U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., SE
Washington, D.C. 20590

In Reply Refer To:
HSST/B-211A

Mr. Dean L. Sicking, Ph.D., P.E.
Director, Midwest Roadside Safety Facility
University of Nebraska - Lincoln
P.O. Box 880601
Lincoln, NE 68588-0601

Dear Dr. Sicking:

This letter is in response to Messrs. Robert Bielenberg and Ronald Faller request for the Federal Highway Administration (FHWA) acceptance of a wood post alternative to the steel post Midwest Guardrail System (MGS) installed adjacent to a 2H:1V fill slope.

Name of system:	Midwest Guardrail System placed adjacent to a 2H:1V fill slope
Type of system:	Wood Post and W-beam roadside barrier
Test Level:	NCHRP Report 350 Test Level 3
Testing conducted by:	Midwest Roadside Safety Facility
Date of request:	December 21, 2010
Date initially acknowledged:	December 23, 2010
Task Force 13 Designator:	SGR38

You requested that we find a wood post MGS barrier design to be an acceptable alternative to the recently-accepted steel post design when installed at the hinge point of a 2H:1V fill slope. You further requested that the wood post option also be accepted for use on the National Highway System (NHS) as a TL-3 barrier under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350.

Requirements
Roadside safety devices should meet the guidelines contained in NCHRP Report 350 when tested prior to January 1, 2011, and the guidelines in American Association of State Highway Transportation Official's Manual for Assessing Safety Hardware after that date. The FHWA memorandum "ACTION: Identifying Acceptable Highway Safety Features" of July 24, 1997, provides further guidance on crash testing requirements of longitudinal barriers and crash cushions.

FHWA: HSST: WLongstreet: ms: x60087:6/8/11
File: h://directory folder/HSST/B-211A 211-A: Midwest Guardrail System.docx
cc: HSST Will Longstreet

Decision
The following barrier design was found acceptable, with details provided below:

- MGS adjacent to a 2H:1V fill slope with 7.5 feet (2.29 meters) long wood posts

Description
The MGS system has been successfully crash-tested when installed at the hinge point of a 2H:1V fill slope with 9 feet (2.74 meters) long W6 x 9 (W152 x 13.4) steel posts at a standard spacing of 75 inches (1902 millimeters) on centers. This design was accepted by the FHWA for use on the NHS via acceptance letter B-211. Subsequently, the Midwest Roadside Safety Facility was requested to develop a 6 inches x 8 inches (152 millimeters x 203 millimeters) wood post alternative to the steel post design. This alternative design used 7.5 feet (2.29 meters) long wood posts on 75 inches (1902 millimeters) centers to support the W-beam rail element at the MGS height of 31 inches (78.7 millimeters).

Crash Testing
Surrogate testing of single posts was performed using a rigid frame bogie weighing approximately 1800 pounds (820 kilograms) and accelerated to 15 mph (24 km/h). Since the objective of the test program was to determine a wood post size that corresponded closely to the 9 feet (2.74 meters) steel posts previously crash-tested, two of the 7 bogie tests used the steel posts set at the 2H:1V slope breakpoint. The remaining five bogie test used 6 inches x 8 inches (152 millimeters x 203 millimeters) standard wood posts with lengths of 7.5 feet (2.29 meters) and 8 feet (2.44 meters) and with embedment depths from 58 to 64 inches (1,473 to 1,626 millimeters). All posts were installed with the center of each post at the slope breakpoint, one foot (30.5 millimeters) away from the road side of the 3 feet (914 millimeters) diameter drilled shafts that were then backfilled with compacted 8 inches (203 millimeters) lifts.

Findings
A summary of all bogie testing results is shown in the enclosure to this letter. Review of the data from all seven impact tests found that the 7.5 feet (2.29 meters) long, 6 inches x 8 inches (152 millimeters x 203 millimeters) SYP wood posts provided the best alternative to the 9 feet (2.74 meters) long, W6 x 9 (W152 x 13.4) steel posts. Three tests of 8 feet (2.44 meters) long, 6 inches x 8 inches (152 millimeters x 203 millimeters) SYP wood posts resulted in post fracture due to the post-soil forces exceeding the capacity of the wood post. The wood fracture prevented effective rotation of the post in the soil and resulted in insufficient energy absorption during the impact. Thus, the 8 feet (2.44 meters) long, wood posts were deemed unsuitable for the MGS when installed adjacent to a 2H:1V fill slope. In contrast, the 7.5 feet (2.29 meters) long, 6 inches x 8 inches (152 millimeters x 203 millimeters) SYP wood posts correlated reasonably well with the data obtained from the 9 feet (2.74 meters) long, W6 x 9 (W152 x 13.4) steel post tests. The 7.5 feet (2.29 meters) long posts did not fracture during impact and rotated through the soil. The average peak force for the two 7.5 feet (2.29 meters) long, wood post tests was only 5.7 percent greater than the average peak force of the two W6 x 9 (W152 x 13.4) steel post tests. Similarly, the average total energy of the two 7.5 feet (2.29 meters) long, wood post tests was only 6.5 percent greater than the average total energy of the two W6 x 9 (W152 x 13.4) steel post tests. The average force levels for the 7.5 feet (2.29 meters) long, wood post tests were 23 percent greater through 15 inches (381 millimeters) of deflection than the values obtained from

the steel post testing. Thus, the two 7.5 feet (2.29 meters) long, wood posts compared very well with the steel posts in terms of peak force and total energy absorbed, while being slightly higher in terms of average force. It is not believed that the reasonably small differences observed between the 7.5 feet (2.29 meters) long, wood post and the 9 feet (2.74 meters) long, steel post would have any adverse effects on the performance of the MGS system.

In subsequent e-mail correspondence, Mr. Bielenberg noted that a standard W-beam barrier was successfully tested at the breakpoint of a 2H:1V slope using 7 feet (2.13 meters) wood posts at 1/2 the standard post spacing. We believe that the use of slightly longer posts, combined with the additional height of the W-beam and the use of the deeper offset blocks in the MGS system, would result in crash performance similar to that seen in the successfully tested steel post design.

Based on the above considerations, the FHWA agrees that the 7.5 feet (2.29 meters) long, 6 inches x 8 inches (152-millimeter x 203-millimeter) SYP wood post provides a suitable alternative to the 9 feet (2.74 meters) long, W6 x 9 (W152 x 13.4) steel post.

Please note the following standard provisions that generally apply to all the FHWA letters of acceptance:

- This acceptance letter provides an AASHTO/ARTBA/AGC Task Force 13 designator that should be used for the purpose of creating a new or revised Task Force 13 drawing.
- This acceptance is limited to the crashworthiness characteristics of the systems and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices (when applicable).
- Any changes that may adversely influence the crashworthiness of the system will require a new acceptance letter.
- Should the FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the system being marketed is significantly different from the version that was crash tested, we reserve the right to modify or revoke our acceptance.
- You will be expected to supply potential users with sufficient information on design and installation requirements to ensure proper performance.
- You will be expected to certify to potential users that the hardware furnished has essentially the same chemistry, mechanical properties, and geometry as that submitted for acceptance, and that it will meet the crashworthiness requirements of the FHWA and NCHRP Report 350.
- To prevent misunderstanding by others, this letter of acceptance is designated as number B-211A and shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed at our office upon request.
- The MGS barrier design is not a patented product, nor is it considered proprietary. However, if any proprietary devices are specified by a highway agency for use on Federal-aid projects, except exempt, non-NHS projects, (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or

that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

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Sincerely yours,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

U.S. Department of Transportation
Federal Highway Administration

1200 New Jersey Ave., SE
Washington, D.C. 20590

June 10, 2011

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Sincerely yours,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Enclosure

Bogie Testing Results Summary

Test No.	Post Type			Embedment Depth in. (mm)	Impact Velocity mph (m/s)	Peak Force		Average Force		Total Energy kip-in. (kJ)	Maximum Deflection in. (mm)	Failure Type
	Material	Size in. x in. (mm x mm)	Length ft (m)			Force kips (kN)	Deflection in. (mm)	@ 15 in. kips (kN)	@ 20 in. kips (kN)			
MGS221PT-22	Wood (SYP)	6x8 (152x203)	8 (2.44)	64 (1,626)	15.1 (6.7)	12.7 (56.5)	4.7 (119)	NA	NA	48.8 (5.5)	6.2 (157)	Post Fracture
MGS221PT-23	Wood (SYP)	6x8 (152x203)	8 (2.44)	64 (1,626)	16.0 (7.2)	11.2 (49.8)	8.3 (211)	NA	NA	75.0 (8.5)	9.8 (249)	Post Fracture
MGS221PT-24	Wood (SYP)	6x8 (152x203)	8 (2.44)	64 (1,626)	18. 5 (8.3)	17.4 (77.4)	7.3 (185)	NA	NA	103.4 (11.7)	9.0 (229)	Post Fracture
MGS221PT-25	Wood (SYP)	6x8 (152x203)	7.5 (2.29)	58 (1,473)	15.12 (6.76)	12.1 (53.8)	4.9 (124)	9.9 (44.1)	NA	161.7 (18.3)	18.4 (467)	Rotation in Soil
MGS221PT-26	Wood (SYP)	6x8 (152x203)	7.5 (2.29)	58 (1,473)	16.0 (7.2)	15.6 (69.4)	4.7 (119)	11.3 (50.4)	NA	180.9 (20.4)	15.1 (384)	Rotation in Soil
MGS221PT-27	Steel	W6x9 (W152x13.4)	9 (2.74)	76 (1,930)	13.7 (6.1)	13.2 (58.7)	2.4 (61)	8.4 (37.2)	NA	131.8 (14.9)	16.2 (411)	Rotation in Soil & Post Yielding
MGS221PT-28	Steel	W6x9 (W152x13.4)	9 (2.74)	76 (1,930)	16.4 (7.3)	13.0 (57.8)	2.3 (58)	8.9 (39.6)	8.0 (35.6)	189.8 (21.4)	30.4 (772)	Rotation in Soil & Post Yielding