To: New York State Department of Transportation ENGINEERING BULLETIN EB 05-002

Title: REVISED BRIDGE DETAIL SHEETS FOR STEEL BRIDGE RAILING

Distribution:
 xấu Manufacturers (18)
✓ Local Govt. (31)
 deficits Agencies (32)
 vx Surveyors (33)
 vx Consultants (34)
 vx Contractors (39)
 vx ______________ ( )

Approved: /s/ G. A. Christian
GEORGE A. CHRISTIAN
Acting Deputy Chief Engineer (Structures) 1/6/05 Date

ADMINISTRATIVE INFORMATION:

- Effective Date: This Engineering Bulletin (EB) is effective beginning with projects submitted for the letting of 09/08/05.
- Bridge Detail (BD) Sheets BD-RS1 R2, BD-RS2 R2, BD-RS3 R3, BD-RS4 R2, BD-RS5 R3, BD-RS6 R2, BD-RS7 R2 and BD-RS8 R2 are superseded.
- This issuance does not supersede any Engineering Instructions or Engineering Bulletins.

PURPOSE: This EB announces the availability of revised details for steel bridge railing and steel bridge railing to box beam guide rail transitions.

TECHNICAL INFORMATION:

- BD Sheets RS1 R3, RS2 R3, RS3 R4, RS4 R3, RS5 R4, RS6 R3, RS7 R3, and RS8 R3 replace the superseded BD sheets.
- Design changes have been made so that the steel bridge railing to box beam guide rail transition is adequate for NCHRP Test Level-4 (TL-4) service.
- The embedment length of the railing post anchor bolts in bridge decks has been increased to 215 mm. The increased length does not affect the performance of the railing, but minimizes the damage to the deck if a vehicle impact to the bridge railing occurs.
- Minor editorial changes have been made.
- Revisions to specific BD Sheets are described below:
  - BD-RS1 R3 STEEL BRIDGE RAILING TWO-RAIL AND THREE-RAIL
  - BD-RS2 R3 STEEL BRIDGE RAILING FOUR-RAIL
  - BD-RS3 R4 STEEL BRIDGE RAILING FIVE-RAIL FOR BICYCLES
    - Embedment length of the anchor bolt has been increased to 215 mm.
  - BD-RS4 R3 STEEL BRIDGE RAILING TO BOX BEAM GUIDE RAIL TRANSITION
  - BD-RS5 R4 STEEL BRIDGE RAILING FOUR-RAIL FLARED TRANSITION TO HIGHWAY BOX BEAM
    - The top rail on four-rail bridge rails and the fourth rail on the five-rail bridge rail is turned down and bolted to the top of the third bridge rail; the box-beam expansion splice assembly is relocated to the second heavy post upstream of the bridge rail; the bottom bridge rail splice location remains at the first heavy post upstream of the bridge rail but the rail length is extended.
  - BD-RS6 R3 STEEL BRIDGE RAILING ON U-WINGWALLS
    - The top bridge rail is turned down and bolted to the top of the third bridge rail.
  - BD-RS7 R3 STEEL BRIDGE RAILING COMMON DETAILS & TRANSITION

No changes have been made except to consolidate notes.
Dimensions of the fill plate on the sides of the galvanized expansion splice tube are changed to 100 mm x 6 mm x 875 mm; the expansion plate on the top of the tube is moved to the bottom and its dimensions changed to 100 mm x 6 mm x 500 mm; dimensions of the expansion splice bar are changed to 108 mm x 54 mm x 900 mm. Dimensions of the fill plate on the sides of the galvanized tube are changed to 100 mm x 6 mm x 660 mm; dimensions of the fill plate on the bottom of the tube are changed to 100 mm x 6 mm x 660 mm; dimensions of the fixed splice bar are changed to 108 mm x 54 mm x 900 mm. A detail is provided for a chamfer on all bar edges.

TRANSMITTED MATERIALS: No BD sheets are transmitted with this Engineering Bulletin. Bridge Detail sheets BD-RS1 through BD-RS8 with revised details are available on NYSDOT’s website (www.dot.state.ny.us/caddinfo/structures/bd.html).

BACKGROUND: NYSDOT’s steel bridge railings currently in use meet NCHRP 350 standards for Test Level-4 (TL-4). However, the box-beam transition attached to the four-rail curbless bridge railing failed to meet criteria for crash testing performed with a 2,000 kg (4,400 lb) pickup truck at 100 km/hr (60 mph) with a 25° angle of impact. Significant deformation of the vehicle occupant compartment resulted from the vehicle snagging on the rail splice joints after the rail element was partially collapsed.

A finite element model (FEM) of the box beam transition was created to attempt to capture the vehicle-railing interactions that contributed to the deformation of the occupant compartment. When the FEM successfully replicated the behavior of the transition section under crash conditions that simulated those of NCHRP 350 crash testing, the model was altered to see if modifications to the design proposed by NYSDOT and FHWA would mitigate the snagging behavior. Changes included turning the end of the top bridge rail down and bolting it to the top of the third bridge rail element, shortening the distance between the last transition post and the first bridge post, moving the box beam expansion splice for the third and second rails upstream, extending the bottom rail upstream with an expansion splice of its own, and changing splice details to allow for a tighter yet constructible connection. After the modified design performed satisfactorily in the computer simulations, the transition was constructed and retested with the pickup truck. The modified transition section performed acceptably.

The single-unit truck test used to verify TL-4 performance is a less demanding strength test than the pickup truck test because the impact speed and angle are less. The large tires of the single-unit truck are also much less likely to snag on any transition elements. The single-unit truck test is primarily a geometry test because the truck’s high center of gravity creates a potential roll-over problem. Transition sections comparable to NYSDOT’s design have been successfully crash-tested with the single-unit truck with no rollover. Therefore, because of geometric similarity between these designs and NYSDOT’s, and the successful pickup truck crash test of NYSDOT’s transition section with the four-rail bridge railing, the FHWA accepted the box-beam transition design for use with all standard NYSDOT steel bridge railing systems as TL-4 designs, with modifications specific to each system.

It is also noted that the small car crash test was not conducted on the transition section. The critical aspect of this test is whether the small car can get wedged under the bridge rail. NYSDOT’s bridge rail design incorporates a bottom rail which prevents this from happening.
REFERENCES: Crash test reports and background information are available through the Structures Division Standards Unit at the contact telephone number listed below. Previous changes to steel bridge railings already detailed on the BD sheets and in current use are described in EI 01-27 and EB 02-024.

CONTACT: Direct questions about this EI to Laurel Bryden of the Structures Division Standards Unit at (518) 457-9869 or by e-mail to lbryden@dot.state.ny.us.