10-20 Deck and Soffit Slab

Introduction

This Memo to Designers (MTD) provides deck and soffit slab details for bridges designed using the AASHTO Load and Resistance Factor Bridge Design Specifications (LRFD-BDS), Caltrans Amendments to LRFD-BDS and additional Caltrans considerations.

Deck and soffit slab details shown in Bridge Design Details 8-30 are applicable when using Caltrans Load Factor Design Bridge Design Specifications (LFD-BDS) only.

Policy

Design Engineers shall incorporate the deck and soffit slab details as shown in this MTD. Project specific design exceptions may be pursued.

Reinforced Concrete Deck Slabs

The Reinforced Concrete (RC) deck slab reinforcement details (Attachment 1) and the deck slab thickness and reinforcement schedule (Attachment 2) shown in this MTD shall be considered as a lower bound for a given span length.

In addition to AASHTO LRFD-BDS, the following factors have also been considered in developing the deck design charts:

1. **Deck Service Life:** In general, RC bridge decks designed using Caltrans LFD-BDS have been observed to have a satisfactory service life of at least 40 years. This service life has been extended through maintenance repairs.
2. **Fatigue:** One of the factors that affects bridge deck life is its capacity under fatigue loading. Research (Gongkang Fu et al, June 2000) has shown that the deck thickness has a significant influence on its fatigue life. Hence any reduction in deck thickness from that used in the past may adversely affect deck fatigue life.
3. **Deck flexibility:** Thinner decks are more prone to load related cracking than thicker decks over the same girder spacing.

This MTD does not apply to the design of prestressed deck slabs and deck slabs subjected to special vehicular loads such as material hauling equipment loads. The design criteria for these deck slabs should be developed and approved through the Type Selection process.

Deck Slab Design Parameters

Design Loads/Moments	Load Cases	
M_{DC}: Moment due to deck self weight M_{DW}: Moment due to 35 lb/ft^2 future wearing surface M_{LL}: See Table A4-1 and Note 4 Distribution Reinforcement (Art. 9.7.3.2) See Note 11 $220/\sqrt{S_{eff}} \leq 67\%$ S_{eff} = Effective span length	Strength I (Art. 5.7.3.2) $M_u = 1.25\ M_{DC} + 1.5\ M_{DW} + 1.75\ M_{LL}$ Resistance Factor (ϕ)= 0.9	Service I (Art. 5.7.3.4) $M_s = M_{DC} + M_{DW} + M_{LL}$ Exposure factor (γ_e) = 0.75 Negative moment d_c based on 2 1/2 inches clear cover

Deck Overhang Design Parameters

Design Loads/Moments	**Load Cases** (Art. A13.4.1)	
M_{DC}: Moment due to overhang and barrier self weight M_{DW}: Moment due to 35 lb/ft^2 future wearing surface M_{LL}: Moment due to live load plus impact (Art. 3.6.1.3.3 & 4.6.2.1.3) M_{CT}: Moment due to traffic railing design force F_t and F_v. See Table A13.2-1.	Case 1: Extreme Event II $M_u = 1.0\ M_{DC} + 1.0\ M_{DW} + 0.5\ M_{LL} + M_{CT}$ Where $M_{CT} = 1.2 F_t\ H_b / L_c$ (See Note 9) Resistance Factor (ϕ)= 1.0 Case 3: Strength I $M_u = 1.25\ M_{DC} + 1.5\ M_{DW} + 1.75\ M_{LL}$ Resistance Factor (ϕ)= 0.9	Case 2: Extreme Event II $M_u = 1.0\ M_{DC} + 1.0\ M_{DW} + 0.5\ M_{LL} + M_{CT}$ Where $M_{CT} = F_v\ L_{OH} / L_v$ Resistance Factor (ϕ)= 1.0 L_{OH}: Length of overhang (EOD to outerface of exterior girder)

NOTES/LIMITATIONS:

The following Notes/Limitations apply to the design of concrete deck slabs, and the details shown in Attachment 1.

1. Article (Art.) and table numbers correspond to those in the AASHTO LRFD Bridge Design Specifications and the corresponding California Amendments.
2. Design is based on approximate method of analysis – strip method (Art. 4.6.2.1).
3. Deck slab is designed for strength, service and extreme event limit states (Art. 9.5).
4. See Art. A4 for Live Load assumptions and limitations.

5. Design details are applicable only for decks supported on at least three girders and having a width not less than 14 feet between centerlines of exterior girders. They can also be used for bridge widenings, including single cell and two-girder widenings, provided a positive closure pour per MTD 9-3 is utilized, and the distance between the design sections for negative moment of the existing and new girders does not exceed that of any adjacent bay.
6. Overhang details are applicable for solid barriers only. Other types of barriers (example: post-and-beam barriers) will require a special design.
7. For steel girders, the transverse reinforcement shown for the exterior deck span shall be verified for overhang demands.
8. Overhang details are not designed for soundwall loading.
9. $F_t H_b / L_c$ is the moment due to vehicular impact force (Art. A13.2 and A13.4).
10. When the center-to-center spacing between the girders is less than or equal to 11 feet 6 inches, provide additional top transverse deck reinforcement in the overhang for a distance of 5 feet on either side of an expansion joint in the barrier rail, and at the ends of the barrier rail. This reinforcement shall consist of rebars that are the same size as that of the transverse bars, and shall be bundled with each alternating top transverse bar in the overhang. Extend these rebars for a minimum length of 25 bar diameters beyond the centerline of the exterior girder. See Attachment 1.
11. The positive moment region in the deck is assumed to be 0.5 S_{eff} for determining the number of 'D' bars. See Attachment 1, 2 for 'D' bars.

Reinforced Concrete Soffit Slabs

The soffit slab details shown in Table 10-20.2 (Attachment 3) conform to LRFD-BDS specifications and also to established Caltrans practice. While LRFD Specifications permit soffit slabs in prestressed concrete box girders to be thinner than those previously designed per Caltrans LFD-BDS, additional studies need to be conducted to ascertain both the strength and long-term service performance of box girders with thinner soffits. Until such time, the soffit details shown in Table 10-20.2 shall be used.

References

1. AASHTO, LRFD Bridge Design Specifications.
2. CALTRANS, Amendments to AASHTO LRFD-BDS.
3. CALTRANS, Bridge Memo to Designers 1-1.
4. Gongkang Fu *et al*, June 2000, "Effect of Truck Weight on Bridge Network Costs", NCHRP. Report 495, Transportation Research Board, Washington DC.

Attachments

Susan E. Hida

Technical Manager

Supervising Bridge Engineer, Structure Policy & Innovation

Division of Engineering Services