

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

USDA Forest Service / UNL Faculty Publications

U.S. Department of Agriculture: Forest Service --
National Agroforestry Center

8-1998

Plans for Crash-Tested Wood Bridge Railings for Concrete Decks

Michael A. Ritter

USDA Forest Service

Ronald K. Faller

University of Nebraska - Lincoln, rfaller1@unl.edu

Paula D. Hilbrich Lee

USDA Forest Service


Barry Thomas Rosson

University of Nebraska - Lincoln

Sheila Rimal Duwadi

Federal Highway Administration

Follow this and additional works at: <http://digitalcommons.unl.edu/usdafsfacpub>

 Part of the [Forest Biology Commons](#), [Forest Management Commons](#), [Other Forestry and Forest Sciences Commons](#), and the [Plant Sciences Commons](#)

Ritter, Michael A.; Faller, Ronald K.; Hilbrich Lee, Paula D.; Rosson, Barry Thomas; and Duwadi, Sheila Rimal, "Plans for Crash-Tested Wood Bridge Railings for Concrete Decks" (1998). *USDA Forest Service / UNL Faculty Publications*. 364.

<http://digitalcommons.unl.edu/usdafsfacpub/364>

This Article is brought to you for free and open access by the U.S. Department of Agriculture: Forest Service -- National Agroforestry Center at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in USDA Forest Service / UNL Faculty Publications by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.



United States
Department of
Agriculture

Forest Service

Forest
Products
Laboratory

U.S. DOT
Federal Highway
Administration

General
Technical
Report
FPL-GTR-108



Plans for Crash-Tested Wood Bridge Railings for Concrete Decks

Michael A. Ritter
Ronald K. Faller
Paula D. Hilbrich Lee
Barry T. Rosson
Sheila Rimal Duwadi



Abstract

As part of a continuing cooperative research between the Midwest Roadside Safety Facility (MwRSF); the USDA Forest Service, Forest Products Laboratory (FPL); and the Federal Highway Administration (FHWA), several crashworthy wood bridge railings and approach railing transitions have been adapted for use on concrete bridge decks. These railings meet testing and evaluation criteria outlined in National Cooperative Research Program (NCHRP) Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features*, and include a glued-laminated timber (glulam) rail, with and without a curb, at Test Level- 2 (TL-2), a glulam rail with curb at TL-4, and a glulam curb rail for low-volume roads at TL-1. In adapting the railings from a wood deck to a concrete deck, the critical consideration was railing attachment to the deck. A comparable connection was obtained by an analysis of maximum loads measured by field instrumentation during crash testing or by equating the ultimate capacity of connections used on the wood deck to those required for a concrete deck. For the convenience of the user, full drawing sets are provided in customary U.S. and S.I. units.

August 1998

Ritter, Michael A.; Faller, Ronald K.; Lee, Paula D. Hilbrich; Rosson, Barry T; Duwadi, Sheila Rimal. 1998. Plans for crash-tested wood bridge railings for concrete decks. Gen. Tech. Rep. FPL-GTR-108. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 18 p.

A limited number of free copies of this publication are available to the public from the Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398. Laboratory publications are sent to hundreds of libraries in the United States and elsewhere.

The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

The use of trade or firm names is for information only and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or familial status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (braille, large print, audiotape, etc.) should contact the USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410, or call (202) 720-5964 (voice and TDD). USDA is an equal employment opportunity employer.

Plans for Crash-Tested Wood Bridge Railings for Concrete Decks

Michael A. Ritter, Research Engineer¹
 Ronald K. Faller, Research Engineer²
 Paula D. Hilbrich Lee, General Engineer¹
 Barry T. Rosson, Associate Professor²
 Sheila Rimal Duwadi, Research Structural Engineer³

¹USDA Forest Service, Forest Products Laboratory

²Midwest Roadside Safety Facility, University of Nebraska-Lincoln

³Federal Highway Administration, Turner-Fairbank Highway Research Center

Introduction

Cooperative research between the Midwest Roadside Safety Facility (MwRSF); the USDA Forest Service, Forest Products Laboratory (FPL); and the Federal Highway Administration (FHWA) has resulted in the development of several crashworthy bridge railings for wood bridge decks (Faller et al. 1992). These railings involve both wood and steel systems and include crashworthy approach railing transitions. Criteria for evaluation and testing of these railings were originally based on requirements given in National Cooperative Research Program (NCHRP) Report 230, *Recommended Procedures for the Safety Performance Evaluation of Highway Appurtenances* (NCHRP 1981). Starting in 1993, criteria were based on NCHRP Report 350, *Recommended Procedures for the Safety Performance Evaluation of Highway Features* (Ross et al. 1993). In accordance with FHWA policy, those railings found acceptable under the NCHRP 230 criteria are also considered as meeting the requirements of NCHRP Report 350 without further testing. Given the success of the wood bridge railing development and crash testing, interest was expressed at the national level to adapt several of the wood bridge railings to concrete decks. These drawings include four railings that meet NCHRP 350 requirements and were adapted for concrete deck use. They include a glued-laminated timber (glulam) rail, with and without a curb, at Test Level 2 (TL-2), a glulam rail with curb at TL-4, and a glulam curb rail for low-volume roads at TL-1. In adapting the railings from a wood deck to a concrete deck, the critical consideration was railing attachment to the deck. A comparable connection was obtained by an analysis of maximum loads measured by field instrumentation during crash testing or by equating the ultimate capacity of connections used on the wood deck to those required for a concrete deck. For the convenience of the user, full drawing sets are provided in customary U.S. and S.I. units.

The USDA Forest Service and the U.S.DOT FHWA hereby give notice that the information herein contained shall not create any warranty, express or implied. The person or organization using this information waives and relinquishes any and all claims against the United States of America, its officers, employees, and project cooperators, for any loss, damage, personal injury, or death incident to, or occurring as a consequence of, the use thereof.

Acknowledgments

We express sincere appreciation to Brent Prauner, Keith Robertson, and Eric Keller of the Midwest Roadside Safety Facility, University of Nebraska-Lincoln, and the FPL Information Services Team for assistance in preparing this publication.

Specifications

AASHTO. 1989. Guide Specifications for Bridge Railings. Washington, DC: American Association of State Highway and Transportation Officials.

AASHTO. 1995. Standard Specifications for Transportation Materials and Methods of Sampling and Testing. Vol. 1: Specifications. Washington, DC: American Association of State Highway and Transportation Officials.

M111 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 M133 Preservatives and Pressure Treatment Process for Timber
 M168 Wood Products
 M180 Corrugated Sheet Steel Beams for Highway Guardrail
 M232 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ANSI/AASHTO/AWS D1.5-88. Bridge Welding Code. Washington, DC: American Association of State Highway and Transportation Officials.

ASTM. 1998. Annual Book of ASTM Standards. Philadelphia, PA: American Society for Testing and Materials.

A36 Standard Specification for Structural Steel
 A47 Standard Specification for Ferritic Malleable Iron Castings
 A307 Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

SAE 1989. J412. General Characteristics and Heat Treatment of Steels. Warrendale, PA. Society of Automotive Engineers.

References

Faller, R.K.; Ritter, M.A.; Holloway, J.C.; [and others]. 1992. Performance level 1 bridge railings for timber decks. In: Transportation Research Record 1419. Washington, DC: Transportation Research Board, National Research Council: 21-34.

NCHRP. 1981. Recommended procedures for the safety performance evaluation of highway appurtenances. NCHRP Rep. 230. Washington, DC: National Research Council, Transportation Research Board, National Cooperative Highway Research Program.

Ritter, M.; Faller, R. 1994. Crashworthy bridge railing for longitudinal wood decks. In: PTEC 94 Timber shaping the future: Proceedings of Pacific Timber Engineering conference; 1994 July 11-15; Gold Coast, Australia. Queensland, Australia: Fortitude Valley MAC; 2: 298-307.

Ritter, M.A.; Faller, R.K.; Lee, P.D.H., [and others]. 1995. Plans for crash-tested bridge railings for longitudinal wood decks. Gen. Tech. Rep. FPL-GTR-87. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Ritter, M.A.; Faller, R.K.; Bunnell, S.; [and others]. 1998. Plans for crash-tested bridge railings for longitudinal wood decks on low-volume roads. Gen. Tech. Rep. FPL-GTR-**. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Ross, H.E., Jr.; Sicking, D.L.; Zimmer, R.A.; Michie, J.D. 1993. Recommended procedures for the safety performance evaluation of highway features, NCHRP Rep. 350. Washington, DC: National Research Council, Transportation Research Board, National Cooperative Highway Research Program.

Rosson, B.T.; Faller, R.K.; Ritter, M.A. 1995. Performance level 2 and test level 4 bridge railings for timber decks. In: Transportation Research Record 1500. Washington, DC;

Transportation Research Board, National Research Council: 102-111.

Comments

Address comments on these drawings to the Wood Transportation Structures Team, Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398. <http://www.fpl.fs.fed.us/wit/>

Contents

Rail Drawings in Customary U.S. Units		Page
1	Glulam Timber Rail with Curb, NCHRP 350 Test Level 2	3
2	Glulam Timber Rail without Curb, NCHRP 350 Test Level 2	5
3	Glulam Timber Rail with Curb, NCHRP 350 Test Level 4	7
4	Glulam Timber Curb Rail, NCHRP 350 Test Level 1	9
Rail Drawings in S.I. Units		
1	Glulam Timber Rail with Curb, NCHRP 350 Test Level 2	11
2	Glulam Timber Rail without Curb, NCHRP 350 Test Level 2	13
3	Glulam Timber Rail with Curb, NCHRP 350 Test Level 4	15
4	Glulam Timber Curb Rail, NCHRP 350 Test Level 1	17

Rail Drawings in Customary U.S. Units

Rail Drawings in S.I. Units