

 Office of Structures <i>Guidelines and Procedures</i> <i>Memorandum</i>	DESIGN
	Number: D-77-14(4)
	Date: 08-01-2018
Bridge Deterioration Preventative Measures	Approval: 

All projects shall incorporate the following provisions for prevention of future deterioration.

- I. Concrete decks for bridges where the main support system is composed of a longitudinal stringer pattern or stringer and floor beam system.
 - A. New bridges and bridge deck replacements
 1. Provide 2 1/2 inches of concrete cover over the top mat of reinforcing steel in the deck slab. The top 1/2 inch is considered an integral wearing surface and should not be considered in the design strength of the slab.
 2. Use Mix No. 6 concrete (4500 psi, air entrained) with synthetic fibers for the entire superstructure.
 3. Use epoxy coated reinforcing steel for the entire superstructure.
 4. All decks shall receive a coating of linseed oil where it does not conflict with opening of bridge to early traffic use.
 5. All roadway joints shall be water tight.
 - a) For compression/strip seal type joints the protection shall extend up the entire height of parapets, curbs, raised medians and sidewalks. As a secondary measure a trough system shall be placed under the compression/strip seal joint to capture any leakage that could reach a bridge seat area.
 - b) For toothed type joints a foam seal shall be placed directly below the tooth plate to prevent debris and drainage from entering the joint. This protection shall extend up the entire height of parapets, curbs, raised medians and sidewalks. As a secondary measure a trough system shall be used to capture any leakage that could reach a bridge seat area.
 6. Minimize the number of bridge deck roadway joints.
 - a) For new bridges see GPM No. D 87-38(4) - Guide to Selection of Proper Roadway Joints and Location of Fixed Bearings.
 - b) For existing steel stringer bridges with multiple simple spans requiring major substructure repairs in addition to a deck replacement, consideration shall be given to replacing the existing structural steel with new continuous stringers. An evaluation of the existing substructure units must be performed to determine if continuous stringers can be supported.

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- c) For existing simple span stringer bridges requiring minor or no substructure repairs in addition to a deck replacement, evaluate making the stringers continuous for live load by pouring a concrete end block around the ends of the stringers at the piers.

B. Bridge deck rehabilitations (overlays)

1. Remove a uniform thickness off an existing deck. This can vary from 1/4 inch minimum scarification to removal down to within 1" of the top mat of reinforcing steel. Depth of removal is to be determined by the designers based on depth of deterioration and overlay thickness. On new decks not exposed to traffic, sandblast or water blast the entire deck surface. Cores and Ground Penetrating Radar Testing can help to identify the depth of rebar.
2. All areas of deteriorated and/or contaminated concrete beneath that removed in item 1, shall be removed and repaired according to the Specifications.
3. Place overlay to required thickness. Concrete for the overlay shall be latex modified placed at a minimum depth of 1 1/2 inches.
4. All roadway joints shall be water tight.
 - a) For compression/strip seal type joints the protection shall extend up the entire height of parapets, curbs, raised medians and sidewalks. As a secondary measure a trough system shall be placed under the compression/strip seal joint to capture any leakage that could reach a bridge seat area.
 - b) For toothed type joints a foam seal shall be placed directly below the tooth plate to prevent debris and drainage from entering the joint. This protection shall extend up the entire height of parapets, curbs, raised medians and sidewalks. As a secondary measure a trough system shall be used to capture any leakage that could reach a bridge seat area.
5. Consideration shall be given to the use of a cathodic protection system when slab is a part of the main support system (Concrete Box Girders). Evaluation is to be made on a case-by-case basis. If a cathodic protection system is used see Section II below for additional design considerations.

C. Bridge deck widenings (where portion of the existing deck will remain)

1. Use Mix No. 6 Concrete and epoxy coated rebar for all bridge widenings.

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2. If the existing deck has no hot mix asphalt pavement (h.m.a.p.) and is to remain without any remedial work then the bridge shall be widened as in Section A above. If the bridge has a h.m.a.p., and is going to remain without any remedial work, then the widened portion shall be constructed to allow extension of the h.m.a.p. onto the new deck, so that the longitudinal joint between the h.m.a.p. and the new poured to grade deck coincides with a proposed lane or shoulder line. This will necessitate constructing the new portion of deck to be overlaid to the same plane as the top of the existing concrete deck and then stepping up at the longitudinal lane/shoulder joint to match the finished roadway surface. Efforts should be made to eliminate the h.m.a.p. since it will increase the rate at which the underlying concrete deck will deteriorate. Consideration should be given to removing the existing deck back to a proposed lane or shoulder line and constructing the widened deck without a h.m.a.p. Consideration should also be given to eliminating h.m.a.p. and staining new concrete black.
3. If the existing deck is to remain and receive a concrete overlay, then for widenings less than 12 feet wide, the widened portion shall be constructed to the same plane as the top of the existing concrete deck and then the entire bridge deck shall be overlaid (See I.B.1.). For widenings 12 feet and greater the widened portion shall be constructed to match the finished roadway surface as in Section A above and only the existing bridge deck shall be overlaid.

II. Concrete decks for bridges where the top slab is an integral part of the superstructure (e.g. box girder bridges, does not include decks on steel girders)

A. New bridges

1. Follow all measures outlined in Section I.A above.
2. Place a 1 1/2 inch latex modified concrete overlay.
3. Place chloride sensors beneath the overlay at the top of deck which can detect when the chlorides have penetrated the overlay and reached the deck, so that the new overlay may be replaced.

B. Existing bridges

1. Follow measures outlined in Section I.B above except as noted below.
2. The use of epoxy shall be avoided in making repairs to the existing deck if cathodic protection system is to be used. This includes epoxy rebars, epoxy mortar and epoxy bonding compound.

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3. Install a cathodic protection system with chloride sensors on the existing deck prior to placing the overlay.

III. Precast-Prestressed Concrete Girders and Slabs

1. Use Self Consolidating Concrete (SCC) for all prestressed concrete girders and slabs.
2. All reinforcement, except that used for prestressing, shall be epoxy coated.
3. All exposed concrete surfaces of concrete girders and diaphragms shall receive a protective coating.
4. When an overlay is to be placed on slabs or box beams use a 3-inch minimum thick Mix 8 overlay with epoxy coated 6 x 6 - W2.9 x W2.9 welded wire fabric. Provide 2 inches cover from top of welded wire fabric to top of overlay. Prior to overlay, sandblast or water blast top surface of slabs or box beams.

IV. Substructure

1. All reinforcement in all bearing seat pads, abutment back walls, abutment bridge seat areas, and parapet portion of wing walls shall be epoxy coated. All pier cap reinforcement (top 3 feet of solid shaft piers) located under bridge deck roadway joints shall be epoxy coated. All reinforcement which extends into the back walls and wing wall parapets shall be epoxy coated.
2. All concrete abutments and piers located under bridge deck roadway joints shall receive a protective coating. For abutments, coating shall be applied to the entire surface of the bridge seat area and beam pads, the inside surfaces of back walls and cheek walls. For piers, coating shall be applied to the entire surface of the bridge seat area and beam pads.
3. All substructure units in salt water (piles, individual columns and footings) shall receive a protective jacket at the waterline in conformance with the approved Structural Details.
4. Use Mix No. 6 Concrete in abutment back walls and parapets on abutments. All other substructure concrete is to be Mix No. 3.

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V. Box Culverts

1. If the culvert has a minimum of 1'-6" of cover (fill material or paving), use Mix No. 3 Concrete and uncoated reinforcing steel for entire box.
2. If the culvert has less than 1'-6" of cover (fill or pavement), the reinforcing bars in the top mat of the top slab (including truss bars and wall steel extending into top mat), shall be epoxy coated and the concrete in the top slab shall be Mix No. 6.
3. If the top slab of the culvert is built to the grade of the finished roadway and the minimum clearance between the top of the rebar mat and the finished roadway surface exceeds six inches, then a mat of epoxy coated 6 x 6 - W2.9 x W2.9 welded wire fabric shall be placed. In addition, all bars in the top mat of the top slab (including truss bars and wall steel extending into top mat) shall be epoxy coated.
4. All top slabs built to grade shall receive a coating of linseed oil where it does not conflict with opening the bridge to early traffic use.

VI. Steel Superstructure Members

1. Non-weathering Steel - Structures using this type of steel will have all exposed surfaces receive a protective paint system.
2. Weathering Steel over a Railroad or Water - Structures using this type of steel will have the following exposed surfaces receive a protective paint system matching the color of weathering steel.
 - a) All steel within 10 feet of an abutment
 - b) All steel within a 20 foot section centered over a pier
 - c) All steel in a span over an electrified railroad
3. Weathering Steel over a Highway or on a Structure Having Drainage Openings Through the Parapets - Structures using this type of steel will have the following exposed areas receive a protective paint system.
 - a) In addition to the areas described in 2.a) and 2.b) above, the fascia stringers shall be coated.