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of Transportation

Federal Highway
Administration

FHWA REG 4

JUN 06 '91

Memorandum

Washington, D.C. 20590

Subject: Breakaway Sign Supports

Date: JUN 4 1991

From: Chief, Federal-Aid and Design Division

Reply to
Attn. of: HNG-14

To: Regional Federal Highway Administrators
Federal Lands Highway Program Administrator

REG ADM	<i>hsc</i>
SEP REG ADM	<i>ym</i>
REG COUNSEL	
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DIR STPS	
DIR SYSTEMS	
OFFICE	<i>Reynolds</i>

Our July 6, 1990, memorandum "Breakaway Sign and Luminaire Supports" discussed the National pooled-fund study, "Testing of Small and Large Sign Supports." Full scale crash tests of sign supports currently in use by the pooled-fund States are being conducted under this 41-month contract. Because the final results from this study will not be available for at least another 21 months we are transmitting some preliminary information that may be useful to States planning to revise their standard drawings in the near future.

A variety of sign post systems have been tested to date. Those systems that failed crash testing are unacceptable for use on Federal-aid highway projects. Because these systems were all "grandfathered" by virtue of their inclusion in the pooled-fund study they are still in use in many States. Any States still using systems which have failed crash testing should be requested to change their sign support standards to acceptable designs as soon as practical. These States should be encouraged to adopt small sign support systems which have already been successfully tested in both strong and weak soils. Lists of crashworthy roadside hardware, including breakaway sign supports, have previously been sent to your office. Should you need copies of any of the acceptance letters, or an updated list at any time, please contact Mr. Nicholas Artimovich at (FTS) 366-1331. Following is a summary of the testing and a discussion of the results. All tests used automobiles ballasted to weigh 840 kg. (1,850 pounds.) Grade 2 air-dried southern yellow pine posts were used for all wood post tests.

Acceptable - Dual Unmodified 89- x 89-mm (4- x 4-inch) Wood Posts

Test Number	90F050	90F054	90F055	90F015
Soil Type	Weak	Weak	Strong	Strong
Impact Speed, km/h (mph)	32.7 (20.3)	97.0 (60.3)	33.3 (20.7)	94.9 (59.0)
Vehicle Delta V, m/s (fps)	1.31 (4.3)	0.61 (2.0)	0.98 (3.2)	1.21 (4.0)
Occupant Impact, m/s (fps)	No impact	No impact	No impact	No impact
Stub Height - (No stubs were left protruding above the soil.)				

The test results met the Federal Highway Administration's (FHWA) breakaway requirements for velocity change and stub height. Therefore, a sign supported by one or two unmodified 4- x 4-inch (actual dimensions 89- x 89-mm (3.5- x 3.5-inch)) wood posts in strong or weak soil is acceptable for use on Federal-aid highway projects, if requested by a State.

Acceptable - Drilled 140- x 190-mm (6- x 8-inch) Wood Post

Test Number	90F045	90F046
Soil Type	Weak	Weak
Impact Speed, km/h (mph)	33.5 (20.8)	97.0 (60.3)
Vehicle Delta V, m/s (fps)	5.34 (17.5)	1.25 (4.1)
Occupant Impact, m/s (fps)	3.23 (10.6)	No impact
Stub Height, mm (in)	76 (3)	76 (3)

The weak soil tests were judged to be the worst case scenario, therefore, no strong soil tests were conducted. The occupant changes in velocity in both tests met FHWA requirements. The stub heights also met FHWA criteria. Therefore, a sign mounted on a single 6- x 8-inch (actual dimensions 140- x 190-mm (5.5- x 7.5-inch)) wood post with 75-mm (3-inch) diameter holes drilled at 100 mm (4 inches) and 460 mm (18 inches) above the groundline, perpendicular to the roadway centerline, is acceptable for use on Federal-aid highway projects if requested by a State. If multiple 140- x 190-mm (6- x 8-inch) drilled posts are used they must be spaced 2.15 m (7 feet) or more apart.

Acceptable - Drilled 89- x 140-mm (4- x 6-inch) and 140- x 140-mm (6- x 6-inch) Wood Posts

Unacceptable - Unmodified 89- x 140-mm (4- x 6-inch) Wood Post

Test Number	90F037 (Single 89 mm x 140 mm unmodified)
Soil Type	Weak
Impact Speed, km/h (mph)	33.0 (20.5)
Vehicle Delta V, m/s (fps)	7.68 (25.2)
Occupant Impact, m/s (fps)	5.54 (18.2)

The unmodified 89- x 140- mm (4- x 6-inch) wood post in weak soil failed its crash test. This single post system was directly buried in the soil with no weakening features. However, because of the performance of the 89- x 89-mm (4- x 4-inch) unmodified posts and the 140- x 190-mm (6- x 8-inch) post with holes drilled perpendicular to roadway centerline, we believe that single 89- x 140-mm (4- x 6-inch) wood posts modified with 38-mm (1 1/2-inch) diameter

holes and 140- x 140-mm (6- x 6-inch) wood posts modified with 50-mm (2-inch) diameter holes would be crashworthy. The holes should be centered at 100 mm (4 inches) and 460 mm (18 inches) above the groundline and perpendicular to the roadway centerline. Therefore 89- x 140-mm, 140- x 140-mm, and 140- x 190-mm (4- x 6-inch, 6- x 6-inch, and 6- x 8-inch) wood posts in soil, modified by the appropriate size holes, are acceptable when spaced 2.15 m (7 feet) or more apart.

No tests of wood supports placed in concrete have been conducted under the contract. Since we do not know where or how a wood post would fail when constrained by a concrete foundation, we will not discuss concrete foundations for wood posts at this time.

Acceptable - Dual Leg W6x12 and other Structural Shapes on Slip-Bases

Test Number	90F043	90F044
Soil Type	(Slip-Bases Mounted on Simulated Concrete Foundation)	
Bolt Torque, N·m (ft-lb)	75 (55)	75 (55)
Impact Speed, km/h (mph)	33.8 (21.0)	96.4 (59.9)
Vehicle Delta V, m/s (fps)	2.44 (8.0)	2.41 (7.9)
Occupant Impact, m/s (fps)	No impact	No impact
Stub Height, mm (in)	76 (3)	76 (3)

The dual legged W6x12 structural steel shape on rectangular slip-bases mounted on simulated concrete foundations passed the required crash tests. We recommend that the bolt torques shown in Table 4.1 of the Roadside Design Guide be used. In any event the bolt torques should not exceed those of the tested sign support.

Since both posts were struck during the successful tests, two posts up to 18 kg/m (12 pounds-per-foot) each may be used within a 2.15 m (7-foot) span for a large roadside sign. Prior testing had shown that a single post of up to 67 kg/m (45 pounds-per-foot) is acceptable for multiple post supports when the posts are more than 2.15 m (7 feet) apart. That will remain valid. However, it is not acceptable to use two posts whose total unit weight is up to 67 kg/m (45 pounds-per-foot.) On the other hand, from the relatively low delta V's in dual-leg impact tests and those in the 67 kg/m (45 pound-per-foot) post test series [3.0 m/s (9.9 fps) and 2.7 m/s (8.8 fps) for 20-m.p.h. and 60-m.p.h. respectively] it is obvious dual posts each weighing more than 18 kg/m (12 pounds-per-foot) should be allowed. Without further testing, FHWA will accept dual slip-base supports within a 2.1 m (7-foot) span when each support weighs no more than 27 kg/m (18 pounds-per-foot.)

Unacceptable-Full-Length, 6-kg/m (4 pound/foot) Dual Flanged Channel "U" Posts and 6-kg/m (4-pound/foot) Dual Flanged Channel "U" Posts with 460-mm (18-inch)-Lapped Splice at Groundline

Test Article	Dual Base Bending "U" Post	Dual Spliced "U" Post
Test Number	90F047	90F049
Soil Type	Weak	Weak
Impact Speed, km/h (mph)	32.5 (20.2)	32.7 (20.3)
Vehicle Delta V, m/s (fps)	8.3 (27.3)	9.0 (29.6)
Occupant Impact, m/s (fps)	6.0 (19.7)	6.6 (21.8)

Dual base bending 6-kg/m (4-pound/foot) flanged channel "u" posts failed their crash test. Therefore, this system is no longer acceptable for use on Federal-aid highway projects. A spliced version of the dual legged 6-kg/m (4-pound/foot) "u" channel support system also failed a crash test. However the 460-mm (18-inch) long splices were much stronger than the 100-mm (4-inch) breakaway lap splices at the groundline that were successfully crash tested in strong soil under an earlier Arizona Department of Transportation study. We are withholding action on the breakaway lap splice at this time; so it may continue to be used in strong soils per our prior acceptance.

Unacceptable - Dual Back-to-Back 3-kg/m (2-pound/foot) Flanged Channel "U" Posts

Test Number	90F048
Soil Type	Weak
Impact Speed, km/h (mph)	32.8 (20.4)
Vehicle Delta V, m/s (fps)	9.3 (30.4)
Occupant Impact, m/s (fps)	6.4 (21.1)

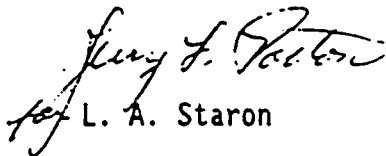
Dual base bending back-to-back 3-kg/m (2-pound/foot) flanged channel "u" post (total 6-kg/m (4-pound/foot)), failed crash testing. Therefore, dual legged direct burial posts of back-to-back 3-kg/m (2-pound-per-foot) flanged-channel supports are not acceptable for use on Federal-aid highway projects.

Unacceptable - Round Steel Pipe, 50-mm (2-inch) Diameter Schedule 40

Test Number	90F051	90F053	90F056	90F057
Soil Type	Weak	Weak	Strong	Strong
Impact Speed, km/h (mph)	31.9 (19.8)	94.6 (58.8)	32.7 (20.3)	95.1 (59.1)
Vehicle Delta V, m/s (fps)	4.51 (14.8)	3.32 (10.9)	4.3 (14.1)	7.14 (23.4)
Occupant Impact, m/s (fps)	3.66 (12.0)	No impact	3.97 (13.0)	6.89 (22.6)
Stub Height, mm (in)	10 (4)	None	Insignificant	None

Fifty-mm (2-inch) diameter, schedule 40 steel pipe in soil failed the crash test program and is no longer acceptable for use on Federal-aid projects. This single post system was directly buried in the soil with no weakening features.

A summary of acceptable and not acceptable systems is attached for your convenience.


for L. A. Staron

Attachment

Geometric and Roadside Design Acceptance Letter Number SS-25

Summary

System	Acceptable	Not Acceptable
Wood Post Systems (Grade 2 Southern Yellow Pine*)		
89- x 89-mm (4- x 4-inch) Unmodified Single Post	X	
89- x 89-mm (4- x 4-inch) Unmodified Dual Post	X	
140- x 190-mm (6- x 8-inch) Drilled Single Post (3-inch holes)	X	
89- x 140-mm (4- x 6-inch) Drilled Single Post (1.5-inch holes)	X	
140- x 140-mm (6- x 6-inch) Drilled Single Post (2-inch holes)	X	
89- x 140-mm (4- x 6-inch) Unmodified Single Post		X
Other Tested Systems		
Dual W6x12** Steel Posts on Slip-Bases	X	
Single W12x45 Steel Post on Slip-Base	X***	
"U" Post 6-kg/m (4-pound/foot) Base Bending Dual Posts		X
"U" Post 6-kg/m (4-pound/foot) with Long Groundline Splice, Dual Posts		X****
Back to Back 3-kg/m (2-pound/foot) "U" Channel Dual Posts		X
50-mm (2-inch) Schedule 40 Single Round Steel Pipe		X

* Southern Yellow Pine is a relatively strong softwood, therefore most other softwood and some hardwoods will be acceptable for use as breakaway signposts. Care should be taken in specifying wood for posts to ensure that the strength does not significantly exceed that of the Grade 2 Southern Yellow Pine tested.

All the metric units shown are actual lumber sizes while the parenthetical units are nominal sizes for dressed lumber. Thus, the actual dimensions for the post lumber in English units are one half inch less than the values shown.

**Use of other shapes weighing up to 27 kg/m (18 pounds per foot) is also acceptable.

***Covered in June 15, 1987, memorandum. Lighter weight sections are also acceptable.

****No new information is available on "u" posts using short ground-level splices.