Plans for Crash-Tested Bridge Railings for Longitudinal Wood Decks

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Abstract

In the past decade, bridge railing design criteria have moved away from static load design and have focused on full-scale crash testing as a more appropriate and reliable means of evaluating bridge railings. The five bridge railing plans presented reflect the results of a cooperative research project between the Midwest Roadside Safety Facility, University of Nebraska–Lincoln; the USDA Forest Service, Forest Products Laboratory; and the Federal Highway Administration. The project objective was to develop and crash test bridge railings and approach railings for longitudinal wood bridge decks. The bridge railings were completed in accordance with AASHTO Performance Level 1, Performance Level 2, and NCHRP Report 350 Test Level 4 (TL-4). Approach railings were tested or adapted from previous testing in accordance with NCHRP Report 230. Full drawing sets are provided in customary U.S. and SI units of measure. The testing procedures, results, and drawings have been approved by the Federal Highway Administration Federal-Aid and Design Office for use on Federal-aid highway projects.

Keywords: Bridge, wood, railing, deck, crash-tested
Plans for Crash-Tested Bridge Railings for Longitudinal Wood Decks

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Introduction

Bridge railings have historically been designed based on static-load design criteria. In the past decade, design criteria has refocused toward full-scale crash testing as a more appropriate and reliable method of evaluating bridge railings. These plans reflect the results of a cooperative research project between the Midwest Roadside Safety Facility, University of Nebraska-Lincoln; the USDA Forest Service, Forest Products Laboratory; and the Federal Highway Administration. The objective of the project was to develop and crash test bridge railings and approach railings transitions for longitudinal wood bridge decks. The bridge railings were completed in accordance with AASHTO Performance Level 1 (PL-1) and Performance Level 2 (PL-2) requirements and are described in the cited reports. One bridge railing was also tested to the requirements of NCHRP Report 350, Test Level 4 (TL-4). Approach railings were tested or adapted from previous testing in accordance with NCHRP Report 230. For the convenience of the user, full drawing sets have been provided in customary U.S. and SI units. The testing procedures, results, and drawings have been approved by the Federal Highway Administration Federal-Aid and Design Office for use on Federal-aid highway projects.

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Specifications


References


Comments

Comments on these drawings should be addressed to the Timber Bridge Team, Forest Products Laboratory, One Oxford Pinhoti Drive, Madison, WA 93705-2306.

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Rail Drawings in Customary U.S. Units
General Configuration

Section A-A

Section B-B

Plan View

Front Elevation

Back Elevation

Railing Details

For stress-tensioned decks, omit internal plate and ASTM A722 steel bars.

End View

Steel Bearing Plate

W6 x 15 Steel Post

W6 x 15 Steel Spacer

Crash-Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail
AASHTO Performance Level 1
September 1995
Sheet 1 of 2
In addition to the notes on Sheet 1, the following apply to the approach rail transition:

1. The approach rail transition was successfully crash tested on 8/13/95, in accordance with the AASHTO Level I (25-1-1), as outlined in AASHTO M180.

2. Thru-beam and thru-beam terminal connections shall be 1/2" grade. W-beam/Thru beam installation and attachment shall comply with the requirements of AASHTO M180.

3. W-beam and thru-beam rut relief bolts and post bolts shall comply with AASHTO M180.
**General Configuration**

**Section A-A**

**Section B-B**

**Plates**

**Front Elevation**

**Railing Details**

For stress-laminated decks, omit internal plate and ASTM A722 steel bars.

**Internal Steel Plate**

**Steel Bearing Plate**

**W6 x 15 Post**

**W6 x 15 Spacers**

**Rail Post Connection Detail**

Note: 1 in. steel bars omitted for clarity.

**DESIGN**

1. This bridge rail was successfully crash tested to the requirements for Performance Level 2 (P-2) as outlined in the AASHTO LRFD Bridge Design Specifications. It is adaptable to longitudinal stress-laminated, stress-graded, and other high-strength wood for which manufacturer's stress-deck tables which are 10-1/2 in. or greater in actual thickness.

2. Steel deck reinforcing bars shall be 1 in. diameter ASTM A722 bars.

3. AASHTO A-233 bars.

4. Steel plates and angles shall comply with the requirements of AASHTO A36.

5. All steel components and fasteners shall be galvanized in accordance with AASHTO M181 or ASTM A525 or the equivalent minimum two-coat process with 2000 g/m² minimum coating weight. Galvanized steel shall bear the marking of the manufacturer or the manufacturer's trademark if not to adversely affect the mechanical properties of the steel. Galvanized steel components after welding.

6. Eccentric spacing and fasteners shall be required in accordance with the requirements of the AASHTO/AISI/DISC/SAE Bridge Design Guide.

**Crash-Tested Bridge Rails for Longitudinal Wood Decks**

**Steel Rail**

AASHTO Performance Level 2

September 1995

Sheet 1 of 4
Steel Channel Details

Type A: Interior Segments 3/4 x 1-1/2 channel. All holes are 5/8 in. # with 1-1/16 in. stats.

Type B: Exterior Segments at Bridge Ends 3/4 x 1-1/2 channel. All holes are 5/8 in. # with 1-1/16 in. stats.

Channel Connection Details

Section C-C

Channel Splice Connection Details

Section D-D

Steel Splice Plate

Steel Angle
Approach Rail Transition General Configuration

- Type C channel
- Type D channel
- See Transition Detail H.
- See Channel Connection Detail X.
- W-beam/W-beam transition
- 10 gauge thin beam

Notes:
- Equal beam gages are necessary for compatibility and tandem use.
- Tolerances may vary due to specific requirements.

W6 x 15 Spacer 1

- 1-1/4" x 1-1/4"
- 1-1/4" x 1-1/4"
- 3-1/8"
- 7-3/16"
- 7-7/16"
- 7-7/16" (typical)

W6 x 15 Spacer 2

- 1-1/4" x 1-1/4"
- 1-1/4" x 1-1/4"
- 3-1/8"
- 7-3/16"
- 7-7/16" (typical)

W6 x 15 Post 1

- 1-3/8"
- 3-1/8" (typical)

W6 x 15 Post 2

- 1-3/8"
- 3-1/8" (typical)

Transition Detail

- See plate-to-plate connection, Detail W.
- See Channel Connection Detail X.

Notes:
- T-beam/W-beam transition and thin beam shall be 10 gauge.
- T-beam/W-beam transition and thin beam shall be 10 gauge.
- All shall comply with the requirements of AASHTO M180.

Crash-Tested Bridge Rails for Longitudinal Wood Decks
The bridge railings depicted on these drawings were developed and crash-tested under a cooperative research agreement between the Midwest Roadside Safety Facility of the University of Nebraska-Lincoln, the USDA Forest Service, Forest Products Laboratory and the Federal Highway Administration.

Crash-Tested Bridge Rails for Longitudinal Wood Decks

University of Nebraska Lincoln
AASHTO Performance Level 2

September 1996
Sheet 4 of 4
Rail Drawings in S.I. Units
Approach Rail Transition General Configuration

All units are in millimeters based on a soft conversion from customary U.S. units.

Transition Connection Details

3 Dimensional Explosion of Transition Connection

Curb Transition

Glulam Rail Boring Detail

Steel Transition Plate

Crash-Tested Bridge Rails for Longitudinal Wood Decks

Glulam Timber Rail with Curb

AASHTO Performance Level 1

University of Nebraska
Lincoln

September 1995
Sheet 2 of 2
The bridge railings depicted in these drawings were developed and crash tested under a cooperative research agreement between the Missouri Research and Development Facility of the University of Nebraska-Lincoln and the USDA Forest Service, Forest Products Laboratory.

Crash-Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail

AASHTO Performance Level 1

September 1996

Sheet 1 of 2
Approach Rail Transition General Configuration

All units are in millimeters based on a soft conversion from customary U.S. units.

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In addition to the notes on Sheet 1, the following apply to the approach rail transition:

1. The approach rail transition was successfully crash tested to the requirements for Service Level 1 (SL-1), as outlined in NCHRP Report 239.
2. Pipe sheet and pipe gusset corner connection seen on Sheet 1. Slotted W-beam and/or rail transition must be installed on the rail with the requirements of AASHTO M600, all rail comply with the requirements of AASHTO M180.
3. W-beam and pipe beam rail splice bolts and post bolts shall comply with AASHTO M600.

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Crash-Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail
AASHTO Performance Level 1
September 1995
Sheet 2 of 2
General Configuration

All units are in millimeters based on a soft conversion from customary U.S. units.

Section A-A
Three beam rolls
Steel channel

Section B-B
Steel universal profile
Refer to Sheets 3 and 4 for Approach Rail Transition.

Plan
Front Elevation
Back Elevation

A Railing Details
For stress-laminated decks, omit internal plate and ASTM A722 steel bars.

B Rail Post Connection Detail
Note: 25 # steel bars omitted for clarity.

C Internal Steel Plate

D Steel Bearing Plate

E W150 x 22 Post

F W150 x 22 Spacer

The bridge railings depicted on these drawings were developed and crash tested under a cooperative research agreement between the Midwest Roadside Safety Facility at the University of Nebraska-Lincoln, the USDA Forest Service, Forest Products Laboratory and the Federal Highway Administration.

Crash Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail
AASHTO Performance Level 2

September 1995

Sheet 1 of 4
**Steel Channel Details** 

All units are in millimeters based on a split conversion from customary U.S. units.

Type A: Interior Segments 300 x 17 channel. All holes are 19 # with 27 slots.

Type B: Exterior Segments at Bridge Ends 300 x 17 channel. All holes are 19 # with 27 slots.

**End Plate Connection Detail**

Weld Schematic attachment to channel.

**Channel Connection Details**

Section C-C

**Steel Splice Plate**

**Steel End Plate**

**Channel Splice Connection Details**

Section D-D

**Steel Angle**

89 x 89 x 7.0 mm angle

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The bridge railings depicted on these drawings were developed and crash tested under a cooperative research agreement between the Midwest Roadside Safety Facility of the University of Nebraska-Lincoln, the USDA Forest Service, Forest Products Laboratory and the Federal Highway Administration.

University of Nebraska Lincoln

Crash-Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail AASHTO Performance Level 2

September 1995

Sheet 2 of 4
Approach Rail Transition General Configuration

All units are in millimeters based on a soft conversion from customary U.S. units.

W150 x 22 Spacer 1

W150 x 22 Post 1

W150 x 22 Spacer 2

W150 x 22 Post 2

Transition Detail

In addition to the notes on Sheet 1, the following apply to the approach rail transition:
1. The approach rail transition was successfully crash tested to the requirements for Service Level 1 (SL-1), as outlined in NCHRP Report 230.
2. Throat beam and thrie beam termination connection shall be 10 gauge W-beam/thrie beam transition and w-beam shall be in place as shown and comply with the requirements of AASHTO M180.
3. W-beam and thrie beam rail splice bolts and post bolts shall comply with AASHTO M180.

Crash-Tested Bridge Rails for Longitudinal Wood Decks

Steel Rail
AASHTO Performance Level 2

September 1995
Sheet 3 of 4