U.S. Department
Of Transportation
Federal Highway
Administration

400 Seventh St., S.W.
Washington, D.C. 20590

May 26, 1992

Refer to: HNG-14/SS-28

Mr. Leon N. Larson
Regional Federal Highway Administrator (HSY-04)
Atlanta, Georgia

This is in reply to your memorandum of April 9 requesting guidance on the use of 89-mm (3.5 inch) diameter think walled aluminum tube and 6-kg/m (4-pound-per-foot) U-channel small sign supports. You attached a draft report, Evaluation of the Crash Worthiness of the Florida Think Walled Aluminum Tube and Steel U-Channel Sign Supports, dated February 1992 and a video of the testing. The report contained results of 20 full-scale crash tests conducted by the Texas Transportation Institute. Sketches of the aluminum tube and spliced U-channel test installations are attached. A summary of the test results is presented below:

Test Number	Post*	Soil Type	Impact Speed Km/h	Occupant Impact M/s	FHWA Assessment
1	100 mm Tube	Weak	31.2	5.46	Fail (note 1)
2	100 mm Tube	Weak	96.9	6.77	Fail (note 2)
19	89 mm Tube	Weak	30.3	3.05	Fail (note 3)
20	89 mm Tube	Weak	98.3	3.32	Pass
3	Marion Rev.	Weak	29.6	0.27	Pass
4	Marion Rev.	Weak	99.5	(no contact)	Pass
5	Marion Rev.	Strong	31.1	(no contact)	Pass
6	Marion Rev.	Strong	98.3	(no contact)	Pass
11	Marion	Weak	30.9	0.85	Pass
12	Marion	Weak	99.6	(no contact)	Pass
13	Marion	Strong	32.3	(no contact)	Pass
14	Marion	Strong	99.5	(no contact)	Pass
7	Franklin Rev.	Weak	32.7	1.92	Pass
8	Franklin Rev.	Weak	99.0	2.32	Pass
9	Franklin Rev.	Strong	27.4	4.79	Pass
10	Franklin Rev.	Strong	97.8	2.80	Pass (note 4)
15	Franklin	Strong	31.2	1.77	Pass
16	Franklin	Strong	100.4	1.74	Pass
17	Franklin	Weak	32.2	2.16	Pass

18	Franklin	Weak	100.4	1.62	Pass (note 4)

Low speed test target velocity is 32.2 km/h (20 mph)
High speed test target velocity is 96.6 km/h (60 mph)
Maximum allowable occupant impact speed is 4.88 m/s (16 fps)

- The designation "Rev." means that the signpost was mounted in front of the stub post, which is the reverse of the configuration previously recommended by FHWA. Based upon this testing, FHWA continues to prefer the "behind-the-stub" orientation over the other. However, the results are not sufficient to insist on one over the other.

Note 1: This test failed due to excessive velocity change.

Note 2: This test failed due to excessive velocity change and vehicle instability (the vehicle rolled over).

Note 3: The vehicle pushed the sign support over and rode up it until it came to rest of the support. The researchers ruled this test a failure because the support "failed to yield to the vehicle." FHWA does not concur in that assessment and believes that the low occupant impact velocity (at the "desirable" level) permits our acceptance of this support. However, the performance of this support should be considered marginal because it raised the front end of the test vehicle 600 to 750 mm (2 to 2.5 feet) in the low speed test, suggesting the support is close to causing instability in light-weight impacting vehicles.

Note 4: In this test the sign support and panel impacted the roofline. The researchers ruled that the resulting dent was significant and unacceptable passenger compartment intrusion. In prior tests of other supports FHWA judged similar amounts of passenger compartment intrusion acceptable. The relatively low velocity change occurring during the test weighs very much in favor of passing the support. Review of the high-speed film of the test show that the dummy did not contact the damaged vehicle interior. Therefore, FHWA had judged the intrusion acceptable. Nevertheless, the performance must be considered marginal.

Thin-Walled Aluminum Tube

Testing of the 89-mm (3.5 –inch) thin-walled aluminum tube [4.8-mm (3/16-inch) wall thickness, alloy 6061-T6] in weak soil showed its performance to be acceptable, though marginal because of lifting of the vehicle in the low speed test. The thin-walled aluminum tube was previously accepted (Memorandum to Region 1 dated 12/12/89 up to 100 mm (4 inches) in diameter when installed in strong soil. The present Florida testing shows that this larger support fails when installed in weak soils. Therefore, the 89-mm aluminum tube is the largest diameter that should be used in weak soil. FHWA has announced an intention to institute a policy of only accepting those small sign supports that are found crashworthy in both soil types. This will likely occur when FHWA adopts

the updated crash test guidelines (revised NCHRP Report 230.) This was discussed in our memorandum of July 6, 1990, "Breakaway Sign and Luminaire Supports".

6-kg/m (4-pound-per-foot) U-Channel

Splice details: The Florida U-channel splice differs from the breakaway splice derived from Arizona DOT testing that we previously found acceptable for strong soils only. In the Florida splice the overlap is 200 mm (8 inches) and the splice is secured with A307, 9.5-mm x 50-mm (3/8-inche by 2-inch) bolts spaced at 150-mm (6 inches) center-to-center. The stub in the Florida testing was driven to a minimum embedment of 914 mm (36 inches). The Arizona splice has an overlap of 150 mm (6 inches) and uses 7.9-mm (5/16-inch) Grade 9 bolts spaced 100 mm (4 inches) center-to-center. In both cases, a 16-mm (5.8-inch) spacer is used to separate the webs (Arizona's experience is that the spacer must be structurally adequate to transfer the load between the webs of the signpost and the stub.) In both designs the U-channel stubs are driven until they extend no more than 100 mm above the groundline. Acceptance of a breakaway U-channel post configuration in this memorandum refers only to a post with a 150-mm center-to-center-of-bolts Florida splice, in either the "normal" or "reversed" position.

In the Florida splice the diameters of the splice holes and the splice bolts are the same, meaning that the splice holes must be reamed in order to insert the bolts. This destroys the corrosion protection in the hole. Thus, if effective countermeasures are not taken, one should expect accelerated loss of the zinc corrosion protection of the splice bolts as it sacrifices to protect the post, resulting in early loss of splice strength. Perhaps coating the splice holes and bolts with zinc-rich paint paste would be an effective countermeasure. No matter what countermeasures are taken, the strength of the supports depends on the integrity of the splice bolts. Therefore, we would strongly recommend a program to ensure that the integrity of the splice bolts is not lost.

Materials Information: The "Marion" supports are 6-kg/m (4-pound-per-foot) posts of high-carbon billet steel having a nominal yield stress of 552 Mpa (80 ksi). These "Rib-Bak" posts are produced by the Marion Steel Company. The "Franklin" supports are 6-kg/m, re-rolled rail steel posts having a nominal yield stress of 414 Mpa (60 ksi). These posts are produced by Franklin Steel.

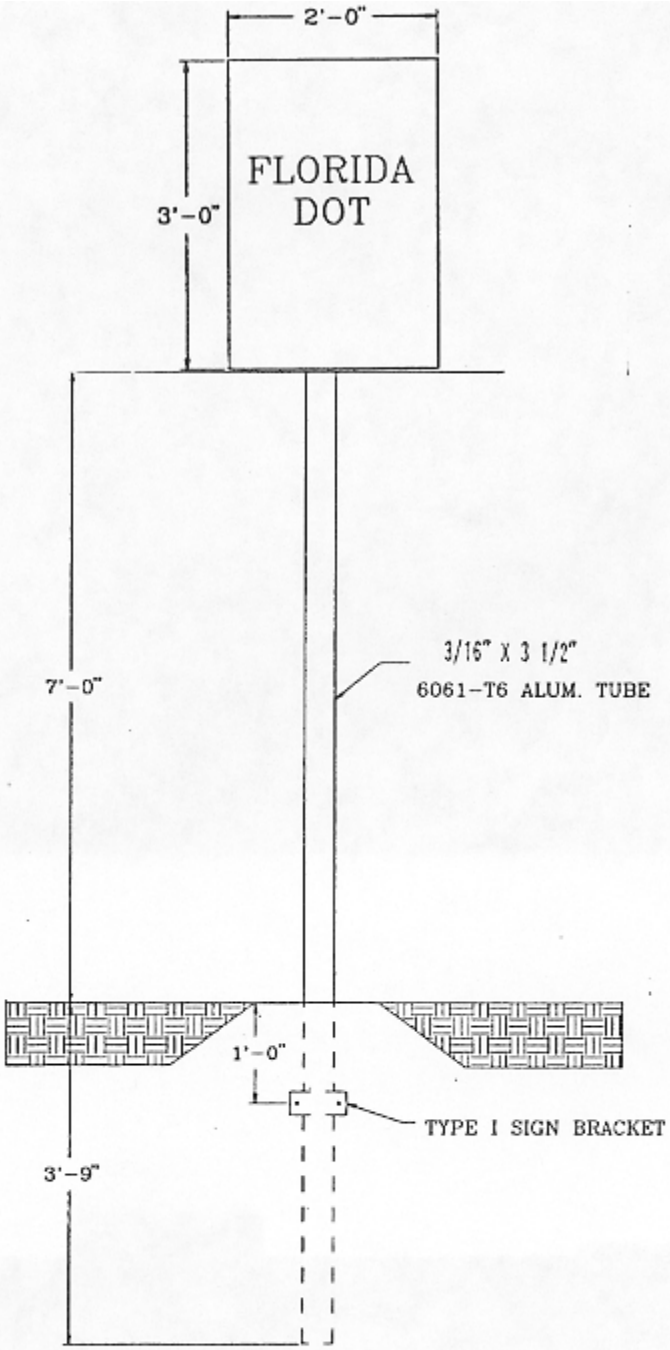
We have received questions about the interchangeability of Franklin and Marion posts and stubs. No crash tests have been done on mixed stub and signposts; FHWA recommends against interchanging them without testing to confirm acceptability. A highway agency that desires to qualify posts of one manufacturer on the stubs of another is advised that careful attention be given to the details of the splice orientation and spacer hardware. The variation in cross-sections between the two products is sufficient to cause problems in nesting under some splice orientations.

In summary, we concur with the Florida DOT that the 89-mm (3.5 inch) diameter aluminum tube support and the 6-kg/m (4-pound-per-foot), 414-Mpa (Franklin, 60-ksi) or 552-Mpa (Marion, 80-ksi) U-channel posts with 150-mm (6-inch) center-to-center-of-

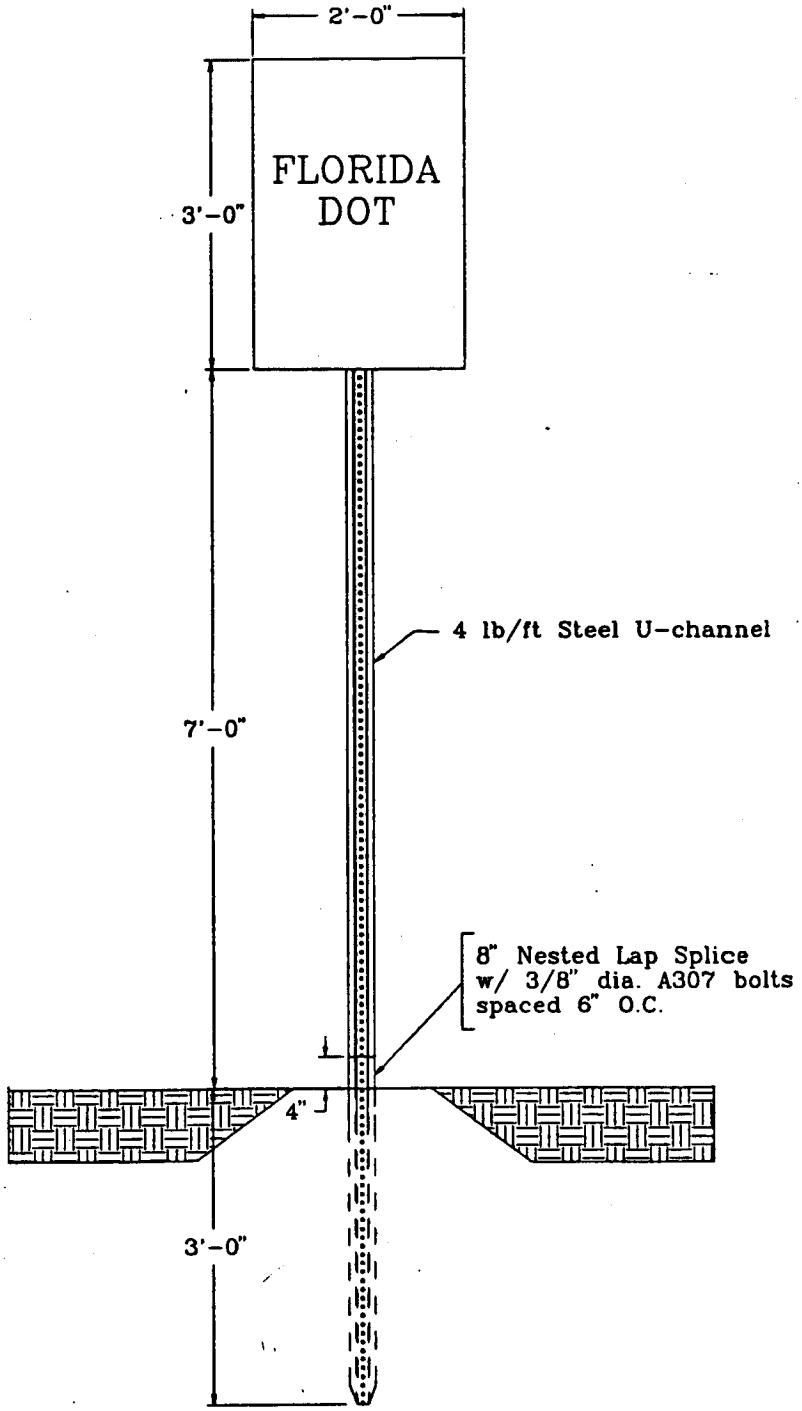
bolts lapped breakaway splices are acceptable for use on Federal-aid highway projects in all soil types, when requested by a state. This acceptance is limited to single supports within a 2100-mm (7 foot) path. Test results of both the thin-wall aluminum tube and the Franklin U-channel supports were marginally acceptable. Care should be taken to ensure that supports are installed in the same manner as those tested with respect to signpost or stub embedment depth, minimum sign height, splice details, etc.

L.A. Staron

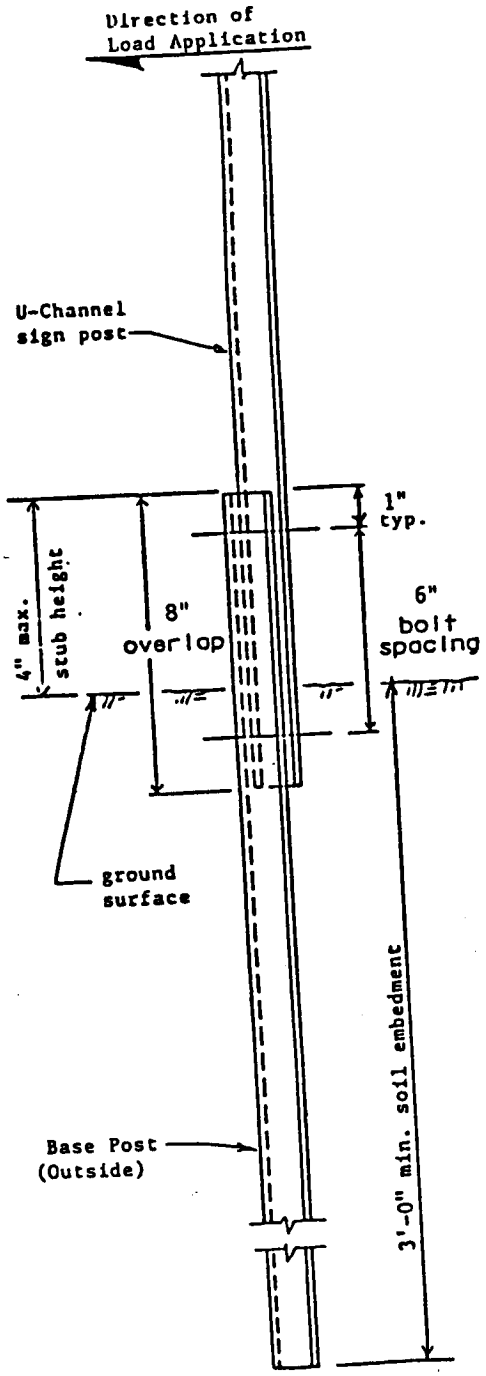
3 Attachments



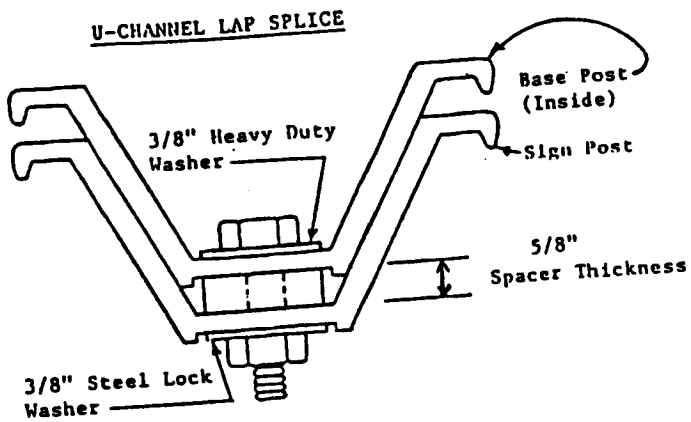
Aluminum Tube Sign Installation.



Steel U-channel Sign Installation.



Elevation View
Reverse Orientation



Section through splice - Normal Orientation

Details of U-channel splice configurations.