work.

**Storage** – Materials such as paint, primer, epoxy, and rapid setting patch materials are stored indoors to prevent freezing and to protect from moisture.

**Special Handling** – Rapid setting products, curing compounds, primers, and other specialty materials must be handled in accordance with manufacture’s recommendations and the material safety data sheets (MSDS) for that particular product.

### **Safety and Training**

Supervisors should review safety training and work zone requirements with employees and ensure compliance with approved guidelines. Employees should review MSDS to learn about products used and to make themselves aware of safety and health precautions and the required personal protective equipment and clothing.

### **Special Precautions**

When working with epoxy adhesives or rapid setting patch materials, employees are to comply with the recommended application temperatures, pot life, and mixing instructions of the material.

Specialized training may be required for bridge repair. Consult with the Bridge Maintenance Engineer if there are any questions about how to do or what to use for a certain bridge repair.

Certification is required for snooper truck operation.

Because of environmental and health concerns, maintenance does not paint steel structures.

### **Environmental Best Management Practices**

Before attempting any maintenance activity that may impact streams, streambeds, wetlands, or other environmentally sensitive areas, consult the MDT Environmental Services Bureau to obtain any necessary environmental permits. On all structure maintenance projects, best management practices will be followed, including:

- Placing refuse material above the bank, away from waterways and wetlands.
- Ensuring that the active flowing stream will not come into contact with fresh dissolvable concrete.
- Disposing of material in appropriate locations.
- Providing a stable, appropriate concrete truck chute clean-out area and requiring the contractor to use it to keep material from being deposited in riparian corridors.
- Using cofferdams for structural repairs as appropriate.
- Containing saw chips where feasible.
- Avoiding use of creosote or “Penta” treated wood for permanent structures without the appropriate environmental permits.

To minimize and/or avoid environmental effects, the following should be considered:

- Structural repair work that requires installation of riprap will consider use of bioengineering solutions where practicable. “Practicable” use areas include areas unshaded by bridge elements above the full bank stage where success is probable and safety of the structure is assured.
- Structural repairs that require in-water work will be independently coordinated through the MDT Environmental Services Bureau with MFWP and other resource agencies to minimize impacts. These contacts will require significant modification of the aquatic system and thus require and ESA Biological Assessment and consultation with USFWS, The Army Corp of Engineers, and Tribes to divert water away from concrete work areas during structural repairs of bridges and culverts.
- Maintenance, when repairing drainage features, will make every attempt (within the engineering solution in coordination with the MDT Environmental Bureau, MFWP Regional Biologist and/or MDT Hydraulics) to incorporate fish passage solutions and enhancements such as adding roughness (cobble).
- Maintenance will perform any in-water work with the SPA 124 permit in the water work window or in a time frame negotiated with MFWP.

### **Procedures for repairs**

1. Consult or coordinate the repair with the Bridge Maintenance Engineer, if necessary.
2. Obtain any required permits or access permissions.
3. Ensure that materials and required specialized equipment are available prior to starting work.
4. Set up traffic control devices, which may include arrow boards, changeable message signs, attenuator protection vehicles, and flaggers as appropriate for each specific job.
5. Perform required maintenance/repair for specific job site during a time when weather conditions permit.
6. Clean up area.
7. Dispose of debris and material containers at appropriate disposal site.
8. Remove traffic control.
9. Report repair to the District Bridge Inspection Coordinator.

## **10.2 Inspection of Structures: Bridges and Culverts (MMS 4201)**

### **Activity Description**

This activity includes performing the Routine Maintenance Bridge Inspections as defined in the MBIM and providing assistance to bridge inspection crews performing the NBIS bridge inspections. Assisting the NBIS crews may include providing traffic control and

mobilization and/or operation of equipment. Also, inspection of culverts, box culverts, and similar drainage structures is done under this activity.

### **Purpose**

The main purpose of the Routine Maintenance Bridge Inspections is to catch any *major* problems or changes that have arose since the last NBIS Bridge Inspection was performed. These major problems or changes that are being looked for during the Maintenance Bridge Inspections would generally be considered urgent. They may affect the safety or integrity of the structure and should be addressed as soon as possible with some type of repair or remedial action.

Any routine maintenance that is needed may also be noted during the Routine Maintenance Bridge Inspections. However, much (but not all) of the needed routine maintenance has been documented in the “Work Candidates” recommendation section (see the Inspections Work Candidates chapter in the MBIM) on the NBIS inspection reports. These Work Candidate recommendations are broke down into three maintenance priorities – low, medium, and high. The low and medium priority Work Candidates are considered routine. The high priority Work Candidates can either be routine or urgent, depending on the bridge element involved. Routine maintenance items includes items in which there is no safety risk or risk of structure failure, and maintenance can be scheduled as labor, equipment and funding are available.

### **Frequency of Routine Maintenance Bridge Inspections**

Maintenance Bridge Inspections on all culverts and bridges (timber, steel, and concrete) are to be performed by maintenance every 6 months. This schedule provides for at least 3 Maintenance Bridge Inspections between each two-year NBIS inspection that is performed by a certified inspector. At the discretion of each division, any bridge(s) of concern, because of its condition, traffic loads, or traffic volume, may be inspected more often than every 6 months.

Also, bridges and culverts are to be inspected if they are involved in a major event such as an earthquake, flood, or high water runoff event.

Possible actions required following a Routine Maintenance Bridge Inspection include:

- Immediately cleaning debris, sand, rocks, and silt from the structures to provide for the safe passage of traffic, or to remove materials threatening the integrity of the structure.
- Immediately cleaning culverts that are plugged or schedule replacement of pipes that are threatened structurally by deterioration.
- Prioritizing the cleaning or repair of structures and culverts based on funding availability and other maintenance priorities.

- Reporting damage to the Bridge Maintenance Engineer in Helena and the District NBIS Bridge Inspection Coordinator, through the Area office.
- Scheduling labor and equipment to assist in making structure repairs, as recommended by the Bridge Maintenance Engineer.

### **Specialized Equipment**

The Maintenance Bridge Inspections are meant to be quick and simple, only focusing on major bridge components and any major changes in their conditions. For this reason, special access equipment (snooper, bucket truck, etc...) is generally not necessary for this level of inspection. However, having a camera on these inspections allows the inspector to document any problems that are found.

### **Safety and Training**

Supervisors should review safety training and work zone requirements with employees to ensure compliance with approved guidelines.

For safety reasons, employees should either perform the Maintenance Bridge Inspections in pairs or check in (on the radio) when arriving and leaving a structure site.

Seasonal caution should be taken for snakes and varmints in culverts and under bridges.

### **Procedures**

Inspect all structures and culverts in accordance with the guidelines in the Maintenance Bridge Inspection Manual.

#### **Culverts**

Inspection of culverts should include checking for the following:

- Culvert barrel, to determine if it is plugged or partially plugged.
- Cracks or joint separation in reinforced concrete pipe (RCP) culverts that might indicate structural concerns or erosion problems.
- Soil erosion at the pipe inlets and outlets.
- Drop inlets to ensure that they are not plugged.
- Metal pipes for corrosion or distortion.

#### **Bridge Structures**

Inspection of bridges should include checking for the following:

- Impact damage from vehicle accidents or high loads.
- Failed, crushed, or cracked timber girders or caps.
- Any crack in a steel beam or very large cracks concrete beams.
- Scouring around piers or abutments.

## Section C

- Abnormal looseness or vibrating of trusses.
- Bridge deck and joint spalls or deterioration.
- Material/debris accumulation around piers and abutments
- Removing trees or brush growing under or close to structures.
- Plugged or partially plugged deck drains.
- Damaged or missing bridge rail, curbs, or wingwalls.
- Loose bolts or other fasteners.
- Vegetation that limits sight distance.
- Cleaning and maintenance of bearings.
- Cleaning and removal of incompressible material (dirt, sand, etc...) from joints.
- Other items as noted in the Maintenance Bridge Inspection Manual.

Questions on structure-related problems should be forwarded to the Bridge Maintenance Engineer through the Area office.

### **Recording the Routine Maintenance Bridge Inspections**

In addition to MMS documentation, each supervisor should maintain documentation of culvert and bridge inspections in accordance with the procedures set forth in the MBIM.

NBIS inspections reports are documented on the Assessment Form for Structures and copies are sent to the Area office by the District Bridge Inspection Coordinator. Electronic copies are also available online, on the Bridge Management System (BMS) site, through the procedures outlined in the MBIM,

