Chapter 6: Bridges

chapter contents

Characteristics of Well-Maintained Bridges ............ 95
Optimum Timing/Conditions for Maintenance ............ 95
Bridge Maintenance Activities .......................... 96
  Bridge Washing ........................................ 96
  Debris Removal ....................................... 96
  Guardrail Mowing ..................................... 96
  Repairing/Replacing Wood Deck Planks .............. 96
  Repairing Concrete Deck Surface ..................... 97

Bridge Observation Activities .......................... 97
  Bridge Approach ...................................... 98
  Guardrail and Shoulders .............................. 99
  Traffic Control Devices .............................. 99
  Bridge Structure ..................................... 99
  Under the Bridge ...................................... 101
  Waterway ............................................ 104

For More Information .................................... 105
Safety Tips for Maintaining Bridges

Always check with your supervisor and follow your agency’s safety policies and procedures.

Suggested personal safety gear

- Snug-fitting clothing to avoid snagging
- Heavy gloves
- Hard-toed footwear
- Hard hat
- Ear protection
- Safety glasses with side shields
- Highly visible apparel (if working near traffic)
- Safety glasses

Advance preparation

- Be properly trained and thoroughly familiar with equipment like pile driver, backhoe, high-reach bucket, jack-hammer, etc.
- Make sure an up-to-date first-aid kit, emergency contact information, and hand-held radios or cell phones are available at the work site.
- Make sure work vehicles are equipped with approved and activated warning lights.

During operations

- If the road is open to traffic use proper temporary traffic control, including flagger(s) if needed, as described in the Iowa Traffic Control Devices and Pavement Markings: A Manual for Cities and Counties; in the MUTCD, part 6; and in your agency’s policies and procedures.
- Wear appropriate safety gear and highly visible apparel whenever you’re out of your vehicle.
- Don’t climb on structures without proper safety devices such as tie-offs, safety rails, and/or netting.
- Use proper lifting techniques or request assistance to lift heavy objects.
- Remove all temporary traffic control immediately when no longer needed.
A bridge failure can be catastrophic. It can cause injury or death and can be very expensive to restore.

City and county road maintenance workers are generally not responsible for extensive bridge inspection and repair. However, as you drive over bridges in your jurisdiction or work in their vicinity, you can and should be aware of the signs of bridge stresses or other problems and report problems immediately to your supervisor. See figure 6–1.

You may also need to perform some basic bridge housekeeping/maintenance activities as directed by your supervisor.

**Characteristics of Well-Maintained Bridges**

Well-maintained bridges have the following characteristics:

- The operating width is the same as when the bridge was constructed.
- Structural members are free from damage and corrosion and are in the same alignment as when they were built.
- The deck is free of debris and deterioration.
- All traffic control devices are in place, well maintained, and visible.
- The channel is free of erosion, and the channel and structural members are clear of debris.
- The bridge railing is in good condition, and any approach guardrail is in place and properly aligned.
- Approach paving provides smooth access to the bridge deck.

**Optimum Timing/Conditions for Maintenance**

Most routine bridge maintenance will be conducted during the spring, summer, and fall. Some activities, like breaking up ice jams or removing debris affecting water flow, may be performed in the winter.

*Figure 6–1. Observe bridge conditions when you are in the vicinity (Ettema, et al.)*
Bridge Maintenance Activities

Consult your supervisor and perform routine bridge maintenance activities as directed. Such activities may include the following:

**Bridge Cleaning**

Clean decks, piers, abutments, and expansion joints. Before washing, remove and properly dispose of accumulated debris. You may be asked to blow incompressibles from the joints.

**Debris Removal**

Remove debris or excess vegetation from the bridge approach, bridge deck, under the bridge, and in the waterway. Do not leave debris where it will be picked up during the next high water event.

**Guardrail Mowing**

Remove overgrown vegetation from under and around guardrails. See figure 6–2.

**Approach Blading**

See Blading at Bridges in Chapter 3, page 23.

**Repairing/Replacing Wood Deck Planks**

If you observe loose or broken bridge deck timbers, notify your supervisor immediately. Both loose and broken planks can create a safety hazard for drivers.

If the plank(s) is/are loose, tighten them immediately with existing or new bolts.

If the plank(s) is/are broken, remove and replace them immediately. Determine the number of planks to be replaced, and measure the lengths required. Bring new bridge planks to the site and cut them to length using a chain saw.

Figure 6–2. Overgrown vegetation at guardrail (CCEE/ISU)
Drill bolt holes in appropriate locations, and attach the planks to the girders and stringers with new bolts.

When the maintenance activity has been completed and the bridge deck is secure, report to your supervisor. Documenting the timing of maintenance repairs can be critical in liability lawsuits.

**Repairing Concrete Deck Surface**

Delamination of concrete bridge decks is usually first noticeable over the steel reinforcing bars (re-bar). It is generally caused by chloride ions that infiltrate the concrete deck, migrate to the bars, and corrode them. When steel corrodes, it expands up to eight times its original volume, pushing up on the concrete. Eventually the bond between the concrete and the re-bar is broken, and cracks develop in the concrete. Cracks will continue to develop until pieces of the concrete deck come loose.

The broken areas are like tooth decay; they will spread until the damaged areas are removed and filled with new material.

To determine the extent of delamination, drag a log chain over the deck. There will be a distinct hollow sound where the concrete deck has delaminated and is deteriorating. Mark this area with paint from a spray can. Be sure to check the entire bridge deck.

Remove the delaminated concrete with jack hammers and hand tools. Remove all of the deteriorated deck down to sound concrete. (You may find that the deterioration has developed under the re-bars.) Thoroughly clean the area with an air compressor and power and hand brooms.

If you are repairing the deck in the winter, place a temporary asphalt patch. (See Temporary (Asphalt) Repair under Concrete Pavement in chapter 3.) If the weather is moderate or warm, place a concrete surface patch. (See Surface Patching under Concrete Pavement in chapter 3.) Before placing a concrete patch, apply a grout or bonding agent to the existing, cleaned surface to bond the new concrete to the existing concrete deck. Check with your supervisor and follow your agency’s policies and procedures and the bonding agent manufacturer’s instructions.

Finally, cure the new concrete by covering it with a liquid curing compound, plastic, or wet burlap, as directed by your supervisor. Curing allows the concrete to develop the required strength before traffic is allowed on the concrete.

**Bridge Observation Activities**

All agencies conduct routine, in-depth inspections of bridges. This manual does not describe such inspections in detail, because they are generally not the responsibility of road maintenance workers.

However, during the course of your regular road maintenance activities, you should routinely observe the general condition of bridges in your jurisdiction, as described in the next section. Conduct these observations on an ongoing basis, during all seasons of the year.

Report any potential problems to your supervisor. Defects, damage, erosion, or other serious flaws in bridges need to be addressed quickly.
When you are driving down the road and approaching a bridge, pay attention. Carefully observe the general condition of the roadway before the bridge, the traffic control and safety devices, the approach surface, and the bridge deck and structural members. Look over the edge of the bridge to see if there is any debris in the channel or erosion and debris around the structure.

Following are some suggestions of specific conditions or problems to watch for.

**Bridge Approach**

On gravel road approaches to bridges, look for the following potential problems:

- Poor crown transition from the road to the bridge deck (see Blading at Bridges in chapter 3)
- Too much aggregate and/or inadequate crust on the bridge approach, so that the aggregate migrates onto the bridge deck. See figure 6–3. Aggregate on the bridge deck may, in effect, narrow the operating width of the bridge.
- Standing water or erosion at the shoulder line

On paved road approaches to bridges, look for the following potential problems:

- Pavement distresses and excessive cracking
- Joint failures
- Erosion at the pavement edges
- Cracking or settlement of approach slabs
- Poor condition of expansion joint where the slab meets the bridge deck
- Poor ride

![Figure 6–3. Gravel on bridge deck (CCEE/ISU)](image-url)
Guardrails and Shoulders

Look for the following potential problems:

- W-beam rail sections badly bent out of shape
- Loose bolts
- Loose, broken, or rotted wooden posts
- Bent or badly off line steel posts
- Inadequate guardrail blister offering too little support of the end section
- Holes or ruts under the guardrail that vehicle wheels could drop into
- Traffic damage
- Too low or too high rail
- Overgrown vegetation under and around the rail

Traffic Control Devices

Typical traffic control devices (TCDs) at bridges include object markers, delin- eators, pavement markings, and signing. All TCDs should be easily visible and not damaged or worn. See figure 6–4.

Bridge Structure

Deck

On timber decks, look for the following potential problems:

- Loose nails, spikes, or fasteners
- Openings between planks over abutments and piers which allow dirt to sift through
- Split, worn, broken, or decayed planks

(To repair wood bridge decks, see Bridge Maintenance Activities earlier in this chapter.)
On concrete decks, look for the following potential problems:

- Cracking
- Leaching
- Exposed reinforcing
- Scaling
- Potholes
- Spalling
- Other evidence of deterioration

(To repair concrete deck surface, see Bridge Maintenance Activities earlier in this chapter.)

On steel decks, look for the following potential problems:

- Corrosion
- Unsound welds
- Loose welds where the deck is fastened to the stringers
- Dirt collected in open-grid decking on top of stringers
- Deteriorated paint

**Structural Members**

Observe the condition of trusses by sighting along the roadway rail or curb and along the truss chord members. Look for truss misalignment, either vertical or horizontal. Bent trusses may reduce the bridge’s operating width and/or reduce the structure’s soundness. Note any members damaged by vehicles.

![Figure 6–5. Well-aligned bridge trusses (Lee Co.)](image-url)
**Under the Bridge**

Pay attention to the condition of the underside of the deck, the structural members, the piers and columns, the slope protection, and the waterway. See figure 6-6.

*Figure 6–6. Elements to observe under the bridge (Adapted from Ettema, et al.)*
**Underside of Deck**

Look for the following potential problems:

- Seepage (figure 6–7)
- Calcium deposits
- Cracks in the deck
- Exposed reinforcing

**Piers and Columns**

Look for the following potential problems:

- Erosion at the bottom of the columns (figure 6–8)
- Deteriorated concrete in the columns
- Pier caps that are cracked or out of alignment
- Piers that are damaged due to ice or other debris
Structural Members under the Bridge

Structural members found under the bridge include the beams, which may be steel or pre-stressed concrete, and the abutments and backwalls. Look for the following potential problems:

- Steel beams that are corroded, discolored, or bent from being hit (figure 6–9)
- Pre-stressed beams that are cracked or have pieces missing, particularly on the bottom flanges
- Backwalls that are eroded or pushed out of alignment
- Abutments that are deteriorated or have erosion problems or leaking deck joint
- Bearings that are corroded or frozen up due to rusting (figure 6–10)

Figure 6–9. Corroded, discolored steel beams (Lee Co.)

Figure 6–10. Abutments, bearings, and backwall with erosion and corrosion problems (Lee Co.)
Bridge Slope Protection

The purpose of bridge slope protection is to control erosion and vegetation growth. On paved slope protection, look for the following potential problems:

- Broken panels (Broken panels may not need to be replaced if they are seated and generally conform to the slope.)
- Cracks (Although cracks themselves are not detrimental to the performance of slope protection, they should be sealed to prevent water intrusion, which may cause settlement and/or sliding of the panels.)

Most slope protection is riprap or revetment. Look for the following problems:

- Bare areas
- Exposed fabric
- Erosion
- Inadequate rock size

Drainage Systems

- Drainage systems should be repaired or replaced as necessary to prevent further damage. See figure 6–6 on page 101.

Waterway

Look for the following potential problems along the waterway:

- Debris collecting near piers or in the stream channel. (Debris accumulations may cause scour, redirect the stream channel, apply excessive hydraulic loads, or become a fire hazard. They should be removed as soon as possible. See figures 6–11 and 6–12.)
• Damage to wing dams, etc., which protect the bridge or control the streambed. (Such damage should be scheduled for repair as soon as possible.)

• Sand and gravel bars that divert water flow and perhaps cause scour

For More Information

For in-depth bridge inspection and repair documents and courses, contact the Iowa Local Technical Assistance Program, 515-294-2481, hoganj@iastate.edu.
BIBLIOGRAPHY


