NPS Bridge Owners' Maintenance Manual

Federal Lands Highway Bridge

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Disclaimer

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Purpose

This manual provides information about tasks that may be performed by park maintenance staff or that may be managed and overseen by maintenance staff if the work is performed by private contractors. This manual first provides an overview of bridge preventive maintenance and then focuses on individual activities and identifies procedures, equipment needed, crew size and crew skills, traffic control, and safety notes.

NOTE: *Some activities contained in this manual require specialized experience and equipment; park facility managers may not be able to perform these activities with their own staff. In those cases, this manual can identify preventive maintenance activities for facility managers to program for contractual work. It is recommended that facility managers consult with the Federal Highway Administration or the Denver Service Center before scheduling and performing these types of work.*

Introduction

Throughout the life of a bridge structure, there are simple preservation and preventive maintenance activities that are necessary to realize the structure's full service life. These activities are simple maintenance that should be performed periodically as recommended in this manual. The objective of these activities is to delay or reduce deterioration of bridges or bridge elements. In doing so, the National Park Service can maintain its bridge assets at the lowest cost over the life of the structures.

Historically, it has been found that a strong preventive maintenance effort is a cost-effective approach. Preservation activities cost much less than major reconstruction or replacement activities. Delaying or forgoing preservation treatments will result in worsening condition for bridge elements and eventually require that bridge elements be rehabilitated or replaced.

From a holistic viewpoint, simple cleaning of key bridge components can eliminate cascading sequences of distressful events. For example, annual cleaning of deck surfaces to remove salts and roadway debris will extend the life of the concrete deck by reducing the infiltration of moisture and chlorides to the embedded reinforcing steel. In addition, washing of debris and sand away from deck expansion joint surfaces will prevent joint seal damage or complete seal destruction. If the deck seals fail, sand and salts may fall onto the beam ends, bearings, and beam seats. This often leads to rusting or seizing of expansion bearings and can ultimately lead to

serious damage to the beam seats and bearing assembly, as shown in Figure 1. Note that, while the moveable or expansion bearing "froze", the bridge superstructure continued to expand and contract, literally tearing the bearing from its concrete seat atop the pier.

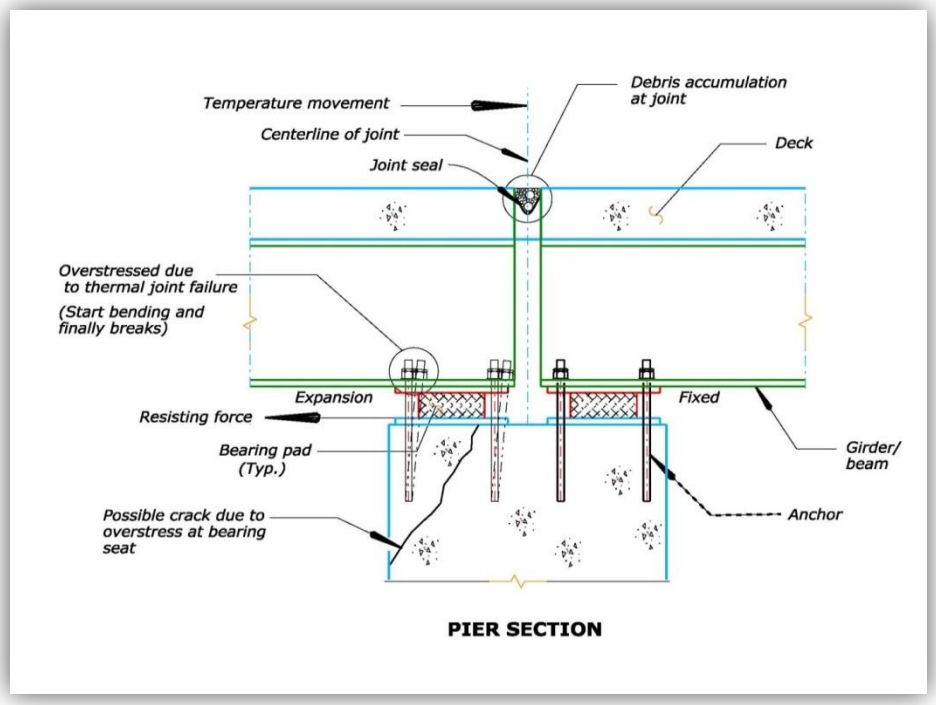


Figure 1. Pier Section

Periodic removal of de-icing salt pile-up on the deck and salt splash on the structure are additional measures that can be taken to prevent concrete deterioration and corrosion of reinforcing steel. When a concrete bridge element has frequent exposure to deicing salts, salt splashes, salt spray, or seawater, chloride ions from these substances can slowly penetrate through micro-cracks into the concrete, eventually reaching the steel. When oxygen and moisture are in the presence of a certain concentration of these chlorides at the steel-concrete interface, the protective film is destroyed and the steel begins to corrode.

Figure 2. Steel Corrosion due to Chloride Reaction

Traffic Control

If traffic control is required for any particular task, including lane and/or shoulder closures, select the appropriate traffic control pattern and/or application from Part VI Temporary Traffic Control, Manual on Uniform Traffic Control Devices (MUTCD). Consider the speed and volume of traffic, duration of the operation, and hazard exposure factors when planning and executing temporary traffic control.

The Bridge as a System

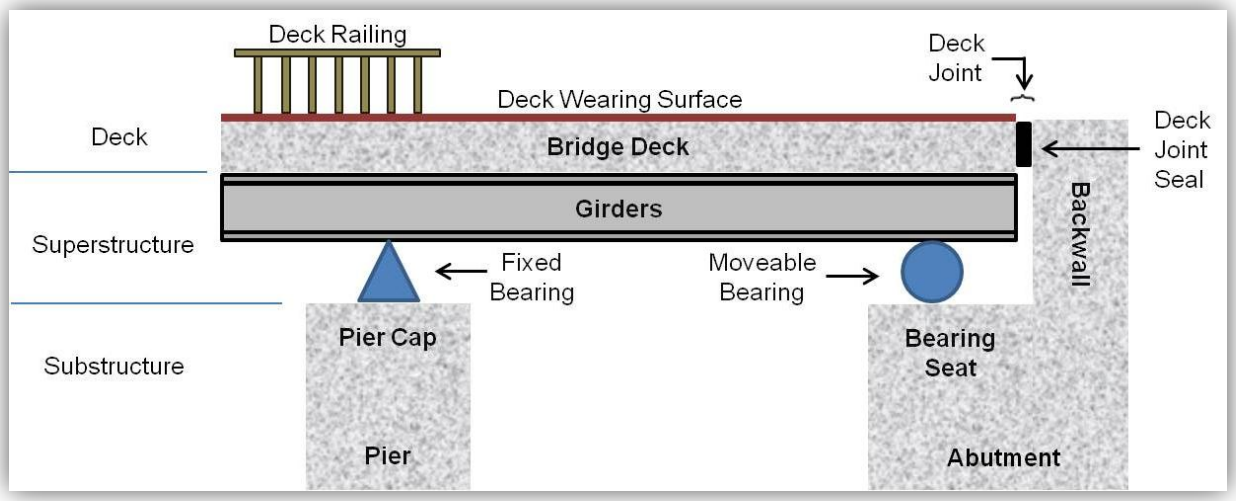


Figure 3. The Bridge as a System

A bridge is typically a system that is composed of three major components and a number of subcomponents. The three major components of a bridge are the deck, the superstructure, and the substructure. These three major components are comprised of the following elements:

Deck Elements

Deck – The roadway portion of the bridge, including shoulders and pedestrian sidewalk. It is usually composed of steel-reinforced concrete, structural steel, or timber and ranges from 4" up to 22" thick. It provides direct support for vehicular and pedestrian traffic and is usually supported by a superstructure.

Wearing Surface – A topmost layer of material (asphalt, concrete, or timber) over the deck which protects the deck from traffic wear and prevents water and deicing salts from reaching the deck. Decks made of steel do not usually have a wearing surface.

Deck Drains (not shown) – Holes in the deck, often covered by steel grates, which allow water to drain from the deck surface. While their primary purpose is safety, they also prevent water from penetrating the deck surface.

Bridge Railing – A safety guardrail along the deck edge that protects both vehicles and pedestrians. In general, railings must be strong enough and tall enough to withstand a vehicle collision and provide pedestrian safety (as appropriate). Note that railings often have cultural resource significance when they are a part of an historic structure.

Deck Joint – The small but important bridge element used to accommodate expansion and contraction movements resulting from temperature changes, without compromising the structural integrity of the bridge.

Deck Joint Seal – An elastic material used to seal joint openings, thereby minimizing infiltration of surface water, gravel, debris, and de-icing salts, preventing those substances from affecting the beams, bearings, and substructure.

Approach Slab – A transition between the roadway pavement and the bridge. The approach slab acts as an intermediate bridge to span the portion of embankment directly behind the abutment/backwall. Not all bridges have approach slabs.

Superstructure Elements

Beams/Girders – Longitudinal members made of timber, steel, or concrete to support and transfer deck dead load (the weight of the deck itself) and traffic live loads (vehicles, pedestrians, equipment, and materials) from the deck to the substructure.

Fixed Bearings – Support elements that transfer loads (dead load and live loads) from the girders to the substructure, while limiting longitudinal (in the direction of traffic) and transverse (perpendicular to traffic) movement.

Moveable Bearings – Support elements that transfer loads (dead load and live loads) from the girders to the substructure, while allowing the movement of superstructure elements in a longitudinal and/or lateral direction. Bridge decks and girders expand and contract with temperature changes; moveable bearings allow this movement while maintaining load transfer.

Substructure Elements

Abutment – Structural element at the end of a bridge that transfers loads from the superstructure to the foundation and provides lateral support for the approach roadway embankment. Most bridges begin and end at an abutment.

Breastwall – The part of an abutment that directly supports the bearings and retains the approach embankment.

Backwall – The topmost portion of an abutment extending above the bearing seat that functions primarily as a retaining wall. It may also serve as a support for the end of the approach slab.

Wingwall – A wall extending from the end of a bridge abutment to retain the side slope material of the approach roadway embankment.

Pier – A substructure unit that supports the spans of a multi-span superstructure at an intermediate location between abutments.

Pier Cap – The topmost horizontal portion of a pier that distributes loads from the superstructure to the vertical pier elements.

Bearing Seat – The section of an abutment or pier below the bearings that transfers all vertical loads (superstructure, deck, and traffic loads) to the substructure.

Bridge Preventive Maintenance

This section describes bridge preventive maintenance activities in brief. These procedures will be described in detail in following sections.

Bridge owners typically apply preventive maintenance to components of structures that still have significant remaining useful life. Preventive maintenance does not renew these components but arrests or significantly slows further deterioration, extending the service life of the component. A major part of bridge preservation, preventive maintenance is a strategy of extending the useful life by applying cost-effective treatments to sound bridges (those in good or fair condition). The concept of preventive bridge maintenance suggests that a planned strategy of cost-effective treatments should be performed to keep bridges in good condition, inhibit future deterioration, and delay large expenses in bridge rehabilitation or replacements.

Preventive maintenance activities can be classified into two groups: scheduled and response. These activities include, but are not limited to, the following:

- **Scheduled –** Typical activities conducted on a scheduled interval basis include:
  - Deck cleaning/washing
  - Deck joint and deck joint seal cleaning
  - Substructure/superstructure washing
  - Painting structural components of steel bridges.
- **Response –** Activities identified through the inspection process and performed on an as-needed basis include:
  - Deck sealing
  - Removing vegetation on and around structures
  - Deck joint seal repair
  - Spot patching of concrete deck
  - Rail spot painting
  - Cleaning debris and vegetation from scuppers and drains.

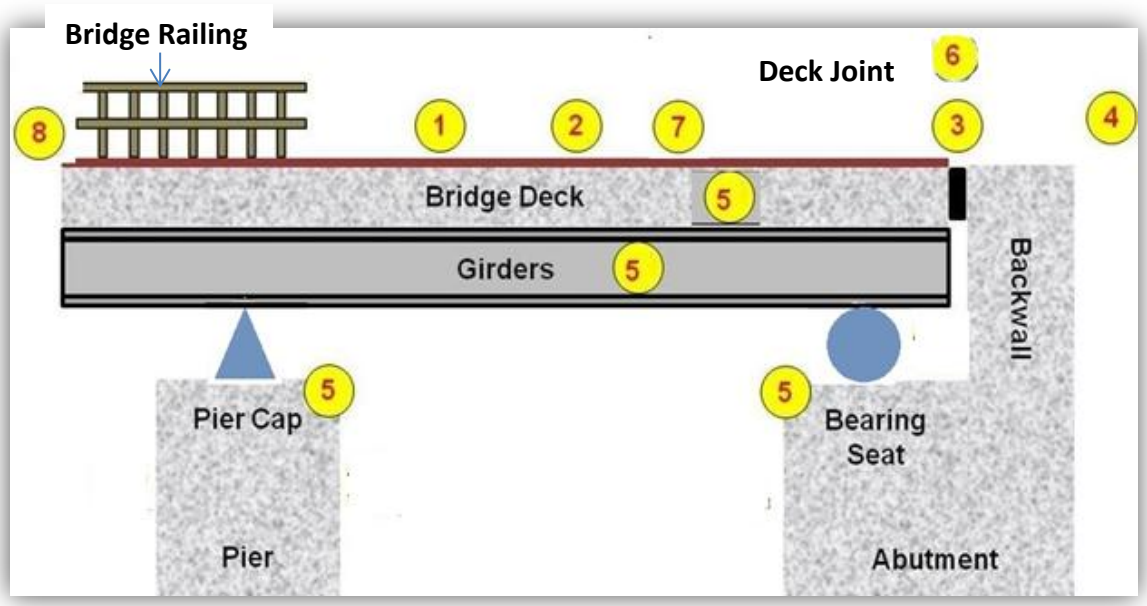


Figure 4. Bridge Preventive Maintenance Activities

The numbers in Figure 4 denote preventive maintenance tasks.

1. **Deck Cleaning/Washing** – Remove trash, loose material, debris, and deicing salt from concrete deck and drainage system by hand sweeping, shovel, or high-pressure water/air or mechanical devices. The objective is to remove material that may trap moisture and salt to prevent penetration into the concrete and subsequent corrosion of the reinforcing steel.

2. **Deck Sealing** – Seal the deck when cracks occur, providing a barrier to prevent chloride penetration. This helps delay further deterioration of concrete and corrosion of the reinforcing steel.

3. **Deck Joint and Deck Joint Seal Cleaning** – Remove debris and fine gravel from the top of the deck joint seal. This delays deterioration of the joint seal by preventing soil and debris from mechanically degrading the seal.

4. **Removing Vegetation On and Around Structures** – Trim or remove trees or plant growth at the deck expansion joint behind the wingwalls and around the structure manually or mechanically. This prevents blockage of the expansion gap against thermal movement of the superstructure and maintains the integrity of the soil retention components.

5. **Substructure/Superstructure Washing** – Remove debris, soil, and salt accumulation from the abutment bearing seats and the top of the pier caps by high pressure washing and on the girders/trusses when the structure crosses over another roadway or water. Moisture, salts, and debris that spill through the joints tend to accumulate on the bearing seats and the top of pier caps. The debris holds moisture and chlorides, which keep the area constantly damp and exposed to rust-inducing chemicals. In coastal areas, salt spray and fog drip worsen these problems. The result is that the moisture and salt deteriorate the concrete at an accelerated rate and penetrate to the reinforcing steel, leading to disintegration of the concrete bearing seats. Splash from this debris, in combination with bird dropping accumulation on the truss/girder surfaces, may also accelerate the deterioration of the superstructure components. It is therefore recommended that the superstructure and substructure be washed at regular intervals, depending upon the accumulation of debris. Note: For steel structures, also include periodic painting of superstructure and substructure steel components. Consult with the FHWA for recommended frequency and procedures.

6. **Deck Joint Seal Repair** – When recommended by the inspection report, preformed joint fillers, compression seals, or sealant should be replaced. Leaking joint seals are commonly evidenced by discoloration of the substructure. If the failed joint seals are not replaced, water and chlorides will spill onto the abutment/pier seats and can lead to deterioration of the concrete and the bearing assembly.

7. Spot Patching of Concrete Deck – Repair concrete delamination or spall on the deck with concrete grout or epoxy in order to delay further concrete deterioration and to arrest corrosion of reinforcement steel. Asphalt material should not be used for patching spalls or delaminated areas of a concrete deck, except in emergency or temporary situations. When deck reinforcement is exposed, it is highly recommended that the repair be handled by the FHWA.

8. **Rail Spot Painting** – Spot paint rail segments in accordance with recommended specifications, after the removal of loose paint and rust. This will prevent further spreading of corrosion to other rail sections.

Specific Bridge Preventive Maintenance Activities

This section provides step-by-step instructions and recommendations for crew size, skills, and types of equipment as well as safety and traffic control requirements. Some photos and diagrams have been provided as appropriate.

1. Deck Cleaning/Washing

This work consists of cleaning bridge decks by collecting and properly disposing of trash and debris from the bridge and pressure washing to remove salts, dust, and any remaining undesired material from exposed bridge surfaces. Perform the work at least once a year, during early spring. Follow the procedure of deck washing/cleaning as detailed below for concrete decks with or without a bituminous wearing surface.

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions and in accordance with MUTCD and Occupational Safety and Health Administration (OSHA) guidance.

Personnel and Skills:

3 to 5 crew members with minimum labor skills to operate machines, equipment, etc. The crew size may be increased depending upon the size of the deck, traffic volume, and type and amount of equipment used. Flaggers and other traffic control personnel may be used as required.

While maintenance staff do not require specialized skills to complete this work; care must be taken 1) to perform a test spray, 2) to maintain appropriate water pressure, and 3) to avoid overspraying a specific section, which may damage the deck's wearing surface.

Equipment:

- Water trailer with pressure water pump, hoses, etc.
- Sewer snake (175 cubic feet per minute compressor) with hoses, etc.
- Square-point shovels, brooms.

Materials:

Water for cleaning: Potable; non-staining; and free of oils, acids, alkalis, and organic matter

Procedure

Cleaning:

- Prepare the work zone (i.e. traffic control, environmental protection, required personnel and equipment)
- Cut and remove vegetation on deck and approaches
- Collect and remove trash, dirt, and other debris on the bridge, including sidewalks, curbs, and approaches by sweeping, shoveling, vacuuming, or other suitable methods.
- Loosen dirt and debris with scrapers and stiff brushes, as necessary
- Remove trash, debris, and sediment in and around deck drains and drainage systems (inlet) at the approaches

- Dispose of all collected materials properly. If sand, dirt, or other similar material is to be disposed of on-site, place it in an upland area from which it cannot enter the stream, water body, or wetland.

Testing:

- Locate a 10 square foot test area on the bridge
- Before beginning the production work, clean a test area to demonstrate aesthetic effects and qualities of material and execution. For the test, use the proposed materials and methods under the same weather conditions to be expected during the production work
- Perform test cleaning and adjust pressure to ensure that spray does not damage the concrete surface
- Do not begin any further concrete cleaning/washing work until receiving the approval of the test area results
- Coordinate with park and regional environmental staff to obtain any necessary permits before carrying out the operation.

Washing:

- Pressure wash the deck surface, generally beginning at the highest point and working downward using clean, fresh water. Carefully avoid excessive pressure that may damage paint, grout, or other materials. Operate the pump for washing at pressures between 1750 and 2000 pounds per square inch (psi) and with a minimum flow rate of 3.5 gal/minute. Do not perform the operation when ambient temperatures are less than 40°F or when ambient temperatures are expected to drop below 40ºF before the bridge is dry.
- Flush scuppers and drainage systems, but prevent sediment and debris from discharging into streams and other surface-water bodies.
- Remove scupper gratings and downspout clean-out plugs to flush and snake trapped debris, as necessary.
- Use caution to control water pressure during drainage system flushing.
- A silt fence may be required to protect embankments from eroding during the operation.

ENVIRONMENTAL NOTES: *If performed in an environmentally sensitive area, use the deck as a retention basin by placing sand bags at the bridge ends and temporarily covering the deck drains. If required, furnish a sediment trap to remove cleaning water from the deck. The sediment trap consists of one geotextile bag, one pump, a 4" discharge hose, and aggregate or straw underlayment as shown below. Place the pump at the lower end of the bridge.*

The bag is a sediment control device made of permeable, nonwoven geotextiles. The bag will be able to retain silt, sand, gravel, and other fines while allowing the filtered water to drain out to the nearest inlet. The type and size of the bag will be determined based upon the water flow rate, strength, and permeability.

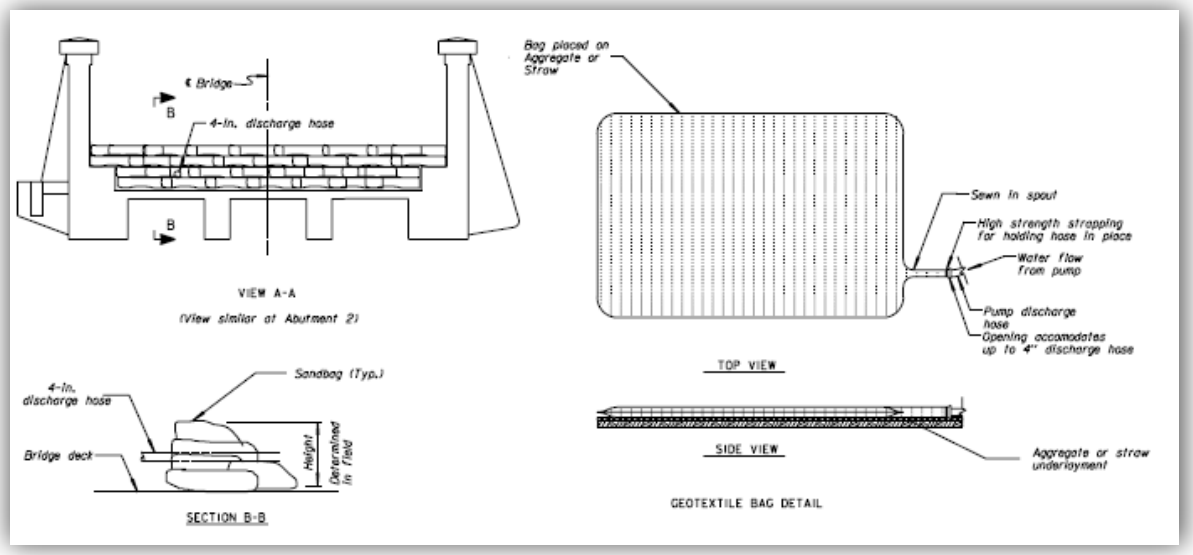


Figure 5. Environmental Notes

Figure 6. Sweep Surface but NOT into Stream or onto Road

Figure 7. Typical Debris Accumulation on Deck and around Deck Drain

Figure 8. Removing Soil and Debris and Washing the Deck

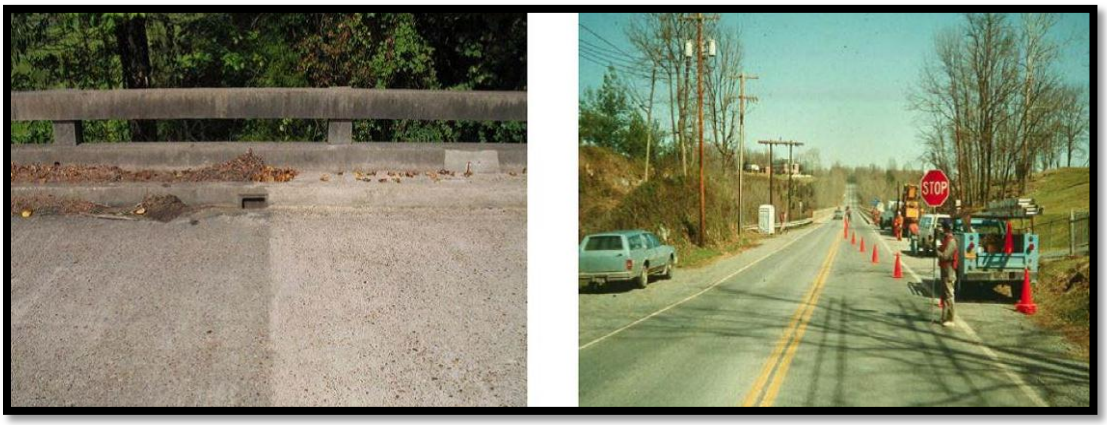


Figure 9. Deck Washing (Before and After) and Typical Traffic Control Operation

2. Deck Sealing

This work consists of preparing and sealing cracks in a concrete deck with an epoxy resin mixture to prevent water and chlorides from reaching the reinforcing steel. Generally, concrete decks should be sealed at least once every four years. It is particularly important to seal the concrete decks which have numerous hairline map cracks (width size less than 0.01"). However, cost-effectiveness should be taken into account for this activity. For example, if a structure is less than 30 years old, sealing the deck is highly recommended. Otherwise, it may be preferable to postpone the activity and request funding for future partial or full depth deck replacement.

NOTE: *The materials used to seal decks can be hazardous. It is recommended that facility managers consult with the FHWA or the Denver Service Center before scheduling and performing work.*

Follow the procedure for deck sealing as detailed below:

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions, and in accordance with MUTCD and OSHA guidance. NOTE: Some deck sealants are hazardous and flammable when they are being applied.

Personnel and Skills:

3 to 5 crew members with specific experience in applying deck sealants. The crew size may be increased depending upon the size of the deck, traffic volume, and the type and amount of equipment used. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Compressor with hoses, etc.
- Sandblaster
- Shovels, scrapers, and brooms
- Trucks with pumps and spray bar
- Special clothing or protective equipment.

Materials:

- Water: Potable; non-staining; and free of oils, acids, alkalis, and organic matter
- Epoxy resins, surface sealant used for concrete deck ONLY (silanes, siloxanes, silicone, polymers), conforming to American Association of State Highway and Transportation Officials (AASHTO) M235

Procedure:

- Prepare work zone (i.e. traffic control, environmental protection, equipment)
- Loosen and remove heavy dirt deposits on concrete
- Clean deck by washing, sweeping, and/or using compressed air
- Surface must be clean and dry prior to application, and air temperature and wind velocity must be at an appropriate level

- Apply sealer according to manufacturer's instructions, controlling the application rate to avoid running or puddling. Use multiple coats, if necessary
- Unless specifically required, do not use asphalt sealers, asphalt pavement or chip seals on concrete decks. These materials do not perform as well as acrylic sealants. Additionally, water which does permeate the asphalt overlay will settle onto the deck surface and accelerate deterioration.

Figure 10. Typical Map Cracking on the Deck; Deck Sealing Equipment

Figure 11. Sand-Blasting Deck Surface and Applying Deck Sealant

3. Deck Joint Seal Cleaning

This work consists of removing/cleaning the debris and fine gravel from the top of the deck joint seal. This deck joint cleaning work postpones the deterioration of the joint seal by preventing soil from mechanically degrading the seal.

Procedure:

Perform similar tasks as described for deck cleaning/washing maintenance work associated with this maintenance activity.

NOTE: *Care must be taken not to damage the deck seal. Proper water and air pressure must be observed, and nylon brushes should be used instead of metal brushes.*

Figure 12. Debris Accumulation in Joints

Figure 13. Deck Joint Cleaning and Removal of Debris by Compressed Air

4. Remove Vegetation On and Around Structures

This work consists of cutting and/or removing vegetation on decks and around superstructures, substructures, and approaches. Removal should be minimized to limit habitat loss, erosion, and sedimentation. This work includes removing any vegetation and dead trees from streambeds and channel banks adjacent to the structure which restrict the stream flow or might become dislodged and cause hazardous conditions in the future. Remove vegetation either by manual and/or mechanically-assisted means.

NOTE: *Care must be taken not to damage the bridge itself when removing large tree trunks deposited by high-water events. These pieces should be cut into sections before removal. Tree roots and branches should be carefully dislodged from the bridge prior to removal.*

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions and in accordance with MUTCD and OSHA guidance.

Personnel and Skills:

4 crew members. The crew size may be increased depending upon the size of the bridge, traffic volume, and the type and amount of equipment used. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Chain saw
- Winch or pulling equipment (see NOTE above)
- Backhoe, front end loader (as allowed by site conditions)
- Bush ax
- Various hand tools.

Procedure:

- Obtain the necessary permits or compliance approvals from park or local government environmental control organizations
- Comply with the approved procedural requirements during the operation
- Remove vegetation and debris on and around the structure
- Remove with care any vegetation, rodent's nests, etc. from the weep holes. DO NOT use a rod for removal as it may damage the sheet drain behind the abutment wall
- Remove only large vegetation and dead trees from stream banks and streambeds
- Consult with local park resources regarding disposal or utilization of vegetation and debris.

Figure 14. Vegetation Around Structures that Requires Removal

5. Substructure/Superstructure Washing

This work consists of removing debris, dirt, salt, and grit from bearing seats, pedestals, truss/girders, breastwalls (front wall of the abutment), and cap beams (top element of the pier to provide bearing seats). It includes unplugging and cleaning the drainage system below the superstructure and along the abutments such as weep holes. Perform this task at least once a year during the spring.

NOTE: *Consult with local park resources staff regarding environmental impacts and mitigation due to runoff, waste, and equipment operating near the waterways related to this operation. Ensure adequate attention to worker safety during the operation.*

NOTE: *Some components of a bridge superstructure can be damaged by high-pressure water. Also, many older bridges contain lead paint, and if/when removed, this becomes a hazardous material. It is recommended that facility managers consult with the FHWA or the Denver Service Center before scheduling and performing work. See Section 8. Rail Spot Painting for more information on lead paint testing.*

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions and in accordance with MUTCD and OSHA guidance.

Personnel and Skills:

3-7 crew members. The crew size may be increased depending upon the size of the bridge, traffic volume, need for traffic control during the operation, and the type and amount of equipment used. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Water tank with pressure hoses or compressor

- Access equipment
- Various hand tools.

Materials:

Water: Potable; non-staining; and free of oils, acids, alkalis, and organic matter

Procedure:

Perform the following tasks associated with this maintenance activity:

- Obtain the necessary permits or compliance approvals from park or local government environmental control organizations
- Set up scaffolding or ladders, bucket truck, or under bridge inspection truck, as required
- Thoroughly flush all bearing seat areas at abutments and piers and all concrete surfaces of rails, girders, piers, and abutments with high pressure water to remove salt, dirt, debris, chlorides, and bird droppings
- Scrape, brush, or chip all accumulated debris that cannot be removed by high pressure water flushing
- As noted above, consult with local park resources staff regarding runoff and waste associated with this operation
- Silt fence may be required to protect embankment from erosion during the operation
- If bird nests or roosting bats are encountered, consult with local park biologists or resources staff for guidance related to any disturbance.

Figure 15. Power Washing

Figure 16. Consult with Local Park Biologists or Resources Staff for Guidance Before Removing Empty Bird Nests

Figure 17. Abutment Breastwall in Need of Washing; Abutment Bearing Seat in Need of Cleaning

6. Deck/Curb Joint Seal Repair:

This work consists of removing damaged, deteriorated, or non-adhering existing sealing material; cleaning and preparing the surfaces along and around the deck joint; placing a backer rod or bond breaker; and pouring/placing new joint sealing material, either in solid or liquid form. Perform this task when recommended in the bridge inspection report.

NOTE: *In many cases, joint seal repair requires experience and specialized equipment. It is recommended that facility managers consult with the FHWA or the Denver Service Center before scheduling and performing work.*

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions, and in accordance with MUTCD and OSHA guidance.

Personnel and Skills:

3 crew members. The crew size may be increased depending upon the size of the deck, traffic volume, and the type and amount of equipment used. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Air compressor
- Rubber seal installation tools
- Various hand tools
- Square-point shovels
- Brooms
- Joint levelers
- Personal safety equipment.

Materials:

- Concrete joint sealer hot-poured elastic type, conforming to AASHTO M173 or equivalent
- Compression joint seal, conforming to AASHTO M297
- Backer rod, conforming to ASTM D 5249, type 1 or equivalent. Use a compatible sealant as recommended by the rod manufacturer
- Low-modulus silicone joint sealant, conforming to ASTM D 5893, type SL or equivalent
- Preformed expansion joint fillers for concrete, conforming to AASHTO M33 or equivalent.

Procedure:

Reseal Deck Joint (Liquid Seal Material/Poured Joint):

- Prepare the work zone (i.e., traffic control, environmental protection, required personnel and equipment)
- Joint must be dry and air temperature must be at or above 40°F
- Clean joint of all existing sealer and backer rod material using a broom and air compressor. Do not remove preformed joint filler unless it is deteriorated
- Remove all sealer material from the joint faces with wire brushes or air compressor. Remove loose, eroded, and unsound asphalt and concrete from the joint area
- For backer rod and sealant system, insert joint backer rod into the joint opening, and push down approximately 3/4" below the concrete surface. Conform to Table 1 for the appropriate size of the backer rod
- Install temporary dams at ends of joint to contain joint sealant
- Pour sealant into joint to 1/8" below the concrete surface.

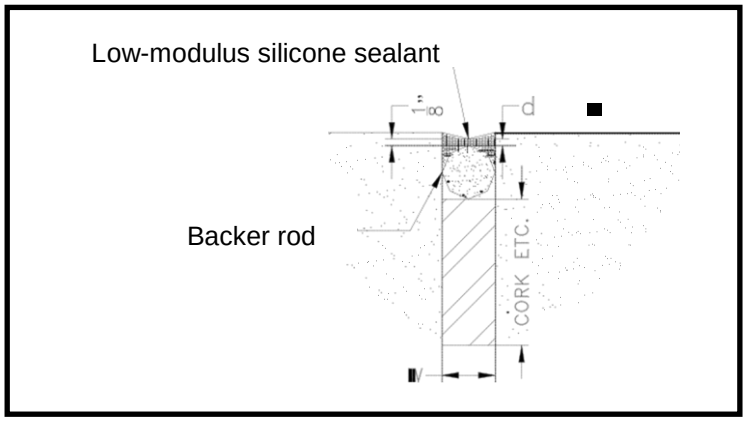
Replace Deck Joint (Solid Seal Material/Compression Seal):

- Prepare the work-zone (i.e., traffic control, environmental protection, required personnel and equipment)
- Joint must be dry and air temperature must be at or above 40°F

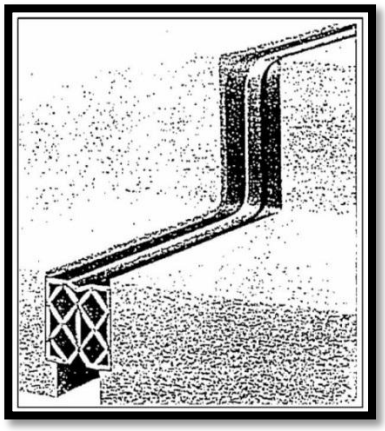
- Remove all old joint material and compression seal
- Remove loose, eroded, and unsound concrete from the surface within the joint area. Sandblast or abrade the concrete surface free of oil, dust, dirt, traces of asphaltic concrete, or other contaminants. Restore concrete surface to the original shape, if necessary, before placing the seal
- Install bridge joint seal according to the manufacturer's recommendations. See Figure 18 for additional information.

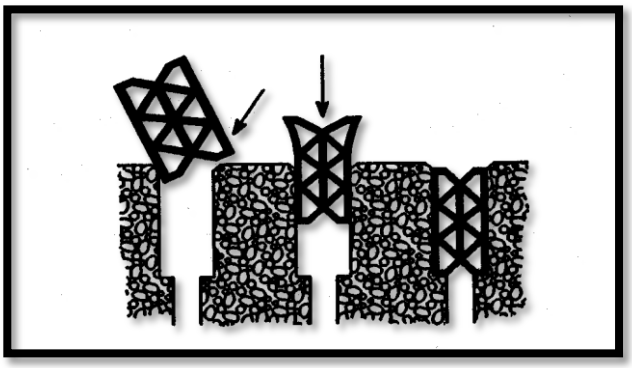
Table 1. Backer Rod Sizes

Joint Width After Preparation	Rod Diameter
5/16"	3/8"
3/8"	1/2"
1/2"	5/8"
5/8"	3/4"
3/4"	1"
1"	1¼"
1¼"	1½"
1½"	2"



Backer rod/sealant joint





Compression seal at curb joint

Compression seal placement

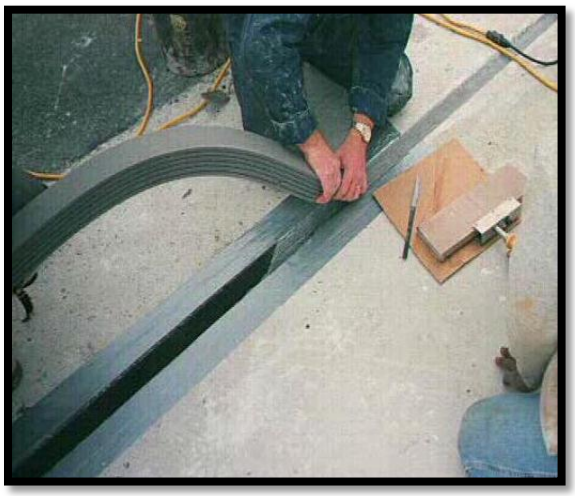


Figure 18. Deteriorated Deck Joint Filled with Debris; Pre-Formed Joint Seal Installation

7. Spot Patching of Concrete Deck:

This work consists of removing deteriorated or damaged concrete from the deck surface and placing new concrete. Perform this task when recommended in the bridge inspection report.

Concrete deck spalls should be repaired with concrete. Use bituminous material for emergency repairs only and replace with concrete as soon as possible. Do not perform this task when the deck reinforcement is exposed or the depth of the deteriorated concrete is greater than 1".

NOTE: *Extreme caution should be used when executing saw cuts to ensure depth does not exceed 1" in order to prevent damage to existing reinforcing steel. Seek to avoid excessive removal of sound concrete. It is recommended that facility managers consult with the FHWA or the Denver Service Center before scheduling and performing work.*

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions and in accordance with MUTCD and OSHA guidance.

Personnel and Skills:

The typical crew size is 4 crew members. The crew size may be increased depending upon the size of the deck, traffic volume, and the type and amount of equipment used. Crew members should be skilled in use of pneumatic hammers and working with reinforced concrete. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Air compressor with jackhammer
- Generator
- Personal safety equipment
- Brooms and brushes
- Various hand tools.

Materials:

- Blasting sand
- Water
- Ready-mixed concrete or other patching material. Consult with the FHWA or Denver Service Center for specific material requirements for thin patch repairs.

Procedure:

- Prepare work zone (i.e. traffic control, environmental protection, equipment)
- Identify and mark extent of damaged portions
- Saw cut outline of repair area (straight cuts). Repair areas should be rectangular and should extend at least 3" beyond the damaged concrete (see NOTE above)
- Cautiously remove deteriorated concrete using pneumatic hammers and/or hand tools
- Clean the area using water-blasting or sandblasting
- Before placing concrete or patching material, apply a bonding agent to the clean surface according to the manufacturer’s recommendations
- Place new concrete or patching material (depending on repair depth)
- Broom-finish surface of the patch

- Provide for proper cure to avoid shrinkage cracks in accordance with the manufacturer's recommendations.

Figure 19. Deteriorated Concrete Deck

Figure 20. Placing the Patch Material

8. Rail Spot Painting

This work consists of cleaning and spot painting of bridge rails at the locations where minor scratches and damage, loss of paint, paint peeling, rusting, pitting, etc. are observed. Before performing this task, examine the existing coat to determine if it is lead-based; the percent of the area rusting; the presence of rust scaling and pitting; the adhesion of the existing paint coat; and the compatibility of existing coats with the paint system proposed for use. Do not schedule or proceed with work if lead paint is encountered. Obtain permits and approval of the containment system plan as required when the structure crosses a water body. Perform this task when recommended in the bridge inspection report.

NOTE: *Many older bridges contain lead paint which, when removed, may become a hazardous material. It is recommended that facility managers consult with the FHWA or the Denver Service Center before scheduling and performing work.*

Safety and Traffic Control:

Implement work zone traffic control and safety procedures as appropriate for specific site conditions and in accordance with MUTCD and OSHA guidance.

Personnel and Skills:

3 crew members. The crew size may be increased depending upon the size of the bridge, traffic volume, and the type and amount of equipment used. Flaggers and other traffic control personnel may be used, as required.

Equipment:

- Power chippers (for heavy duty removal of paint)
- Power brushes
- Sand blasting equipment
- Paint brushes

- Rollers
- Paint sprayers
- Paint thickness tester
- Various hand tools
- Personal safety equipment
- Pressurized water.

Materials:

Paint coat system conforming to the Steel Structures Painting Council (SSPC-PA Guide 3).

Procedure:

Perform the following tasks associated with this maintenance activity.

Surface Preparation

- For painted metal surfaces, check if the existing paint is lead-based by visual inspection and chemical testing. The lead-based paint may consist of an orange colored primer. Many commercial products are available to perform lead paint testing. Follow manufacturer's instructions to perform testing. Take appropriate measures to protect both workers and the environment during the operation

- Wash all areas to be painted with pressurized water to remove dirt, surface chalking, loose rust, and contaminants such as chlorides. Maintain a wash water pressure of at least 500 psi. Capture all wash water and removed waste according to appropriate regulations

- Conform to SSPC-SP 2 for Hand Tool Cleaning, SSPC-SP 3 for Power Tool Cleaning, and SSPC-SP 6 for Commercial Blast Cleaning to remove dust, dirt, loose mill scale, loose rust, pitting, or paint that is not firmly bonded to the underlying surface

- Clean small areas that show pinhole corrosion, stone damage from traffic, or minor scratches

- Clean the affected areas to bright metal. Clean at least 2" beyond the damaged areas. Feather edges of remaining old paint to achieve a reasonably smooth surface

- Take appropriate measures to allay dust, if necessary

- Take measures to protect adjacent property, vehicles, pedestrians, concrete surface, and waterways

- Perform the operation when the air temperature is above 40ºF, relative humidity is less than 85%, and the surface is neither hot nor damp.

Figure 21. Lead Testing

Application of Paints

- Consult with the FHWA or Denver Service Center in selecting the appropriate paint system
- Apply the coating systems as recommended by the FHWA, Denver Service Center, or the paint manufacturer
- Perform a test to check the color and compatibility with the existing system
- Spot paint neatly with brush, roller, or sprayer
- Spot paint into all cracks, if appropriate
- Apply each coat to the wet film thickness as recommended by the paint manufacturer to obtain the specified dry film thickness. Verify the application rate of each coat with a wet film paint thickness gauge immediately after applying paint to the surface. Confirm the application rate by measuring the dry film thickness after the solvent has evaporated from the surface
- Apply the additional coat if necessary only after the preceding coat is completely dried
- For galvanized surfaces, remove all oil, grease, or other contaminants on the surface by washing with a mineral spirit solvent according to SSPC-SP 1 prior to applying the coating system.

Figure 22. Rusted Railings with Peeling/Flaking Paint that Require Spot Painting

REFERENCES:

1. Florida State DOT—Bridge Maintenance and Repair Handbook
2. NYSDOT Fundamentals of Bridge Maintenance and Inspection
3. PennDOT Bridge Maintenance Academy Handbook 2008
4. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-03
5. DelDOT—Bridge Maintenance Manual
6. AASHTO—Maintenance Manual for Roadway and Bridge 2007
7. SSPC-PA Guide 3—Steel Structure Painting Council
8. Manual on Uniform Traffic Control Devices (MUTCD), Part VI web link.