16.8 Analysis of Deck Overhangs on Existing Bridges for Solid Concrete Parapet Rail Collision Forces

16.8.1 GENERAL

This STP addresses the analysis of deck overhangs on existing bridges for solid concrete parapet rail collision forces.

For barrier rail upgrade projects using solid concrete parapet rails with heights less than or equal to 3.5 feet, replacement and existing deck overhangs on existing bridges must meet the requirements of the American Association of State Highway and Transportation Officials Load and Resistance Factor Design Bridge Design Specifications, 8th Edition, (AASHTO LRFD) Article A13.4.1 Design Case 1 unless otherwise specified herein. This document addresses Design Case 1 in Article A13.4.1 only.

16.8.2 DESIGN CASE 1

The deck overhang must be designed for the load combination of Extreme Event II limit state without including the effects of the longitudinal design force, F_L, from AASHTO LRFD Table A13.2-1. The force effects on the deck overhang due to the rail collision force, F_t, as shown in Figure 1 must be taken as the combined transverse tensile force T and transverse moment M_{ct} as specified below:

For portions of the overhang located further than 5 feet from a deck joint:

$$T = \frac{F_t}{L_c + 2H + 2X}$$

$$M_{ct} = \frac{F_t H}{L_c + 2H + 2X}$$

For portions of the overhang located within 5 feet of a deck joint:

$$T = \frac{F_t}{L_c + H + X}$$

$$M_{ct} = \frac{F_t H}{L_c + H + X}$$

where:

T = deck overhang transverse tensile force per unit length due to F_t (kip/foot)

M_{ct} = deck overhang transverse moment per unit length due to F_t (kip-feet/foot)

F_t = transverse traffic railing design force from AASHTO LRFD Table A13.2-1 (kips)

L_c= critical length of solid concrete parapet rail yield line failure pattern (feet); L_c must be taken as 10 feet on portions of overhangs located further than 5 feet from a deck joint and 5 feet on portions of overhangs located within 5 feet of a deck joint.

H = height of solid concrete parapet rail (feet)

X = transverse distance from the toe of barrier to the deck overhang section being considered (feet)

For simplicity of analysis, H is used as the moment arm to determine M_{ct}. The theoretical moment arm is the vertical distance between the centroid of the collision force and the centroid of the overhang section being analyzed. The effective length of the deck overhang resisting the rail collision force is shown in Figure 2.

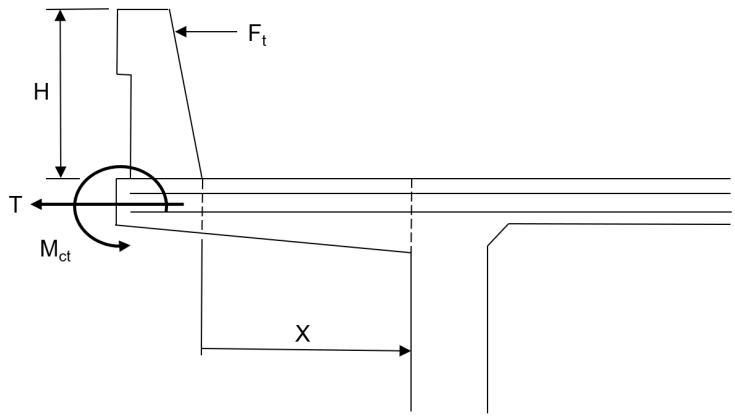

Figure 1. Force Effects on Deck Overhang Due to Rail Collision Force

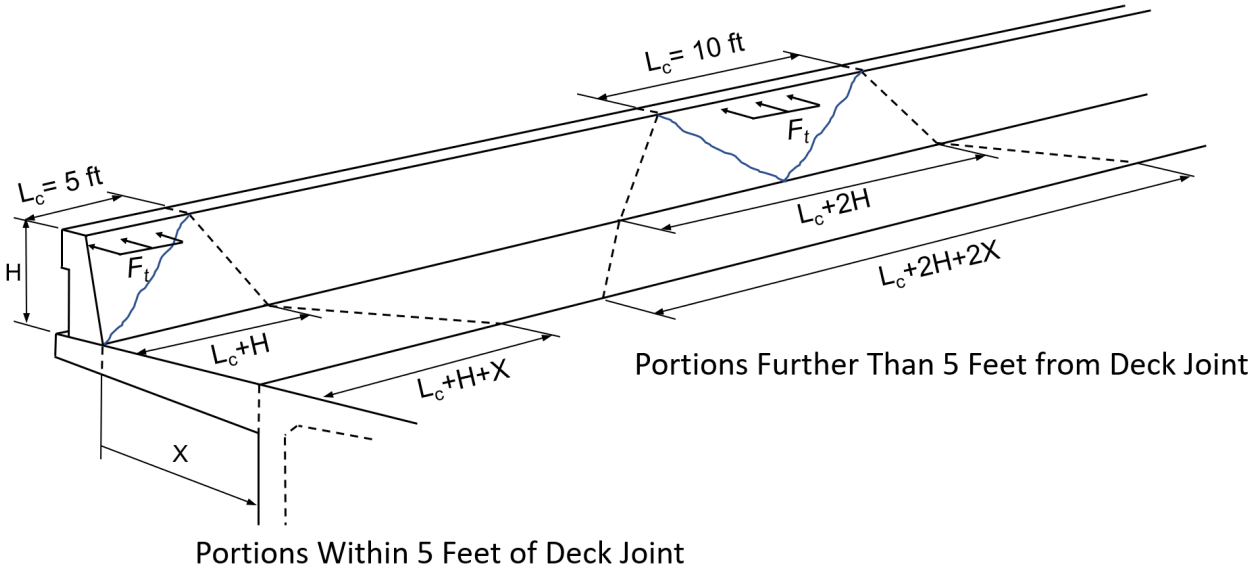

Figure 2. Effective Length of Deck Overhang Resisting Rail Collision Force

16.8.3 FLEXURAL RESISTANCE

The flexural resistance of the deck overhang must be determined in accordance with AASHTO LRFD and California Amendments Section 5 with the following additional requirements:

- For existing overhangs, both the top and the bottom transverse reinforcement must be considered.

The expected yield strength of the existing overhang reinforcement and the expected concrete compressive strength of the deck overhang must be used in lieu of the specified minimum yield strength and specified concrete compressive strength respectively. The strain hardening of the reinforcement beyond the expected yield strength must not be considered.