U.S. Department of Transportation
Federal Highway Administration

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

September 23, 2009

In Reply Refer To:
HSSD/SS-160

Mr. Scott U. Jollo, P.E.
ODOT Traffic Structures Engineer
Oregon Department of Transportation
Traffic-Roadway Section
355 Capitol Street NE, Fifth Floor
Salem, OR 97301-3871

Dear Mr. Jollo:

This letter is in response to your request for the Federal Highway Administration (FHWA) acceptance of Douglas Fir No. 1 and Hemlock Fir Select Structural material as wood sign supports for use on the National Highway System (NHS).

Name of system:	Wood sign supports of nominal sizes up to and including 6 inches by 8 inches.
Type of system:	Sign Support
Test Level:	NCHRP Report 350 TL-3
Testing conducted by:	E-tech Testing Services, Inc.
Date of request:	July 27, 2009

You requested that we find Douglas Fir No.1 and Hemlock Fir Select Structural wood sign supports acceptable for use on the NHS under the provisions of the National Cooperative Highway Research Program (NCHRP) Report 350 "Recommended Procedures for the Safety Performance Evaluation of Highway Features."

Requirements
The FHWA memorandum, "ACTION: Identifying Acceptable Highway Safety Features" of July 25, 1997, provides further guidance on testing requirements of sign supports and outlines procedures for pendulum testing and estimation of high-speed breakaway performance of sign supports from low-speed pendulum test results.

Product Description
The 6 inches by 8 inches Douglas Fir No.1 was selected for testing to compare to the impact performance of the previously FHWA accepted Southern Yellow Pine No. 2. Hemlock Fir Select Structural material properties are equivalent or weaker than Douglas Fir No.1 and testing was waived for this material type but acceptance will be considered for both materials. The

following Table 1 summarizes the basic design values for posts 5 inches by 5 inches or larger in Table 9-4 of the Fifth Edition 2009 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Table 1 (6x6 and 6x8 posts)		
Material Type	**Bending F_b (ksi)**	**Shear F_v (ksi)**
Douglas Fir No.1	1200	85
Hemlock Fir Select Structural	1200	70
Southern Pine No. 2	850	100

The following Table 2 is included to summarize the basic design values with the adjusted shape factors applied for post sizes of 4 inches by 4 inches and 4 inches by 6 inches in Table 9-3 of the Fifth Edition 2009 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals.

Table 2 (4x4 and 4x6 posts)			
Material Type	**Post Size**	**Bending F_b (ksi)**	**Shear F_v (ksi)**
Douglas Fir No. 1	4 x 4 in.	1500	95
Douglas Fir No. 1	4 x 6 in.	1300	95
Hemlock Fir Sel. Str.	4 x 4 in.	2100	75
Hemlock Fir No. 1	4 x 4 in.	1463	75
Hemlock Fir Sel. Str.	4 x 6 in.	1820	75
Hemlock Fir No. 1	4 x 6 in.	1268	75
Southern Pine No. 2	4 x 4 in.	1500	90
Southern Pine No. 2	4 x 6 in.	1250	90

Test Article Installations

Five Douglas Fir No.1 posts and five Southern Yellow Pine No. 2 posts were tested. Each post had nominal dimensions of 6 inches by 8 inches and was drilled with 3-inch diameter holes through the neutral axis in bending at 4 inches and 18 inches above grade. The posts were 16 feet long; preservative treated, and inserted 5 feet deep into a rigid socket that was flush with ground level. The mass of the posts was approximately 170 pounds on average.

Testing

The wood materials were tested at the E-Tech outdoor pendulum testing facility. The pendulum bogie was built according to the specifications of the Federal Outdoor Impact Laboratory's pendulum, and the frontal crush of the aluminum honeycomb nose of the bogie simulated the crush of an actual vehicle. Tests with pendulums are acceptable for most breakaway supports with the exceptions of base bending or yielding supports. Pendulum testing can be used on wood post sign support systems as a surrogate for a vehicle crash testing.

In each of the ten tests, the wood posts were impacted on center by the pendulum nose and fractured upon impact across the lower hole. The E-tech test report noted “there was no

statistical difference in the change in velocity between the wood materials however there was a significant difference in dynamic peak g's with the Southern Yellow Pine No. 2 testing at 22 percent stronger than the Douglas Fir No. 1." Testing results of the Douglas Fir No. 1 indicated acceptable change in velocity values, with a maximum of 8.8 ft/s that is well within tolerance of the maximum 16.4 ft/s. A summary of the test results is enclosed.

Based on the test results, Douglas Fir No.1 and Hemlock Fir Select Structural material as wood sign supports as described above meet the appropriate evaluation criteria for the NCHRP 350 Test Level 3. Additionally, the post sizes are limited to the conditions and configurations stated in the FHWA's previous acceptance letters, SS-25 and SS-36, addressing wood post supports. Table 3 provides a summary of the acceptable posts sizes with drilled holes.

Table 3

Post Size (inches)	**Drilled hole diameter at 4 inches and 18 inches above grade**
4 x 4	Not required
4 x 6	1.5 inches
6 x 6	2 inches
6 x 8	3 inches

This FHWA acceptance applies to Douglas Fir No.1 and Hemlock Fir Select Structural material as wood sign supports. These materials may be used at all appropriate locations on the NHS when selected by the contracting authority. This acceptance is based on the reported crash performance and is not meant to address the limitations of testing or the systems' installation, maintenance, or repair characteristics.

Standard Provisions
Please note the following standard provisions that apply to FHWA letters of acceptance:

- This acceptance is limited to the crashworthiness characteristics of the devices and does not cover their structural features, nor conformity with the Manual on Uniform Traffic Control Devices.
- Any changes that may adversely influence the crashworthiness of the device will require a new acceptance letter.
- Should FHWA discover that the qualification testing was flawed, that in-service performance reveals unacceptable safety problems, or that the device being marketed is significantly different from the version that was crash tested, it reserves the right to modify or revoke its 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 they will meet the crashworthiness requirements of FHWA and NCHRP Report 350.

- To prevent misunderstanding by others this letter of acceptance designated as number SS-160 shall not be reproduced except in full. This letter and the test documentation upon which this letter is based, is public information. All such letters and documentation may be reviewed at our office upon request.
- This acceptance letter shall not be construed as authorization or consent by FHWA to use, manufacture, or sell any patented device for which the applicant is not the patent holder. The acceptance letter is limited to the crashworthiness characteristics of the candidate device, and FHWA is neither prepared nor required to become involved in issues concerning patent law. Patent issues, if any, are to be resolved by the applicant.

Sincerely yours,

David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

FHWA:HSSD:MLupes:tb:61331:9/3/09
File: s://directory folder/nartimovich/SS-160
cc: HSSD (Reader, HSA; Chron File, HSSD; MLupes, HSSD; NArtimovich, HSSD; WLongstreet, HSSD; MMcDonough, HSSD)

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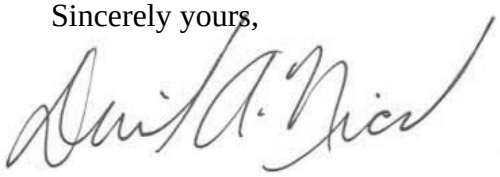

David A. Nicol, P.E.
Director, Office of Safety Design
Office of Safety

Sample	Delta V		Peak g*	Peak g Time	Stub Height	
Douglas Fir No.1	(ft./sec)	(m/sec)	(g)	(sec)	(in.)	(mm)
568-b	7.32	2.23	6.57	0.057	4	102
568-c	7.38	2.25	5.91	0.063	4	102
568-i	8.83	2.69	6.79	0.073	4	102
568-k	4.53	1.38	5.03	0.041	4	102
568-l	7.91	2.41	6.01	0.067	3.5	89
Southern YellowPine No. 2						
568-d	5.35	1.63	6.46	0.040	3.5	89
568-e	8.96	2.73	7.11	0.067	4	102
568-f	13.88	4.23	8.65	0.087	3.75	95
568-g	13.62	4.15	8.21	0.075	3.75	95
568-j	14.37	4.38	8.86	0.086	4	102

* Maximum Ridedown Acceleration does not apply since the flail space was not reached.

Douglas Fir No. 1	Pine No. 2
2.23	1.63
2.25	2.73
2.69	4.23
1.38	4.15
2.41	4.38

Anova: Single Factor: Delta V

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	5	10.96	2.192	0.23992
Column 2	5	17.12	3.424	1.44768

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Btwn Groups	3.79456	1	3.79456	4.49699	0.066762	5.317655
Within Groups	6.7504	8	0.8438			
Total	10.54496	9				

F <	*F crit*	*: No significant difference in delta v between wood groups.*

Douglas Fir No. 1	Pine No. 2	
6.57	6.46	
5.91	7.11	
6.79	8.65	
5.03	8.21	
6.01	8.86	
6.062	7.858	0.228557

Anova: Single Factor Peak g

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	5	30.31	6.062	0.46972
Column 2	5	39.29	7.858	1.06727

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	8.06404	1	8.06404	10.49329	0.011889	5.317655
Within Groups	6.14796	8	0.768495			
Total	14.212	9				

F > F crit : Significant difference in Peak g between wood groups.