DEPARTMENT OF TRANSPORTATION

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Memo

To: **Bridge Design Engineers**

From: **Arielle Ehrlich**
State Bridge Design Engineer

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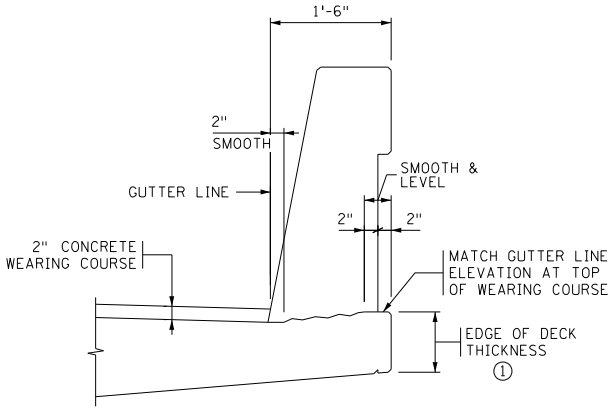
MEMO TO DESIGNERS (2017-01): Edge-of-Deck Thickness on Bridges and Wall Coping Height

For deck-on-beam type bridges, MnDOT's *LRFD Bridge Design Manual* (BDM) Figure 9.2.1 currently requires choosing an edge-of-deck thickness based on the type of deck to be constructed. For bridges with monolithic decks, an edge-of-deck thickness equal to 9" is required. When the deck consists of a 7" structural slab plus 2" concrete wearing course, an 8" edge-of-deck thickness is required. The current method for detailing the structural slab plus wearing course causes an abrupt vertical change in the coping line at the end of bridge expansion joints when the wingwalls are oriented parallel to the roadway. In order to simplify the current practice and provide a continuous coping line, the new practice is to require an edge-of-deck thickness that is equal to the deck thickness specified in BDM Tables 9.2.1.1 and 9.2.1.2 for all cases (typically 9", except for wide beam spacings). In the special case where a deck thickness less than 9" is specified (e.g., redecking of a bridge with existing deck thickness equal to 8½"), provide an edge-of-deck thickness equal to 9". For monolithic decks, the result is the same as current practice. For decks that include a concrete wearing course, the new practice will be accomplished by adjusting the top of deck as it passes beneath the barrier so that the edge-of-deck elevation is the same as the gutterline elevation. See Figure 1.

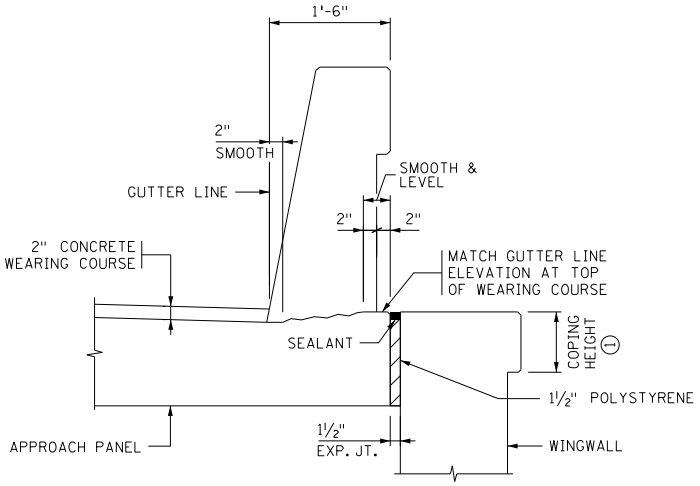
For wingwalls parallel to the roadway, current practice is to provide a coping on the outside face of the wall. For bridges with and without a wearing course, use a coping height that matches the edge-of-deck thickness. This will result in a continuous coping line on and off the superstructure. Figure 1 shows barrier details for the two cases of:

1) a barrier constructed on the approach panel
2) a barrier constructed on a wingwall

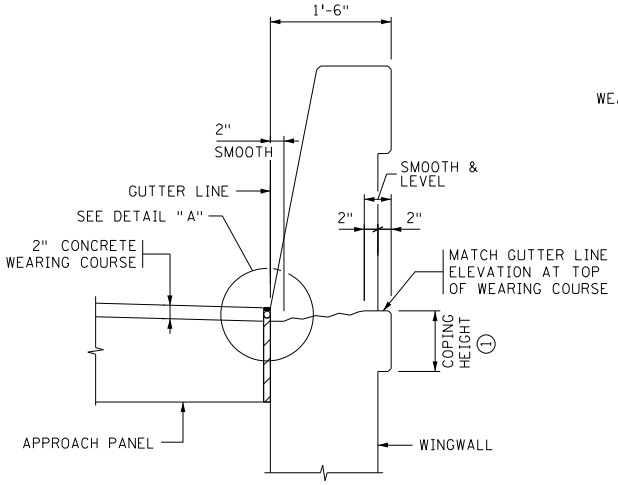
The cast-in-place concrete retaining wall standards currently show an 8" high coping. Revisions to the standards that show a 9" high coping will be published in the near future. Where a wingwall ties into a retaining wall, coordinate with the roadway designer as needed to set the retaining wall coping height to match the edge-of-deck thickness.



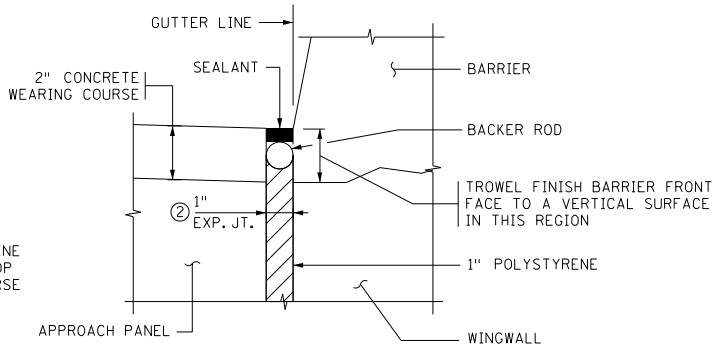
BARRIER SECTION ON DECK



BARRIER SECTION ON APPROACH PANEL



BARRIER SECTION ON WINGWALL



DETAIL A

① USE VALUE FOR "DECK THICKNESS" GIVEN IN BDM TABLES 9.2.1.1 AND 9.2.1.2.

② POLYSTYRENE, BACKER ROD, AND JOINT SEALANT ARE INCIDENTAL TO APPROACH PANEL CONSTRUCTION.

EDGE OF DECK AND COPING DETAILS
FOR BRIDGES WITH A WEARING COURSE

Figure 1

These changes result in the following revisions to previous guidance found in the Memo to Designers (2016-01):

1) In the guidance regarding plumb vs. perpendicular barrier placement, the 5th bullet as well as Figures 2, 3, and 4 of Memo to Designers (2016-01) called for a level deck surface beneath the barrier. For decks that include a concrete wearing course, the top of deck under the barrier will not be level, but will slope as shown above in Figure 1 of this Memo to Designers. However, the barrier orientation will still remain plumb or perpendicular as defined in the previous memo.

2) For the deck overhang design, the net effect of the edge-of-deck change for decks that include a concrete wearing course is to reduce the deck thickness at the gutter line. Therefore, the entire section regarding deck overhang design is superceded by the following:

   Deck Overhang Design

   Deck overhang requirements are dependent on the overhang length and overhang location along the bridge.

   - For deck overhangs (measured from centerline of beam to edge of deck) of up to 40% of the beam spacing that carry a Type S barrier, the BDM deck reinforcement Tables 9.2.1.1 and 9.2.1.2 may be used for the interior overhang regions. For the exterior overhang regions (applies to regions where the longitudinal barrier reinforcement is discontinuous, such as end of bridge joints and expansion joints), the following modifications to the overhang reinforcement are necessary to meet NCHRP 350 Test Level 4 (TL-4). Note that the modifications only apply when the gutter line is located outside the edge of the fascia beam flange. For cases where the gutter line is located inside the edge of the fascia beam flange, provide reinforcement per the BDM deck reinforcement Tables 9.2.1.1 and 9.2.1.2 with no modification.
     - For a 36” Type S barrier on a deck with wearing course supported by steel beams spaced greater than 12 feet apart, provide top transverse hooked #5 bars at 6” spacing over a distance of 8 feet from the joint. Lap these bars to the top transverse #6 bars at 6” called for by Table 9.2.1.2. Include 180 degree standard hooks on the edge-of-deck ends of the #5 bars.
     - For all other cases with a 36” Type S barrier, provide #5 bars at 5” spacing or $A_s = 0.74$ in^2/ft for the top transverse bars over a distance of 8 feet from the joint. Include 180 degree standard hooks on the edge-of-deck ends of these bars. This can be accomplished either by providing hooked overhang bars that splice to the main transverse deck bars or by providing hooked transverse bars that run from edge to edge of the deck.
     - For the 42” Type S, where the deck consists of a 9” monolithic slab or a 7” structural slab plus a 2” concrete wearing course, include 180 degree standard hooks on the edge-of-deck ends of the top transverse bars over a distance of 9 feet from the joint. This can be accomplished either by providing hooked overhang bars that splice to the main transverse deck bars or by providing hooked transverse bars that run from edge to edge of the deck.

- For the 54” Type S, no modification is needed. Provide reinforcement per the BDM deck reinforcement Tables 9.2.1.1 and 9.2.1.2.
- Provide an edge-of-deck thickness that is equal to the deck thickness specified in BDM Tables 9.2.1.1 and 9.2.1.2 for all cases (typically 9”, except for wide beam spacings). When edge-of-deck thicknesses are greater than 9”, adjust the wingwall coping height to match the edge-of-deck thickness. Where the wingwall ties into a retaining wall, coordinate with the roadway designer as needed to set the retaining wall coping height to also match the edge-of-deck thickness.
- For deck overhangs that require a special design, use the following guidance for checking the extreme event limit state.
- Design collision loads F_{cdes} and M_{cdes} will be needed to complete the deck overhang design. For each barrier height H, values for L_c, M_c, and R_w have been determined using the yield line method found in AASHTO LRFD Spec. Article A13.3.1. The TL-4 value of 54 kips for F_t was adjusted for the difference between the barrier height and height of F_t application. Then $4/3 \cdot F_t$ was compared to R_w, and the smaller value distributed over $L_c + H$ for end regions and $L_c + 2H$ for interior regions. Also, M_c was adjusted when $4/3 \cdot F_t$ governed. The results are the moments M_{cadj} and tension forces F_{cadj} given in Table 1 below.

	36" Type S		42" Type S		54" Type S	
	Exterior	Interior	Exterior	Interior	Exterior	Interior
M_{cadj} (k-ft/ft)	20.5	9.4	18.8	7.8	17.4	6.7
F_{cadj} (k/ft)	7.9	3.7	6.1	2.7	4.1	1.8

Table 1

In order to use these values, translate the moment M_{cadj} at the top of the deck to a moment M_{cdes} located at the center of the deck using the following method (refer to Figure 2):

$$e = M_{cadj} / F_{cadj}$$

$$F_{cdes} = F_{cadj}$$

For monolithic decks: $M_{cdes} = F_{cdes} \cdot (e + 0.5 \cdot t_{deck})$

For decks consisting of structural slab plus wearing course:

$$M_{cdes} = F_{cdes} \cdot (e + 0.5 \cdot t_{str\ slab})$$

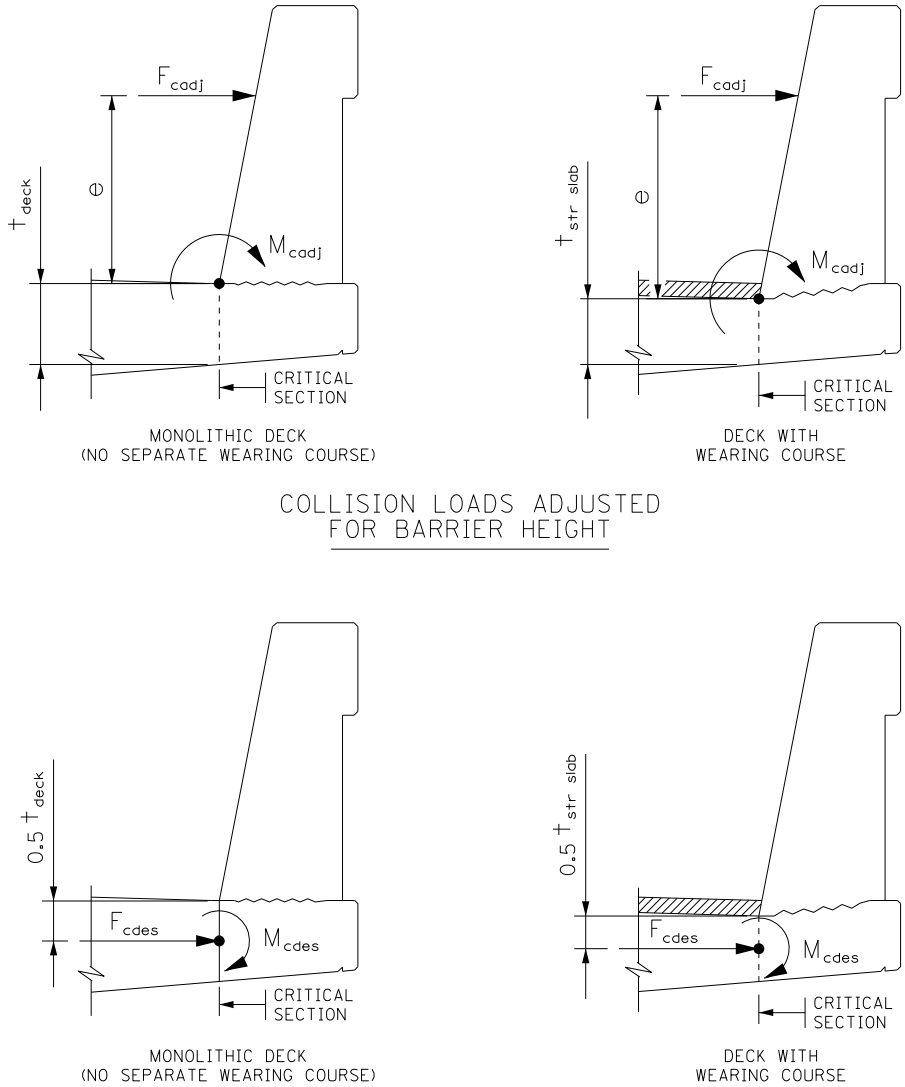


Figure 2

Use the tension force F_{cdes} and moment M_{cdes} as the collision loads for the deck overhang design.

Revision of the edge-of-deck thickness and coping height per this memo is to begin immediately for all new preliminary bridge plans.

If you have any questions, please contact Dave Dahlberg (dave.dahlberg@state.mn.us or (651) 366-4491) or me.

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