SECTION 8
DECKS AND DECK PROTECTIVE SYSTEMS

TABLE OF CONTENTS

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8.1 DECK TYPES

8.1.1 General

A deck is defined as a component, with or without a wearing surface, which supports wheel loads directly and is supported by other components.

8.1.2 Cast-In-Place Concrete Decks

8.1.2.1 Materials *(Rev. 04/19)*

Refer to **BDM** [6].

8.1.2.2 Design *(Rev. 12/19)*

The design of cast-in-place reinforced concrete decks using the empirical design method described in the **LRFD** [9.7.2] is not permitted.

Cantilever deck overhangs shall be designed in accordance with **BDM** [12] for railing loads. For deck overhang limits, see **BDM** [6] and [7].

8.1.2.3 Minimum Slab Thickness *(Rev. 03/05)*

The minimum thickness of a cast-in-place concrete deck slab shall be 8.5 inches. The cover to the top mat of reinforcement shall be 2.5 inches. The top 0.5-inch shall be included in calculations as dead load only. It should be assumed to be sacrificial and not included as a permanent part of the deck for design purposes.

8.1.2.4 Haunches

The minimum haunch depth shall be 1 inch (2 inches for prestressed bulb tees) measured from the top of the top flange of the member to the bottom of the slab. For members with splices, the top of the member shall be the top of the splice plate. A deeper haunch may be required when the width of the top flange of a member exceeds 1.33 feet due to the cross slope of the slab. Changes in flange plate thicknesses and allowable camber tolerances shall be taken into consideration when determining the haunch depth to use in calculations.

Haunches with thicknesses less than 4 inches do not require reinforcement. Haunches with thicknesses from 4 inches to 6 inches shall be reinforced as shown in **BDM [**Division 3]. Reinforcement for haunches with thicknesses greater than 6 inches shall be detailed by the designer.

8.1.2.5 Reinforcement Details

8.1.2.5.1 Main Reinforcement Placed Perpendicular to Traffic

For decks with a skew angle less than or equal to 20 degrees, the main reinforcement shall be placed on the skew. For decks with skew angles greater than 20 degrees, in general the main reinforcement shall be placed perpendicular to the centerline of the structure.

At acute corners of the deck, when the skew angle exceeds 20 degrees, additional reinforcement shall be placed parallel to the end of the slab with appropriate increase in slab thickness.

Additional distribution reinforcement shall be placed midway between the top and bottom longitudinal bars at the end of decks. The bar size and length shall be as follows:

- for spans up to 50 feet.....Use #5 x 5 feet
- for spans over 50 feet and up to 80 feet .....Use #5 x 8 feet
- for spans over 80 feet.....Use #5 x 10 feet

8.1.2.5.2 Main Reinforcement Placed Parallel to Traffic

Main reinforcement parallel to traffic shall be designed in accordance with **LRFD**.

8.1.2.5.3 Cover Requirements *(Rev. 03/05)*

The minimum concrete cover over top reinforcement shall be 2.5 inches. The minimum concrete cover over bottom reinforcement shall be 1 inch.

8.1.2.5.4 Splices

Splices for all deck reinforcement, both longitudinal and transverse, shall be shown on the plans. A minimum of 1 splice shall be detailed for the transverse reinforcement. The use of mechanical connectors to splice reinforcement is permitted when lap splices cannot be accommodated and more than 1 inch of cover is provided. For additional information, see **BDM** [6].

8.1.2.5.5 Tie Down Bars

Tie down bars aid in supporting and anchoring the mats of deck reinforcement. Tie down bars shall be shown on the plans.

8.1.2.6 Construction Joints

Construction joints to facilitate deck construction are permitted. Transverse construction joints are typically required when a sequence of pours is necessary. Longitudinal construction joints may be required for stage construction. Decks adjacent to construction joints shall be properly designed and supported for all loading conditions. The members supporting the deck adjacent to the construction joints shall also be investigated to ensure that they are adequate for all loading conditions. Closure pours may be detailed for stage construction conditions where large differential deflection is anticipated.

8.1.2.7 Forming *(Rev. 04/19)*

Typically, forms for the construction of cast-in-place concrete bridge decks may be removable or stay-in-place metal forms. Prestressed concrete stay-in-place forms may be used only with the written approval of the **CTDOT**.

The use of stay-in-place metal forms is permitted in all but the following locations:

- Under cantilever slabs such as the overhang outside of fascia girders.
- Under longitudinal deck joints between median girders
- A bridge less than 15 feet above mean high water level of a salt-laden body of water.

For all bridges where stay-in-place metal forms are permitted, the designer shall include the provision in his design calculations for the stay-in-place metal forms. All affected members shall be designed to carry the additional dead load of the stay-in-place forms. Lightweight foam filler shall be used to fill valleys of the stay-in-place forms. The cover for the bottom reinforcements shall be measured from the top of the stay-in-place metal forms. Welding of stay-in-place metal form supports to tension zones in girder top flanges is not allowed. The Designer shall clearly identify on the structural steel plans all top flange tension zones where welding of stay-in-place form supports is not permitted.

For all bridges for which stay-in-place metal forms are permitted, girder deck load deflection and camber calculations shall include the estimated weight of stay-in-place forms with foam valley fillers. Where stay-in-place metal forms are provided, the designer must note the assumed uniform weight of the stay-in-place metal forms on the bridge plans.

8.1.2.8 Deck Pouring Sequence

For bridges with continuous members, cast-in-place concrete decks shall be placed in sequence. The sequence of pouring concrete shall be shown on the plans and include the following:

- sections in which the deck is to be poured,
- sequence in which the sections are to be poured,

- direction of pouring each section, and
- minimum compressive strength the concrete in each section must obtain prior to placing concrete in other sections.

Additionally, the following note shall be shown on the plans:

A deck pouring sequence different from that shown may not be used without the prior approval of the Engineer.

8.1.3 Adjacent, Transversely Post-Tensioned, Prestressed Box Members *(Rev. 04/19)*

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8.1.4 Precast Concrete Deck Panels

Vacant

8.1.5 Bridge Grid Decking

Vacant

8.1.6 Aluminum Bridge Decks

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8.2 DECK PROTECTIVE SYSTEMS

8.2.1 Highway Bridges

8.2.1.1 General

The decks of all bridges, both new and rehabilitated, shall be protected from damage, deterioration and corrosion due to deicing salts.

8.2.1.2 Concrete Decks *(Rev. 04/19)*

The preferred method to protect cast-in-place and precast concrete decks consists of using galvanized reinforcement and a membrane waterproofing protected with a bituminous concrete overlay.

The standard membrane waterproofing shall be "Membrane Waterproofing (Cold Liquid Elastomeric)." The membrane waterproofing for existing bridge decks with an anticipated remaining life of less than 20 years may be “Membrane Waterproofing (Woven Glass Fabric).”

If during construction, a temporary condition is required to restore traffic, the following shall apply:

- Temporary pavement is required
  - Not intended for winter shutdown
    - Apply bond breaker to deck and apply temporary pavement
    - For final pavement, remove temporary pavement and apply "Membrane Waterproofing (Cold Liquid Elastomeric)"
  - Intended for winter shutdown
    - Apply "Penetrating Sealer Protective Compound" to concrete, bond breaker and temporarily pave.
    - In spring, remove temporary overlay, apply "Membrane Waterproofing (Cold Liquid Elastomeric)"
- Temporary pavement is not required
  - Allow traffic to ride on bare deck and/or aggregated "Membrane Waterproofing (Cold Liquid Elastomeric)." Pave as soon as possible.

This membrane shall be protected by a bituminous concrete overlay. The minimum thickness of the bituminous overlay atop the membrane waterproofing shall be 3 inches on all new bridges as well as all existing bridges that have adequate load carrying capacity. The designer shall consult with the **CTDOT** for final verification of pavement type and determination of Traffic Level for the top course.

Existing bridges that do not have adequate load carrying capacity for a 3-inch overlay shall receive a 2.5-inch thick bituminous concrete overlay. The designer shall consult with the **CTDOT** for final verification of pavement type and determination of Traffic Level for the top course.

On new decks where it is necessary to increase the overlay thickness to obtain the proper profile and cross-slope, such as bridges composed of adjacent box members, the bituminous overlay shall have a top and bottom course, and an intermediate wedge course. The bottom course of bituminous concrete shall be a uniform 1-inch thick. The intermediate wedge course shall vary in thickness to achieve the desired profile and cross-slope. A detail and/or note shall be included on the plans providing pavement lift requirements for intermediate wedge courses. The top or finish course shall be a uniform 2-inch thick. The hot mix asphalt mix design to be used for the intermediate wedge course will be determined by the **CTDOT** based on the minimum and maximum thicknesses required.

Weepholes shall be provided in cast-in-place concrete decks to drain the membrane and overlay interface. Weepholes shall be placed along gutterlines adjacent to deck joints at the low end of spans on the low side of cross slopes. Weepholes shall outlet on the inside of fascia members. The outlet pipe of the weephole shall be extended as required so as not to drain onto the superstructure members and components. Weepholes shall not be located over travel lanes, shoulders, sidewalks, parking areas, or in spans over railroad tracks. Where easily achieved during rehabilitation projects, existing weepholes should be

plugged and paved over when not in accordance with these requirements.

Other methods to protect concrete decks such as using a cathodic protection system or latex modified concrete may only be used with the written approval of the **CTDOT**.

8.2.1.3 Other Deck Types

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8.3 FINISHED DECK AND GRADE ELEVATIONS

8.3.1 General

All elevations necessary for construction of the deck and placement of the bituminous concrete overlay shall be shown on the plans.

Bridges located at merging and diverging roadways shall be carefully detailed with the dimensions and elevations necessary for construction.

8.3.2 Finished Deck Elevations *(Rev. 04/19)*

For cast-in-place concrete decks, finished deck elevations and member deflections shall be tabulated at member bearing points and at points equally spaced along the members at approximately ten feet on center or at tenth points along the span, whichever is greater. The finished deck elevations are those elevations on the top of the concrete deck. The tabulated member deflections are those deflections due to all dead loads except the selfweight of the members and cross members. These elevations and deflections are to be used to calculate haunch depths.

For precast concrete deck panels, deck elevations shall be tabulated at edges of the panels at the panel joints. The deck elevations are those elevations on the top of the concrete panel.

8.3.3 Finished Grade Elevations

Finished grade elevations are those elevations on top of the final riding surface (such as the bituminous concrete overlay). On all bridges, the finished grade elevations shall be shown at the following points:

- the intersection of the point of application of grade line with the deck joints and ends of slabs,
- the intersection of the gutter lines with the deck joints and ends of slabs, and
- the intersection of the cross slope breaks at the shoulders with the deck joints and ends of slabs.