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Regional Federal Highway Administrators
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I Introduction

Our July 6, 1990, memorandum "Breakaway Sign and Luminaire Supports" announced FHWA's adoption of the 1985 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals," Section 7 "Breakaway Supports" (AASHTO 1985). The memorandum also discussed the national pooled-fund study, "Testing of Small and Large Sign Supports." The study, which used the 1800-pound (820-kg) test car required under the new specifications, was conducted at the FHWA Federal outdoor Impact Laboratory (FOIL). For small sign support systems crash test performance in both strong and weak soils was to be considered. The priority matrix of supports to be tested was determined by a vote of the pooled-fund State representatives. Sign support systems on the priority matrix that had been found acceptable under the requirements of the 1975 edition of the AASHTO specifications were considered provisionally acceptable pending the completion of the pooled-fund study.

Our Jun 24, 1991, memorandum, "Breakaway Sign Supports", detailed several sign support systems that had been tested under Phase I of the study and found to be acceptable or not acceptable. After conducting a total of 48 tests under Phases I and II, the study is now completed. Of the 43 different sign support systems included in the priority matrix, 28 different systems (or modifications) were tested. The results have been provided to the Office of Engineering for analysis.

II Analysis

This memorandum details the results of our analysis and describes the sign support systems tested under this study that were found acceptable and those that are unacceptable for use on National Highway System (NHS) projects. Initially our intent was to find acceptable only those sign support systems found to be crashworthy in both strong and weak soils at both high (96.5 km/h (60 mps)) and low (32.2 km/h (20 mph)) speeds. The first test that was conducted on most systems was the low speed test in weak soil. This has usually been found to be a "worst-case scenario". If the results fo the first

test met the velocity change criteria, the support in question would be test further, at least to the high speed test in weak soil. Some systems have been found acceptable if they passed the weak soil testing at high and low speeds because, for those systems, strong soil tests have been judged to be less demanding. When a system failed a test, testing proceeded to the next sign support in the priority matrix.

Two factors have caused us to reconsider the plan to require all supports to qualify in weak soil. First, the crash test guidelines have changed. The NCHRP Report 230, which provided for testing on both S-1 (strong) and S-2 (weak) soils, has been replaced by NCHRP Report 350. Report 350 calls for testing in a "standard" soil. This soil is the same as the "strong" soil of Report 230. However, Report 350 also states:

> "The weak soil should be used, in addition to the standard soil, for any feature whose impact performance is sensitive to soul-foundation or soul-structure interaction if identifiable areas of the…jurisdiction in which the feature will be installed contain soil with similar properties, and if there is a reasonable uncertainty regarding performance of the feature in weak soil."

While Report 350 permits testing sign support systems in only the standard soil, using support that has been accepted in only standard or strong soil places an additional burden on the highway agency. The agency must determine the soil type at sign support locations. Where "weak" soils are encountered a sign support system that has been qualified in weak soil should be used.

The second reason is because it became evident that some widely used base-bending sign post systems were not performing well in weak soils. For example, prior testing in strong soil had shown various u-channel post configurations were crashworthy. However, under the pooled-fund study, most breakaway splice and base-bending u-channel multiple post supports failed the initial test. Because these posts are very popular among highway agencies around the country and appear to be providing good in-service performance, we believe that it is impractical to completely disqualify them because of weak soil test failures. Supports passing "standard" soil tests are acceptable even though they fail or are not tested in weak soil, provided their use is limited to sites with suitable soils.

III Acceptance Criteria

To review briefly, Section 7 of the AASHTO support specifications requires breakaway devices to be tested with an 1800-pound (820-kg) vehicle at 20 mph (32.2 km/h) and at 60 mph (96.6 km/h). The support may not cause a velocity change in excess of 15 fps (the velocity change that is of interest is the impact speed of the theoretical occupant hitting the windshield.) When FHWA adopted Section 7, it allowed the maximum velocity change to be 16 fps (4.88 m/s).

The NCHRP Report 350, which has been adopted as a guide to BHWA (Federal Register Vol. 58, No. 135, dated July 16, 1993), recommends a maximum velocity change of 5.0 m/s. This is 2.5 percent higher that the value adopted by FHWA. In conformity with the

rest of the highway community, we will consider velocity change of 5.0 m/s (16.4 fps) or less to be acceptable. (The NCHRP Report 350 also calls for a slightly different speed range – 35 km/h (21.7 mph) to 100 km/h (62.1 mps.))

IV Action

The FHWA field offices should review State standard drawings, specifications, design manuals, etc. to determine if all breakaway sign supports have been found acceptable for use on the NHS. The hardware previously found acceptable for use on Federal-aid highway projects under AASHTO 1985 requirements meets this criterion. Those sign supports systems that have not been found acceptable are to be phased out of service as soon as possible or, if considered capable of meeting acceptance requirements, tested to determine acceptability. At the latest, only sign supports meeting NCHRP Report 350 (or AASHTO 1985) evaluation criteria will be permitted to be included in projects advertised on the NHS after January 1, 1995. Retrofit of existing, non-crashworthy supports is eligible for Federal-aid funding and is encouraged. The need to retrofit should be evaluated on all 3R projects.

V Results

The sign support systems tested under the second phase of this study which have been judged to be acceptable for use on NHS projects are listed in section **V A**. For each listing, the heading includes a basic description of the breakaway device and/or the support. The number of supports installed in a test and the number impacted is included. Many small sign supports were tested with two or three posts impacted by the test vehicle. A single post of an acceptable dual post system (two posts within a 7-foot span, both supports struck by test vehicle) is also considered acceptable as a sign support. Similarly, one or two posts will be considered acceptable as a sign support. Similarly, one or two posts will be considered acceptable if they are of the same type found acceptable in a triple post system.

The table associated with each sign support type summarizes the crash tests conducted for each sign support system. The soil types are either S-1 “strong” or S-2 “weak” soil according to the NCHRP Report 230. Large sign support breakaway systems mounted directly to the rigid FOIL base are identified by listing “concrete” under soil type. In some cases, small sign supports are embedded in concrete foundations that are placed in S-2 soil. The narrative following the table includes more detail, where appropriate, as well as necessary cautions or restrictions. A statement of acceptability is also given. Failing tests are indicated by shading.

Section **V B** includes sign supports that failed FOIL tests in weak soil, but passed strong soil tests at the FOIL or elsewhere. The tests that qualify the supports for use in strong soil are summarized in the table accompanying each description. If the tests are not part of the pooled-fund study, the date and location of the tests are given in the narrative following the table. Section **V C** included various sign support systems that failed testing and have not been retested under other conditions.

Appendix A includes drawings of the tested systems. **Appendix B** is a summary of systems tested under Phases I and II. Full details of the tested systems and the crash testing may be found in the Final Reports. The final reports of Phase I and Phase II testing are expected by the end of 1993. **Appendix C** is a copy of the original pooled-fund crash test matrix annotated to show which sign support systems were not tested under the study and, therefore, must be crash tested by others to be considered for future use on NHS projects. **Appendix D** is a current list of the Geometric and Roadside Design Acceptance Letters on sign supports based on AASHTO 1985.

Note on SI units

Most dimensions are given in SI (Systeme International, or metric) units with the U.S. customary units following in parentheses. Exceptions include those instances where direct reference is being made to a specification that is in U.S. customary units, in which case the SI value follows. Dimension of metal supports are direct SI conversions. Wood post SI dimensions are the dressed measurements, whereas the U.S. customary units in parentheses are the nominal sizes. For example, a nominal four inch square wood post actually measure three and on-half inches. The metric dimension is taken from the dressed size and is shown as 89 mm.

V **A Acceptable Sign Support Systems – Strong Soil and Weak Soil**

Acceptable – Triple Square Perforated Steel Tube, A446 Gr 42, 2.7-mm (12-ga) Wall, 4.76-mm (3/16") Perforations, 45-mm 1 ¾") Square post in 2.7-mm (12-ga) Wall, 50-mm (2") Square Anchor Base, Three Posts Hit

Test Number	91F010	92F039	92F040
Soil Type	S-2 (Weak)	S-1 (Strong)	S-1 (Strong)
Embedment Length, mm (in)	920 (36)	920 (36)	920 (36)
Splice Length, mm (in)	230 (9)	230 (9)	230 (9)
Impact Speed, km/h (mph)	32.4 (20.1)	32.8 (20.4)	95.3 (59.2)
Velocity Change, m/s (fps)	7.23 (23.7)	8.69 (28.5)	3.23 (10.6)
Occupant Impact, m/s (fps)	4.97 (16.3)	4.39 (14.4)	2.47 (8.1)
Stub Height, mm (in)	(see text)	(see text)	44 (1.75)

In test 91F010 the occupant impact speed exceeded the 16.0 foot-per-second limit. However, the adoption of NCHRP Report 350 with its 5.0 meters-per-seconds limit will result in this being a passing test. It should be noted that during test 92F040 the impact of the sign on the roof and windshield caused approximately 150 mm of denting and the windshield was shattered. While denting of this magnitude is not unusual for luminaire supports, it is relatively severe for a sign support. Therefore, the performance of this sign support is considered marginal.

The high-speed test in weak soil is not considered necessary because previous tests of single and dual supports using perforated square steel tubes with anchor bases show the high-speed, weak soil test results to be less severe than the low-speed results. The after-test signpost stubs were greater than 100 mm for various reasons. Some bases were pulled slightly out of the soil, some posts broke higher than the base, and some posts were just bent over by the car. None of the remaining stubs were considered significant because they would not snag the undercarriage of the vehicle.

Because these results have been judged to meet the FHWA breakaway requirements, signs mounted on one, two, or three 2.77-mm wall, 45-mm square perforated steel tube posts mounted in 2.7-mm wall, 50-mm bases in soil are acceptable for use on NHS projects if requested by a State.

Acceptable – Inclined Slip Base, S7x15.3, Concrete Foundation, One Post of Dual Posts Hit

Test Number	91F016	91F017
Soil Type	Concrete	Concrete
Embedment Length, mm (in)	N/A	N/A
Impact Speed, km/h (mph)	33.2 (20.6)	97.6 (60.6)
Velocity Change, m/s (fps)	2.53 (8.3)	2.01 (6.6)
Occupant Impact, m/s (fps)	2.41 (7.9)	1.89 (6.2)
Stub Height, mm (in)	100 (4)	100 (4)

This system was tested using two supports mounted on the FOIl universal foundation. The legs were attached to inclined slip bases using four 15.9-mm (5/8-in) bolts torqued to 43.7 N.m (55 lb ft). A 28-gauge [0.38-mm (0.015-in)] galvanized steel keeper place was installed between the two slip surfaces. The legs were 2.1 m (7 ft) apart, and only one support was struck by the FOIL bogie in each test. The mass of each leg was approximately 51 kg (112 lbs.) below the hinge. The hinge/slip fuse plate joint was made using eight (four per flange) 19.1-mm (3/4-in) bolts torqued to 368.5 N.m (275 lb ft).

The test results indicate that this inclined slip base meets the FHWA breakaway requirements when mounted on a concrete foundation comparable to that tested and is acceptable for use on NHS projects when requested by a State. When a single post is used, it should be approximately the same size as the tested post. Smaller posts may be more susceptible to bending before the base slips away and larger posts may be too massive to keep the velocity change within specification. If additional posts are needed they are to be placed 2.1 m (7 ft) or more apart.

Acceptable – Inclined Slip Base, 200-mm x 100-mm x 4.8-mm (8x4x3/16-in) Steel Tube, Concrete Foundation, Single Post Hit

Test Number	91F019	91F031
Soil Type	Concrete	Concrete
Embedment length, mm (in)	N/A	N/A
Impact Speed, km/h (mps)	33.6 (20.9)	94.3 (58.6)
Velocity Change, m/s (fps)	1.46 (4.8)	1.62 (5.3)
Occupant Impact, m/s (fps)	1.37 (4.5)	1.62 (5.3)
Stub Height, mm (in)	100 (4)	100 (4)

This system was tested using one support mounted on the FOIL universal foundation. The leg was attached to an inclined slip base using four 15.9-mm (5/8-in) bolts torqued to 67 N.m (50 lb ft). A 28-gauge [0.38-mm (0.015 in)] galvanized steel keeper plate and four hardened round washers were installed between the two slip surfaces. The total mass of the sign and support was 106.8 kg (235 pounds).

The test results indicate that this inclined slip base meets the FHWA breakaway requirements when mounted on a concrete foundation comparable to that tested and is acceptable for use on NHS projects when requested by a State. When a single post is used, it should be approximately the same size as the tested post. Smaller posts may be more susceptible to bending before the base slips away and larger posts may be too massive to keep the velocity change within specification.

Acceptable – Omni-Directional Slip Base, X6X12, Concrete Foundations, One Post of Dual Posts Hit

Test Number	91F020	91F030
Soil Type	Concrete	Concrete
Embedment length, mm (in)	N/A	N/A
Impact Speed, km/h (mps)	33.5 (20.8)	93.2 (57.9)
Velocity Change, m/s (fps)	2.01 (6.6)	1.65 (5.4)
Occupant Impact, m/s (fps)	2.01 (6.6)	1.65 (5.4)
Stub Height, mm (in)	100 (4)	100 (4)

This system was tested using two supports mounted to the FOIL universal foundation. Each leg was attached to a slip base using three 28.6-mm (1 1/8-in) bolts torqued to 127.3 N.m (95 lb ft). A 28-gauge [0.38-mm (0.015 in)] galvanized steel keeper plate and three hardened round washers were installed between the two slip surfaces. The legs were seven feet apart, and only one support was struck by the FOIL bogie in each test. The total mass of the sign and supports was 350 kg (770 pounds). The weight of the impacted post below the hinge was 35.4 kg (78 lb).

The test results indicate that the omni-directional slip base meets the FHWA breakaway requirements when mounted on a concrete foundation comparable to that tested and is acceptable for use on NHS projects when requested by a State. Posts should be approximately the same size as the tested post. Smaller posts may be more susceptible to bending before the base slips away and larger posts may be too massive to keep the velocity change within specification. Posts should be spaced no closer than 2.1 m (7 ft) apart.

Acceptable – Single 89-mm x 140-mm (4-in x 6-in) Southern Yellow Pine Wood Post, Concrete Foundation

Test Number	91F032	91F033
Soil Type	Concrete in S-2	Concrete in S-2
Embedment length, mm (in)	610 (24)	610 (24)
Impact Speed, km/h (mps)	33.2 (20.6)	98.0 (60.9)
Velocity Change, m/s (fps)	4.02 (13.2)	1.52 (5.0)
Occupant Impact, m/s (fps)	3.72 (12.2)	1.52 (5.0)
Stub Height, mm (in)	<100 mm (4 in)	<100 mm (4 in)

This support consisted of one undrilled wood post (grade unknown) placed in a 460-mm (18-in) diameter, 760-mm (30-in) deep concrete foundation with a steel sleeve, which was mounted in S-2 soil. The test results indicate that the single, undrilled 89-mm x 140-mm wood post set in a concrete foundation comparable to that tested meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State. (For this system, breakaway performance in S-1 soil is estimated to be equal to or better than performance in S-2 soil.)

Acceptable – Dual 89-mm x 140-mm (4-in x 6-in) Southern Yellow Pine Wood Posts in Soil, Modified with two 38-mm (1.5-in) Holes, Two Posts Hit

Test Number	92F009	92F010
Soil Type	S-2 (Weak)	S-2 (Weak)
Embedment length, mm (in)	914 (36)	914 (36)
Impact Speed, km/h (mps)	32.2 (20.1)	94.3 (58.6)
Velocity Change, m/s (fps)	4.36 (1.43)	2.29 (7.5)
Occupant Impact, m/s (fps)	2.62 (8.6)	2.29 (7.5)
Stub Height, mm (in)	(see text)	< 100 mm (4 in)

This support consisted of two drilled wood posts (grade unknown) placed in soil. The holes were placed at 100 mm (4 in) and 460 mm (18 in) above the ground line. The stub of one post in the low-speed test exceeded 100-mm. However, it was severely tilted in the direction of impact and is not considered substantial. The test results indicate that the dual modified 89-mm x 140-mm wood post support set in soil meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State. A single post of this description is also acceptable.

Acceptable – Single Round Southern Yellow Pine Timber Post, 127-mm (5-in) Diameter, Mounted in Soilcrete

Test Number	92F016	92F026
Soil Type	S-2 (Weak)	S-2 (Weak)
Embedment length, mm (in)	914 (36)	914 (36)
Impact Speed, km/h (mps)	32.2 (20.1)	94.3 (58.6)
Velocity Change, m/s (fps)	4.36 (1.43)	2.29 (7.5)
Occupant Impact, m/s (fps)	2.62 (8.6)	2.29 (7.5)
Stub Height, mm (in)	(see text)	< 100 mm (4 in)

This support consisted of a single 127-mm (5-in) diameter wood pole (grade unknown) as measure at the top. The pole used in test 92F016 had a diameter at bumper height of 178 mm (7-in) and the pole in test 92F026 had a bumper-height diameter of 165 mm (6.5 in). Each was modified with two 50-mm (2-in) holes. In test 92F016 they were at 150 mm (6 in) and 460 mm (18 in) above the groundline and in test 92F026 they were at 100 mm (4 in) and 460 mm above the groundline. The support was placed in a 460-mm diameter, 1100-m (42 in) deep Soilcrete foundation. (The Soilcrete mix was 9 parts sand to 1 part Portland cement.) The stub height of test 92F016 exceeded the 100-mm requirement because the bottom hole was drilled at 150-mm per the state specifications. To meet FHWA breakaway requirements, this hole must be placed at 100-mm above the groundline, as was the case in test 92F026. The test results indicate that a single modified 127-mm diameter timber pole (with bottom hole centered at 100 mm) set in a Soilcrete foundation comparable to that tested meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State.

Acceptable – Single 140-mm x 190 (6-in x 8-in) Southern Yellow Pine Wood Post in Concrete Foundation, Modified with Two 75-mm (3-in) Holes, One Post of Dual Posts Hit

Test Number	92F020	92F021
Soil Type	Concrete in S-2	Concrete in S-2
Embedment length, mm (in)	610 (24)	610 (24)
Impact Speed, km/h (mps)	34.5 (21.4)	97.4 (60.5)
Velocity Change, m/s (fps)	2.26 (7.4)	0.91 (3.0)
Occupant Impact, m/s (fps)	2.26 (7.4)	0.91 (3.0)
Stub Height, mm (in)	90 (3.5)	90 (3.5)

This support consisted of two drilled 140-mm x 190-mm wood posts (grade unknown) placed in 610-mm (24-in) diameter, 760-mm (30-in) deep concrete foundations with steel sleeves, which were mounted in S02soil. The 75-mm holes were placed at 100 mm (4 in) and 460 mm (18 in) above the ground line. Only one support was hit with the FOIL bogie. The test results indicate that this single modified 140-mm x 190-mm wood post support set in a concrete foundation comparable to that tested meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State. If additional posts are needed they are to be placed 2.1 m (7 ft) or more apart.

Acceptable – Dual Braced 3-kg/m (2-PPF) U-Channels, with 610-mm Splice, In Soil, Two Posts Hit

Test Number	92F024	92F025
Soil Type	S-2	S-2
Embedment length, mm (in)	1070 (42)	1070 (42)
Impact Speed, km/h (mps)	34.7 (21.5)	97.3 (60.4)
Velocity Change, m/s (fps)	4.45 (14.6)	2.56 (8.4)
Occupant Impact, m/s (fps)	3.51 (11.5)	2.56 (8.4)
Stub Height, mm (in)	(see text)	(see text)

This support consists of two braced 30kg/m (2-pound-per-foot (ppf)) high carbon steel U-channel posts. The upper support sections are spliced onto stubs embedded into soil and extending 1000 mm (40 in) above ground. The splices overlap 610 mm (24 in) and each has two 9.5-mm (3/8-in) aluminum bolts spaced at 508 mm (20 in). The upper sections are located behind the stubs. The wind braces are attached to stubs behind the sign, which are embedded 1067 mm (42 in) and extend 100 mm (4 in) above ground. The fasteners used in the vertical support splices, the wind brace connections, and the sign panel attachments are all 9.5-mm (3/8-in) aluminum bolts.

Following the test, the signpost stubs were greater than 100 mm. They consisted of the upper 1000 mm of the base stub bent in the direction of impact. They are considered insignificant in that they would not snag the undercarriage of the vehicle. The test results indicate that this dual 3-kg/m braced U-channel support set in soil meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State. Because all bolts broke in these supports when tested, it is essential that the same type of aluminum bolts used in the test be used in field installations. The use of the 610-mm overlap splice above the bumper line in the vertical posts must also be considered important to the proper performance of this system. If additional posts are needed they are to be placed so that no more than two will fall within a 2.1-m (7-ft) path.

Acceptable – Dual 75-mm (3-in) Diameter, 3.2-mm (1/8-in) Thick Wall, Fiber Reinforced Plastic Posts, In Concrete, Two Posts Hit

Test Number	92F035	92F036
Soil Type	Concrete in S-2	Concrete in S-2
Embedment length, mm (in)	610 (24)	610 (24)
Impact Speed, km/h (mps)	32.2 (20.0)	97.3 (60.4)
Velocity Change, m/s (fps)	8.84 (29.0)	2.44 (8.0)
Occupant Impact, m/s (fps)	4.15 (13.6)	2.44 (8.0)
Stub Height, mm (in)	(see text)	(see text)

This support consisted of two fiberglass posts set in 305-mm (12-in) diameter, 762-mm (30-in) deep concrete foundations placed in S-2 soil. Each foundation had a steel sleeve, and a single 6.4-mm (1/4-in) bolt was used to secure each post to its sleeve.

Both posts were struck with the test automobile. The signposts crushed and broke at various heights, leaving some stubs of bent and broken fiberglass greater than 100 mm, however the are considered insignificant in that they would not snag the undercarriage of the vehicle. The test results indicate that this dual 75-mm diameter fiberglass support set in a concrete foundation comparable to that tested meets the FHWA breakaway requirements and is acceptable for use on NHS projects when requested by a State. If additional posts are needed they are to be placed so that no more than two will fall within a 2.1-m (7-ft) path.

V B Acceptable Sign Support Systems – Strong Soil ONLY

Acceptable in Strong Soils Only – Triple, Sliced 3.7 kg/m (2.5 PPF) and 3.0 kg/m (2 PPF) U-Channel, Three Posts Hit

Test Number	92F022 (3.7 kg/m)	92F023 (3.0 kg/m)	92F037 (3.7 kg/m)	92F038 (3.7 kg/m)
Soil Type	Weak	Weak	Strong	Strong
Embedment length, mm (in)	914 (36)	914 (36)	914 (36)	914 (36)
Impact Speed, km/h (mps)	35.1 (21.8)	34.3 (21.3)	34.0 (21.1)	95.3 (59.2)
Velocity Change, m/s (fps)	8.96 (29.4)	9.57 (31.4)	2.96 (9.7)	1.52 (5.0)
Occupant Impact, m/s (fps)	6.37 (20.9)	6.00 (19.7)	2.44 (8.0)	1.52 (5.0)
Stub Height, mm (in)	>100 (4)	>100 (4)	100 (4)	100 (4)

These triple 3.7-kg/m and 3.0-kg/m u-channel sign supports of 550-Mpa (80-ksi) steel used the "Florida Splice". In this splice the post overlaps the foundation stub approximately 200 mm (8 inches). It is secured by two 9.5-mm (3/8-in) SAE grade-2 bolts spaced at 150 mm (6-in) and between the sections of u-channel, held in place by the splice bolts, are spacers made up of stacked, 15.9-mm (5/8-in) steel washers. In the tests the tops of the foundation stubs extended 100 mm above ground. All three posts were struck with the automobile. The test results indicate that single, dual, or triple 3.7-kg/m U-channel posts with the Florida splice set in strong soil meet the FHWA breakaway requirements and are acceptable for use on NHS projects when requested by a State. The use of 3.0-kg/m posts is also acceptable. If additional posts are needed they are to be placed so that no more than three will fall within a 2.1 m (7 ft) path.

This support should not be used in weak soils.

Acceptable in Strong Soils Only – Dual Spliced 6 kg/m (4 PPF) U-Channel, Two Posts Hit

Test Number	92F011	1122-6A	1122-7
Soil Type	Weak	Strong	Strong
Embedment length, mm (in)	920 (36)	920 (36)	920 (36)
Impact Speed, km/h (mps)	32.6 (20.3)	29.9 (18.9)	97.3 (60.5)
Velocity Change, m/s (fps)	8.66 (28.4)	2.20 (7.2)	1.65 (5.4)
Occupant Impact, m/s (fps)	6.52 (21.4)	3.1 (10.2)	None
Stub Height, mm (in)	<100 (<4)	100 (4)	100 (4)

The weak soil test failed because the support plowed through the sand before any bolts broke. This absorbed enough energy to prevent the proper activation of the breakaway mechanism. The strong soil tests were conducted at the Texas Transportation Institute (TTI) in august of 1988. This u-channel sign support of 550-Mpa (80-ksi) steel used a lap splice with special grade-9 bolts spaced at 100 mm (4 inches). The foundation stub extended 100 mm above the ground. The post overlapped the stub approximately 125 mm (5 inches). Both posts were struck with the automobile. The test results indicate that single or dual 6-kg/m U-channel posts with the 100-mm splice set in strong soil meet the FHWA breakaway requirements and are acceptable for use on NHS projects when requested by a State. If additional posts are needed they are to be placed so that no more than two will fall within a 2.1-m (7-ft) span. This support should not be used in weak soils.

Note: Other testing at TTI showed similar good results with dual 4.5-kg/m (3-ppf) U-channel posts with breakaway splices using the special grade-9 bolts spaced at 75 mm. Thus, this system is also acceptable where use is limited to strong soils.

Acceptable in Strong Soils Only – Dual Direct Bury 4.5 kg/m (3 PPF) U-Channel, Two Posts Hit

Test Number	92F012	7024-22	7024-23
Soil Type	Weak	Strong	Strong
Embedment length, mm (in)	920 (36)	762 (30)	762 (30)
Impact Speed, km/h (mps)	33.3 (20.7)	32.2 (20.0)	101 (62.8)
Velocity Change, m/s (fps)	8.05 (26.4)	2.87 (9.4)	3.57 (11.7)
Occupant Impact, m/s (fps)	6.19 (20.3)	(not reported)	(not reported)
Stub Height, mm (in)	> 100 (4)	(see text)	(see text)

The weak soil test failed because the support plowed through the sand before the u-channel could deform and bend away. This absorbed enough energy to prevent acceptable breakaway performance. The strong soil tests were conducted at the Texas Transportation Institute (TTI) in September of 1985. This 550-Mpa (80-ksi) u-channel sign support system was buried directly into the soil. There was a structural lap splice just below the sign panel. It did not, however, affect the results of the test. Such lap splices are not desirable. Those that begin above the bumper level or that will significantly strengthen the supports at the bumper or ground lines, especially, should be avoided. Both posts were struck with the test vehicles. Some stubs, consisting of the post broken near the bumper and bent in the direction of impact, exceeded 100 mm but were not substantial and would not snag the undercarriage of a vehicle. The test results indicate that the single or dual 4.5-kg/m U-channel posts set in strong soil meet the FHWA breakaway requirements and are acceptable for use on NHS projects when requested by a State. If additional posts are needed they are to be placed so that no more than two will fall within a 2.1-m (f-ft) path. This support should not be used in weak soils.

V C 1. Unacceptable Sign Support Systems

Unacceptable – Omni-Directional Slip Base, 200-mm x 200-mm x 5-mm (8-in x 8-in x 0.19-in) Square Steel Tube Support, One Post Hit

Test Number	91F018
Soil Type	Concrete
Embedment length	N/A
Impact Speed, km/h (mps)	34.1 (21.2)
Velocity Change, m/s (fps)	10.8 (35.5)
Occupant Impact, m/s (fps)	10.8 (35.5)

The total weight of the support and sign was 298 kg (655 lb). The three 25-mm (1-in) bolts of the triangular slip base were torqued to 120.6 N.m (90 lb ft). This slip base sign support included a pyramidal riser on the base plate that was supposed to loft the sign support into the air after impact. This design failed because the interior of the bottom of the sign support struck the riser on the base placed before the bolts could disengage.

The State that uses this design intends to crash test a version without the riser. Another, smaller omni-directional slip base sign support was recently found acceptable for use with a 89-mm (3 ½-in) diameter schedule-40 steel pipe (FHWA Geometric and Roadside Design Acceptance letter Number SS34 dated April 20, 1993). The successful design had the bottom interior of the sign support beveled so that the riser could function as intended and not block activation of the slip base mechanism.

V C 2. Unacceptable Small Sign Support Systems

The following small sign support systems were each tested in weak soil at low speed, and failed. In those cases where the posts were embedded in concrete, the concrete footing was in the FOIL weak soil pit. All of these failing sign support systems had either two or three posts. It is possible that some of these failing systems could be found crashworthy with different foundation conditions, such as strong soil or larger concrete foundations.

Unacceptable – Dual Unmodified Wood Posts, 89-mm x 89-mm (4x4-in) or 89-mm x 140-mm (4x6-in), Concrete Foundation, Two Posts Hit

Test Number	92F014 (4x6)	92F015 (4x4)
Soil Type	Concrete in S-2	Concrete in S-2
Footing Depth, mm (in)	760 (30)	760 (30)
Embedment length, mm (in)	610 (24)	610 (24)
Impact Speed, km/h (mps)	33.6 (20.9)	34.8 (21.6)
Velocity Change, m/s (fps)	9.0 (29.5)	8.8 (29.0)
Occupant Impact, m/s (fps)	6.04 (19.8)	5.30 (17.4)

In both the 89-mm x 89-mm dual post test and the 89-mm x 140-mm dual post test, the 460-mm (18-inch) diameter, 760-mm (30-inch) deep concrete foundations rotated in the soil and the vehicle was stopped. It is possible that these wood posts embedded in concrete foundations in strong soil or larger foundations in strong or weak soil may be crashworthy, but no tests have been conducted to date.

Unacceptable – Dual 6 kg/m (4 PPF) U-Channel, Concrete Foundation, Two Posts Hit

Test Number	92F034
Soil Type	Concrete in S-2
Embedment length, mm (in)	762 (30)
Impact Speed, km/h (mph)	33.4 (20.7)
Velocity Change, m/s (fps)	8.66 (28.4)
Occupant Impact, m/s (fps)	7.07 (23.2)

In this test, the dual post system caused the 300-mm (12-in) diameter, 800-mm (30-in) deep concrete foundation to rotate in the weak soil when struck. The vehicle was stopped. From previous experience, it seems doubtful that any dual 6-kg/m post support system without a breakaway device that replaces the simple fracturing or bending of posts can be developed for any foundation conditions.

Unacceptable – Triple 3.7 kg/m (2.5 PPF) and Triple 3 kg/m (2 PPF) U-channel, Direct Bury, Three Posts Hit

Test Number	92F017 3.7 kg/m	92F019 3 kg/m
Soil Type	Weak	Weak
Embedment length, mm (in)	914 (36)	914 (36)
Impact Speed, km/h (mps)	34.7 (21.5)	29.6 (18.4)
Velocity Change, m/s (fps)	9.48 (31.1)	6.1 (20.0)
Occupant Impact, m/s (fps)	6.43 (21.1)	5.43 (17.8)

In both the triple 3.7-kg/m test and the triple 3-kg/m test the vehicle rode up the sign support, which translated in the weak soil. In the 3-kg/m test, the sign support eventually yielded to the vehicle and lay flat.

Because the dual 4.5 kg/m U-Channel support of 550-Mpa (80-ksi) steel has been found acceptable in strong soil, the dual 3.7 kg/m and dual 3 kg/m supports may also be used in strong soil. Additional testing is necessary to determine if any dual-post, direct-burial u-channel supports are crashworthy in weak soils.

Sincerely yours,

Lawrence A. Staron, Chief
Federal-Aid and Design Division

APPENDIX A

DRAWINGS OF THE TESTED SYSTEMS

IN ORDER TESTED

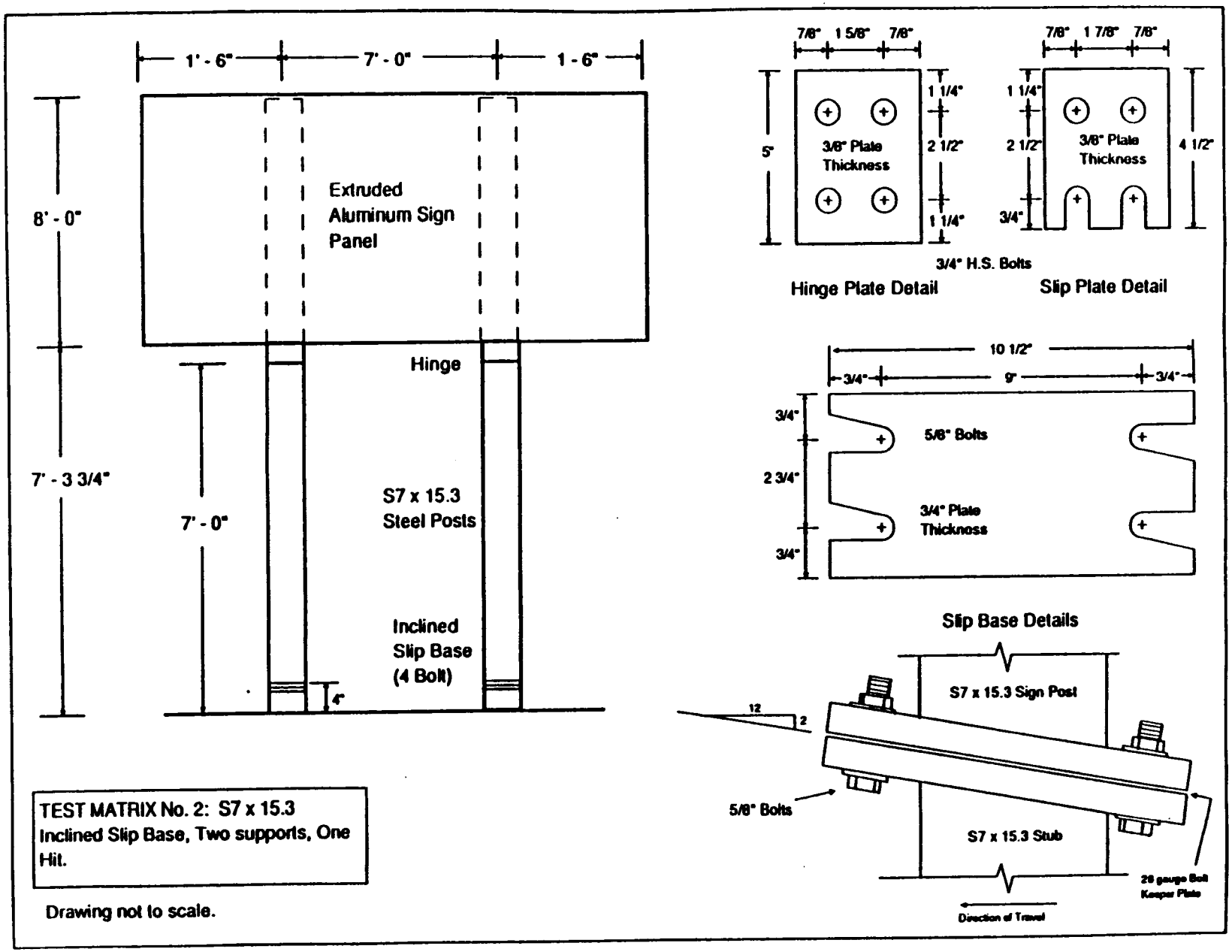


Figure 2. Sketch of the sign support system.

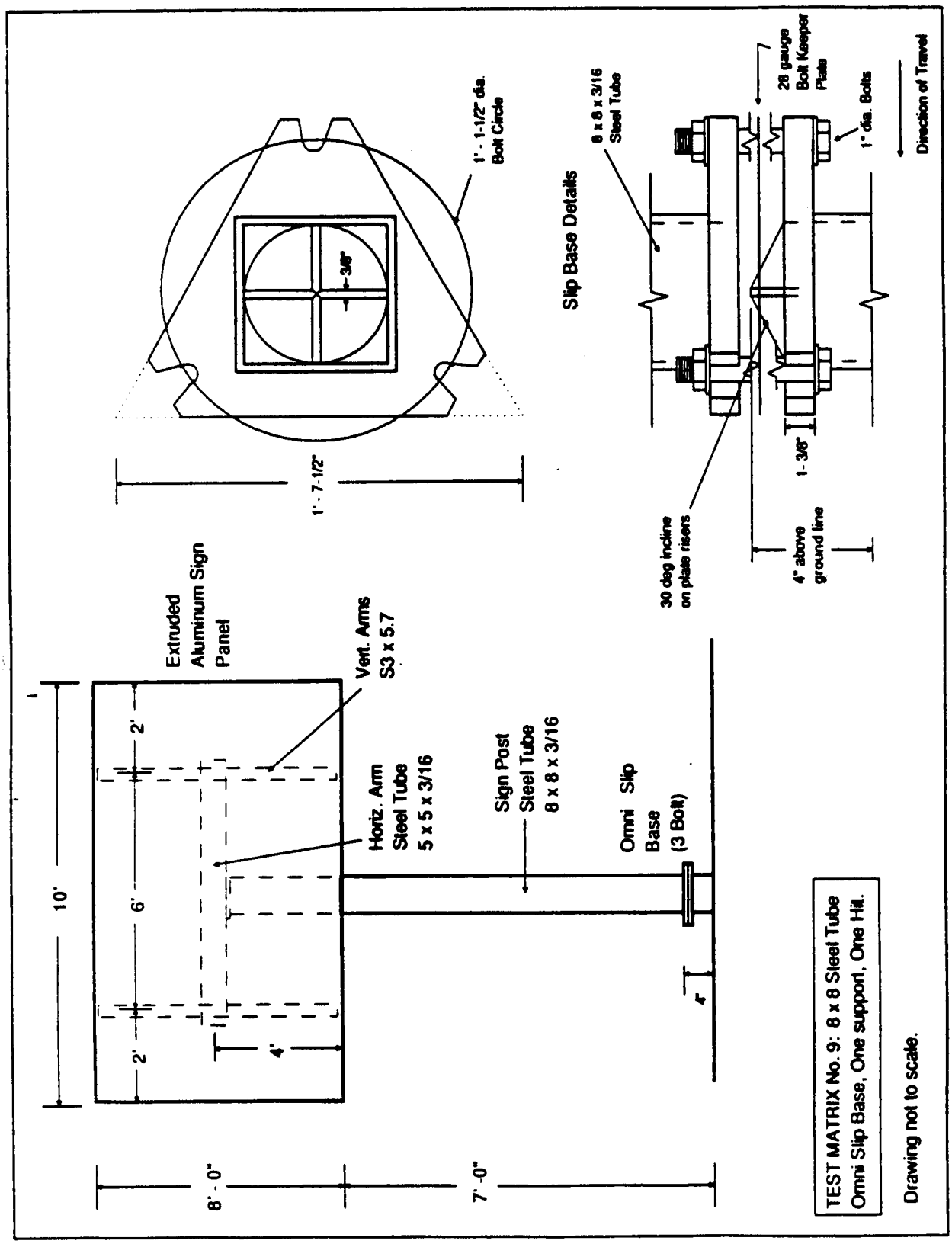
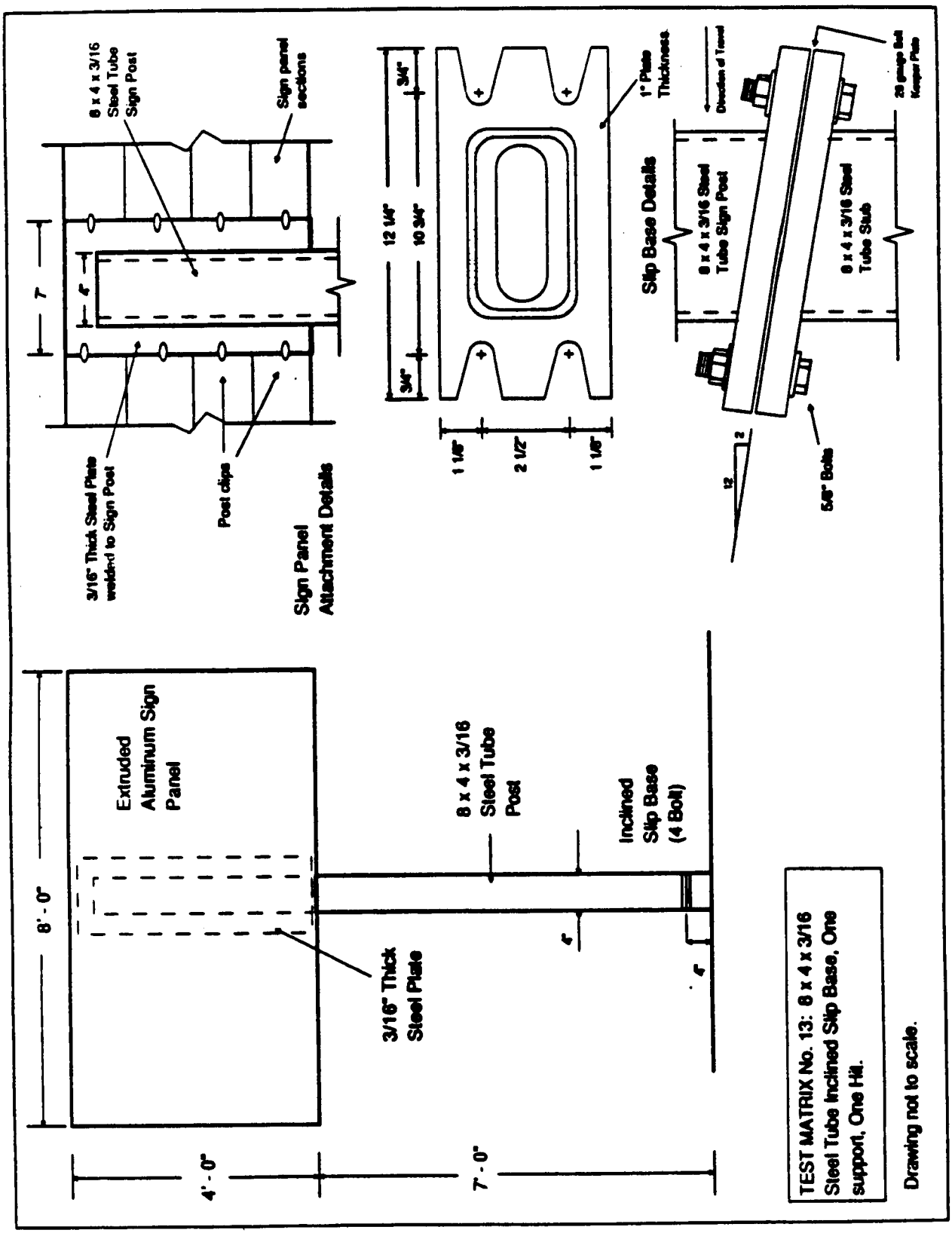


Figure 2. Sketch of the sign support system.



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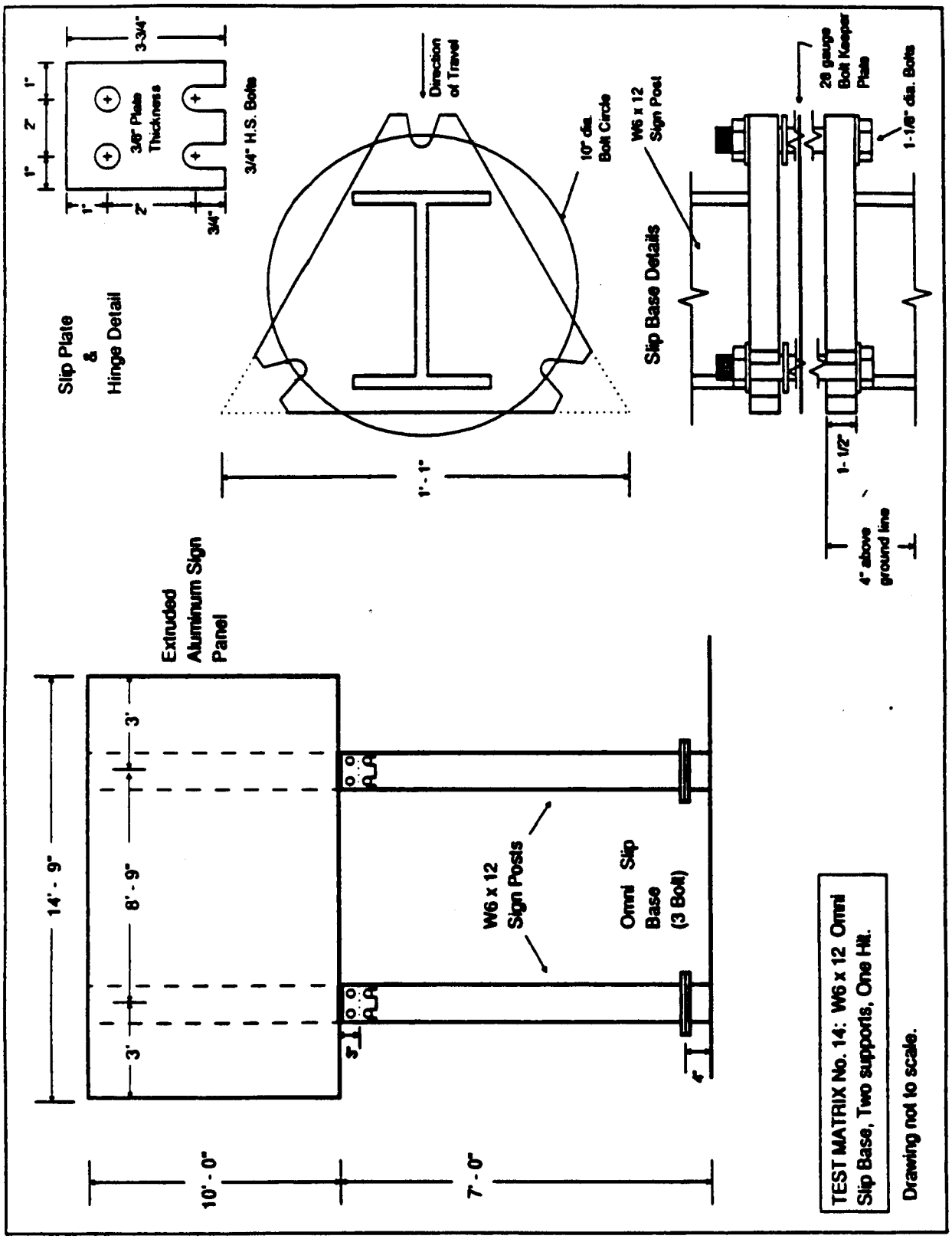


Figure 2. Sketch of the sign support system.

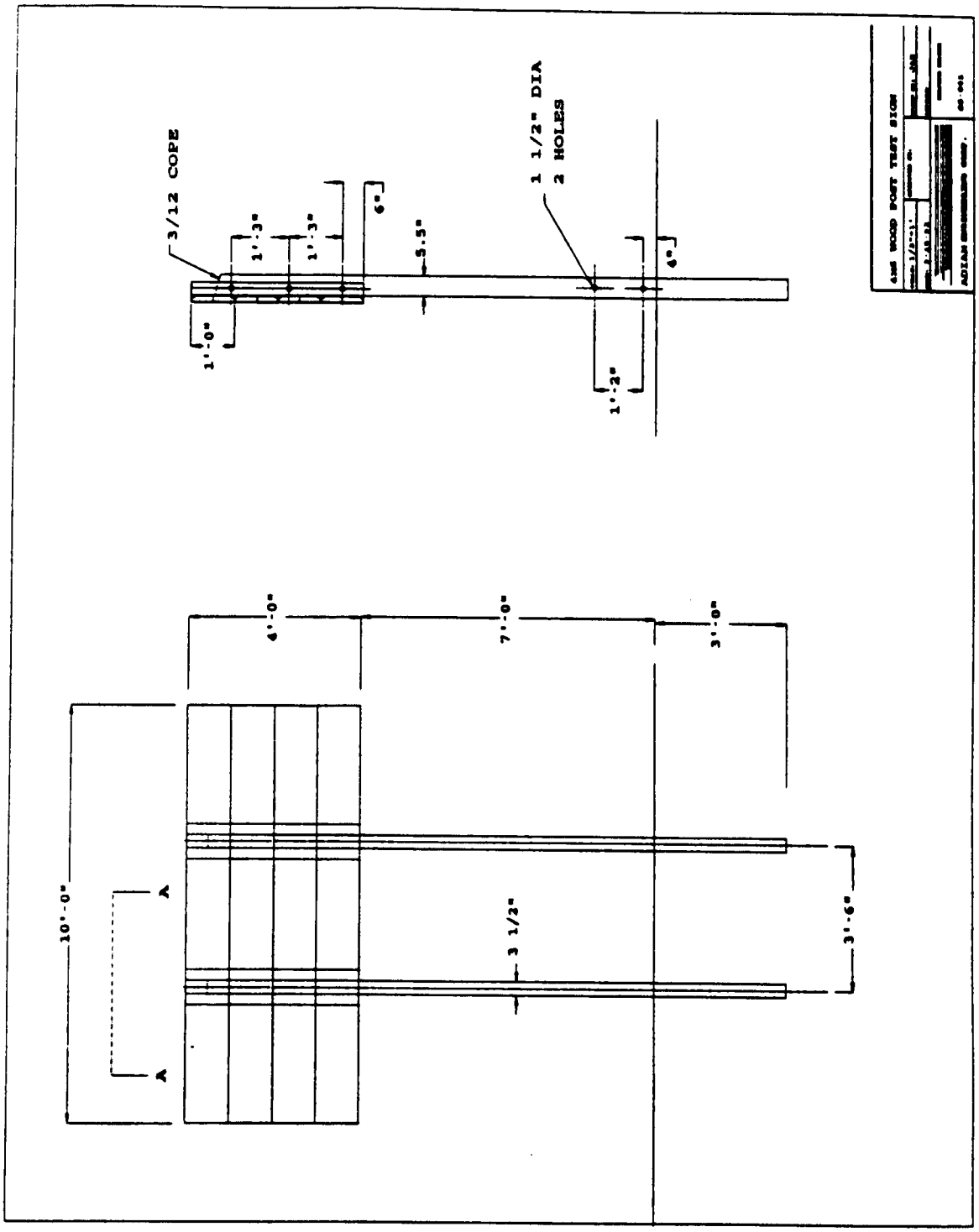


Figure 1. Sketch of small sign support.

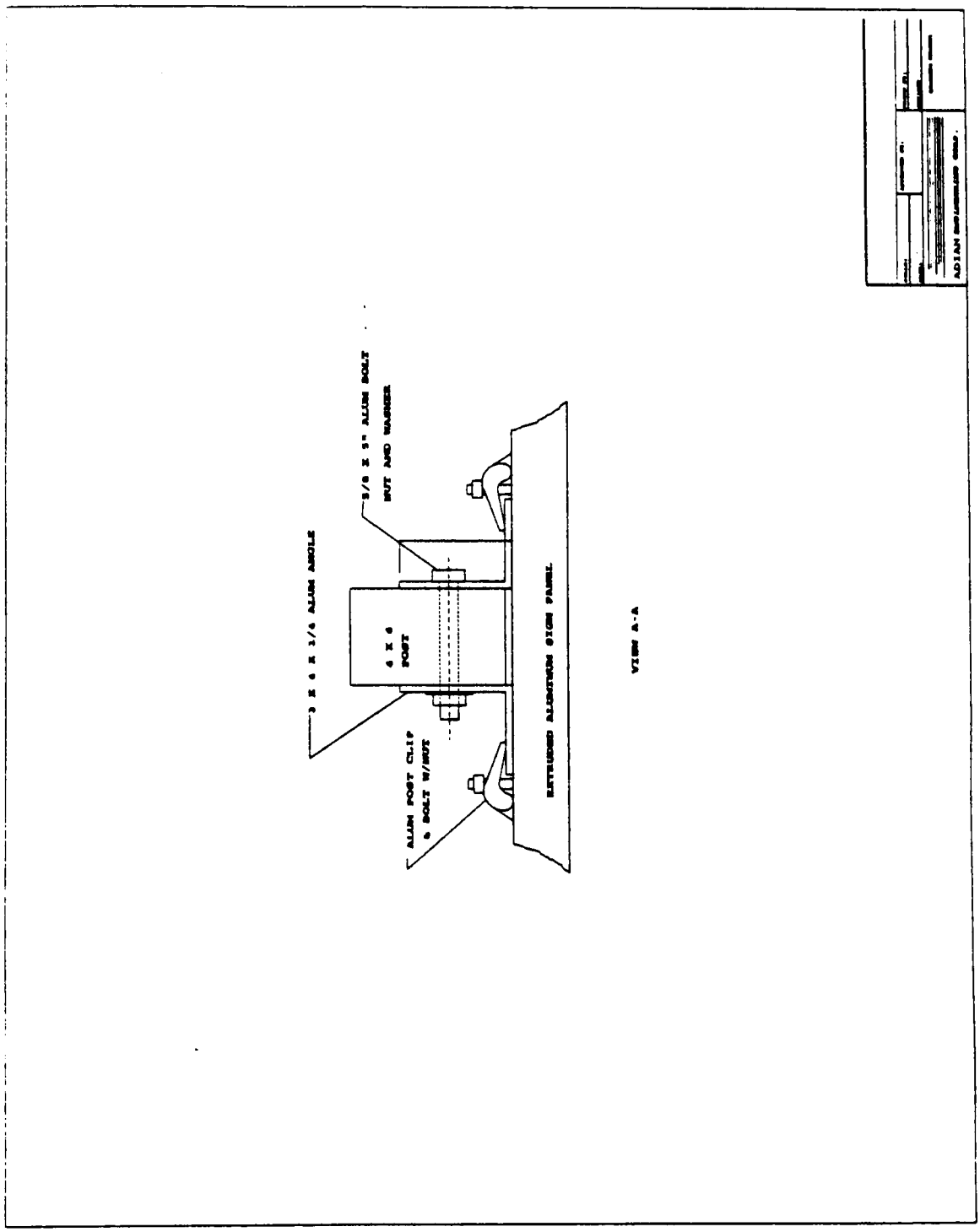


Figure 2. Sketch of small sign support attachment detail.

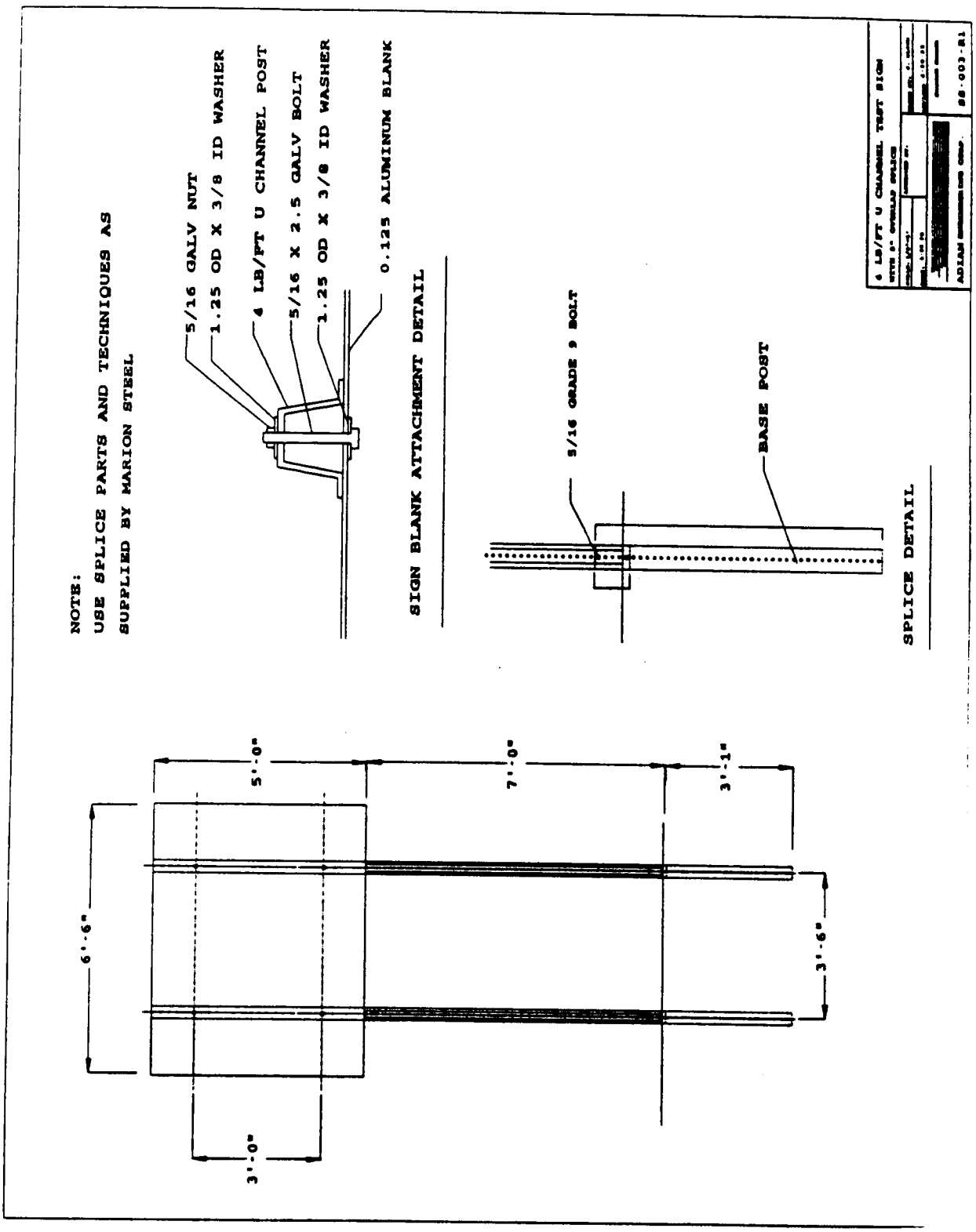


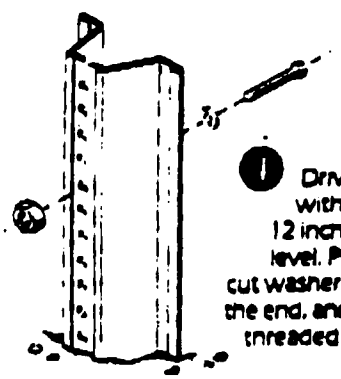
Figure 1. Sketch of small sign support.

THE LAP SPLICE™ U-CHANNEL BREAKAWAY SYSTEM

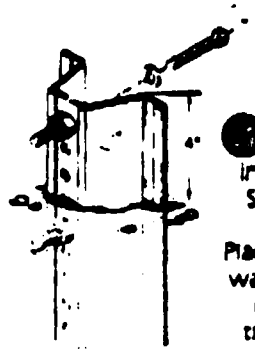
Patent Pending

Installation

The LAP SPLICE system consists of four washers and two specially designed Grade 9 bolts, nuts and threaded spacers. This system is FHWA approved *only* when used to lap splice Marion Steel RIB-BAK® u-channel sign and ground posts.

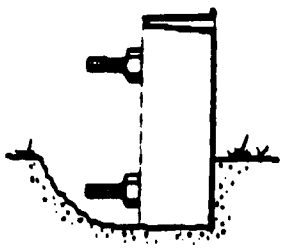


1. Drive ground post to within approximately 12 inches above ground level. Place one bolt and cut washer in fifth hole from the end, and securely tighten threaded spacer onto bolt.

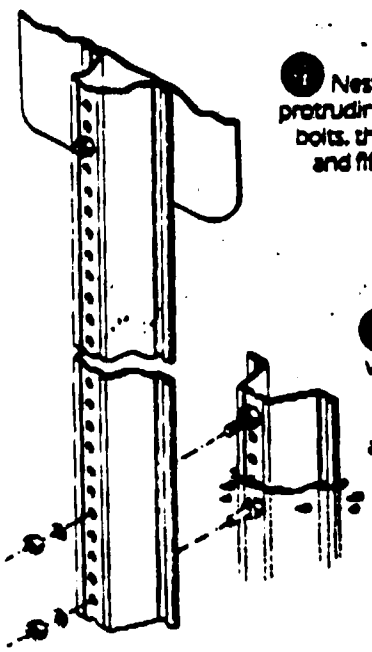


2. Drive ground post to 4 inches above ground level. Some loosening of top soil may make driving easier. Place remaining bolt and cut washer in first hole from the end, and securely tighten threaded spacer onto bolt.

MARION STEEL CO.

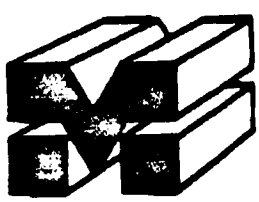


3. Dig out approximately 2 inches from around back of ground post to allow room for top post to be attached.



4. Nest top post over protruding ground post bolts, through the first and fifth holes of the top post.

5. Place a lock washer and nut on each bolt. Tighten nuts and tamp earth around ground post firmly.



MARION STEEL CO.

912 Cheney Avenue
Marion, Ohio 43302
614/383-4011

Figure 2. U-channel splice detail, supplied by Marion Steel.

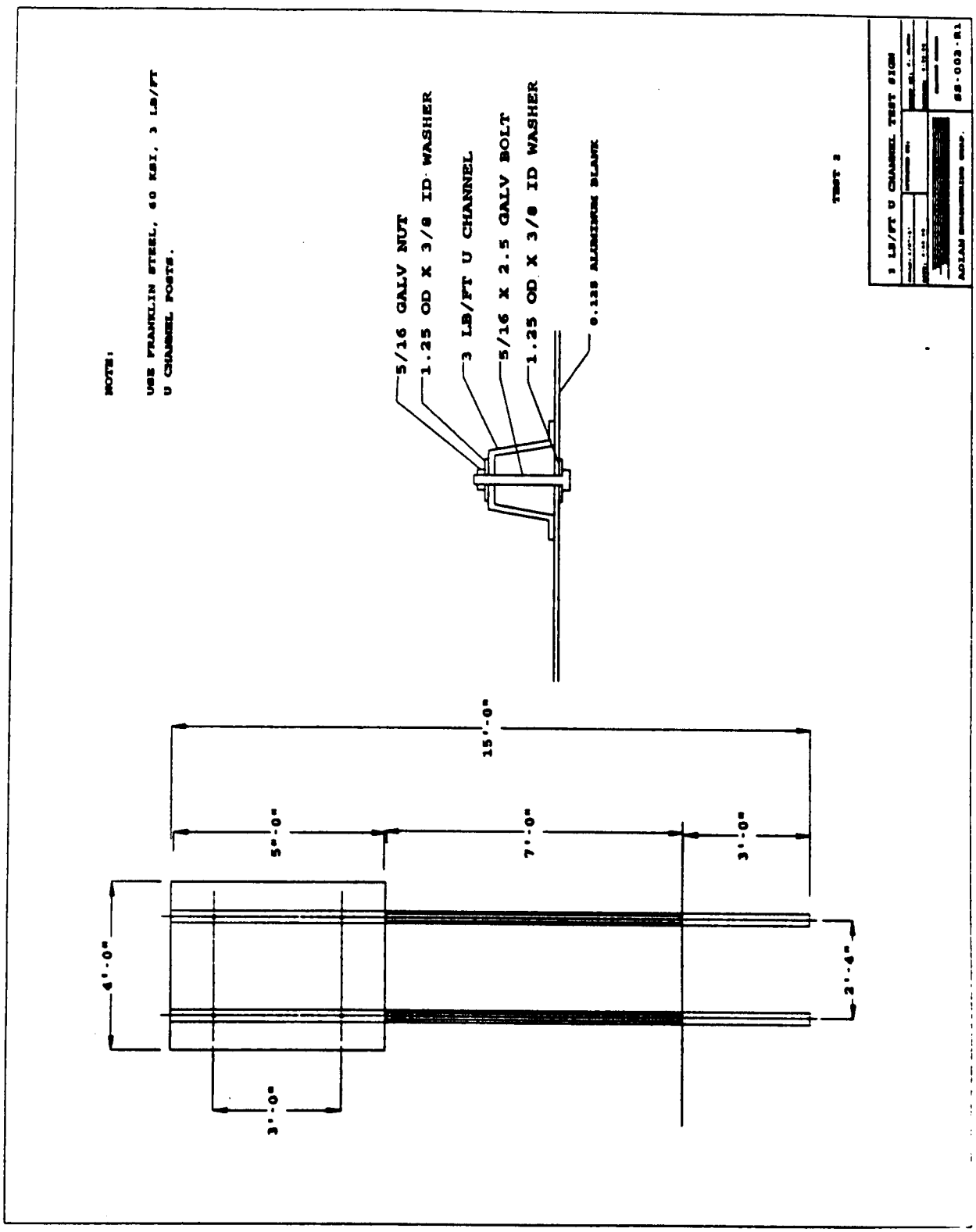
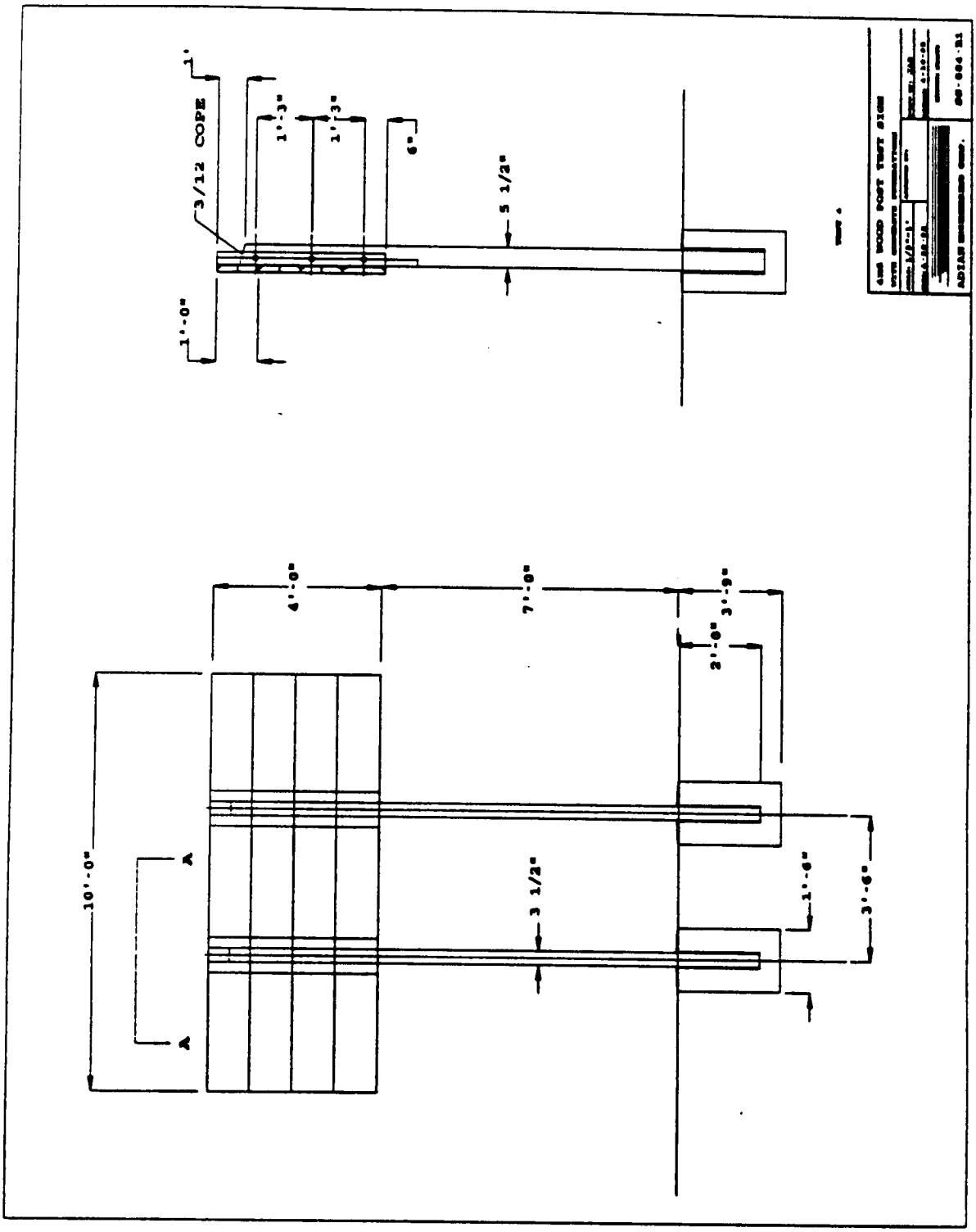


Figure 1. Sketch of small sign support.



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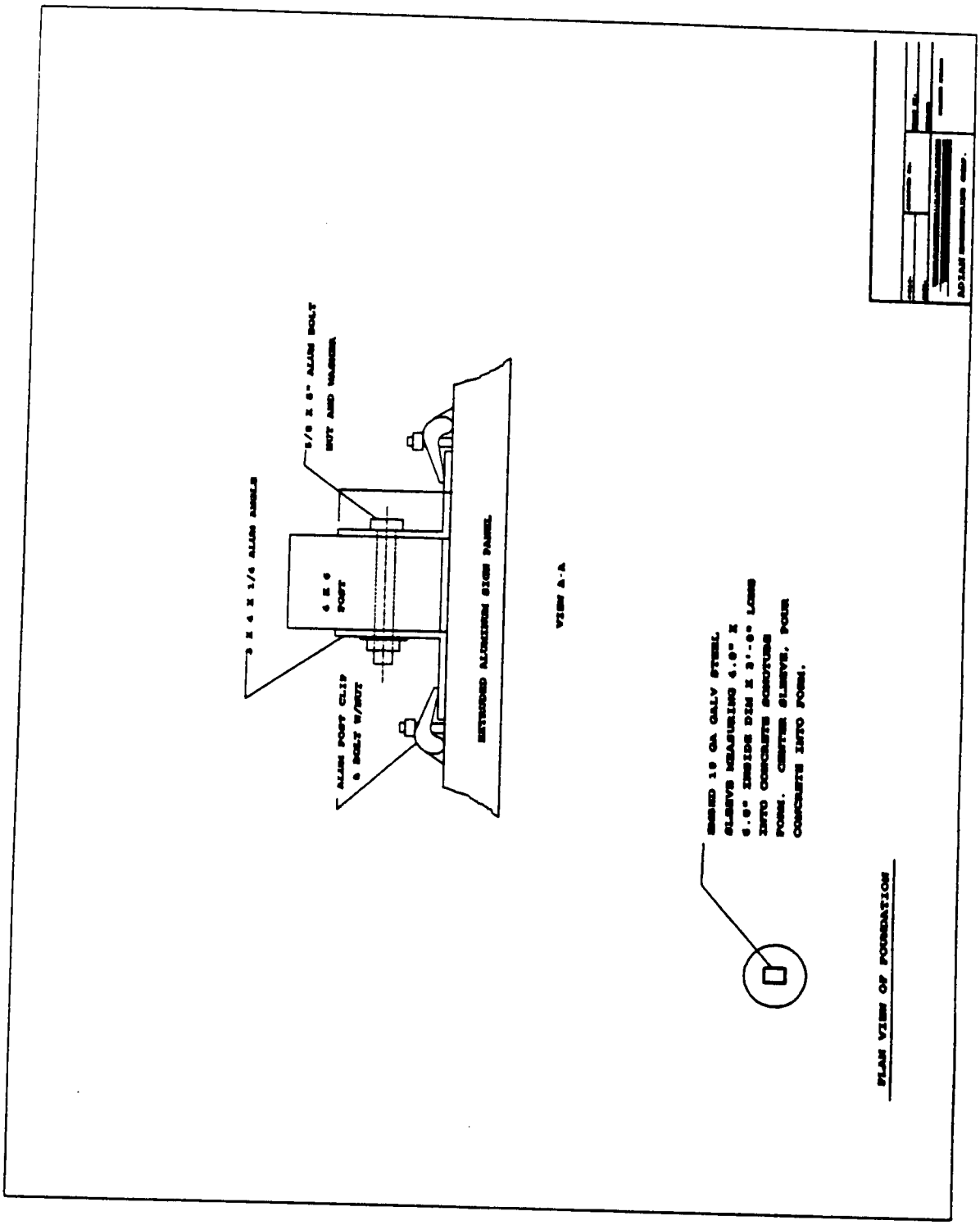
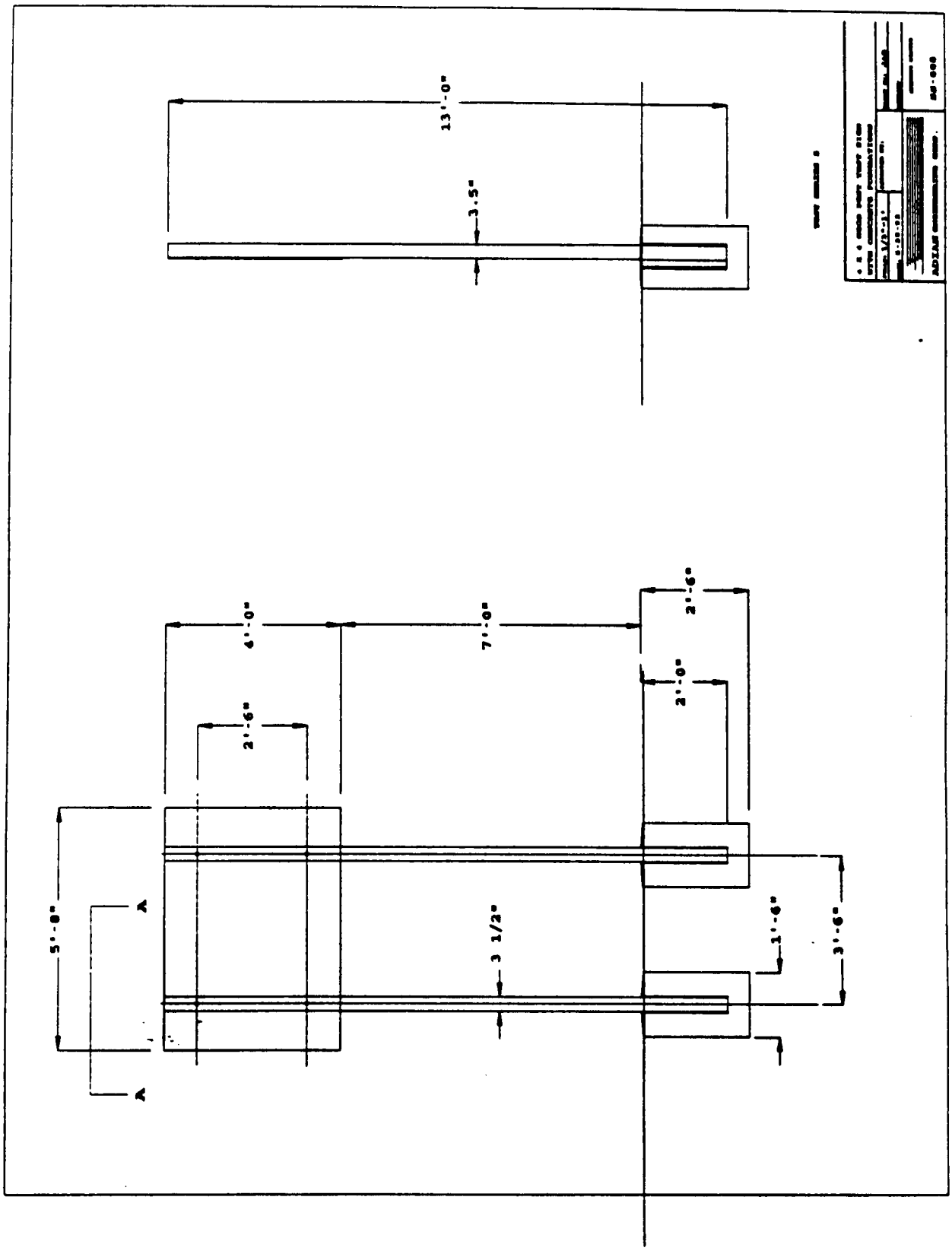


Figure 2. Sketch of small sign support, attachment detail.



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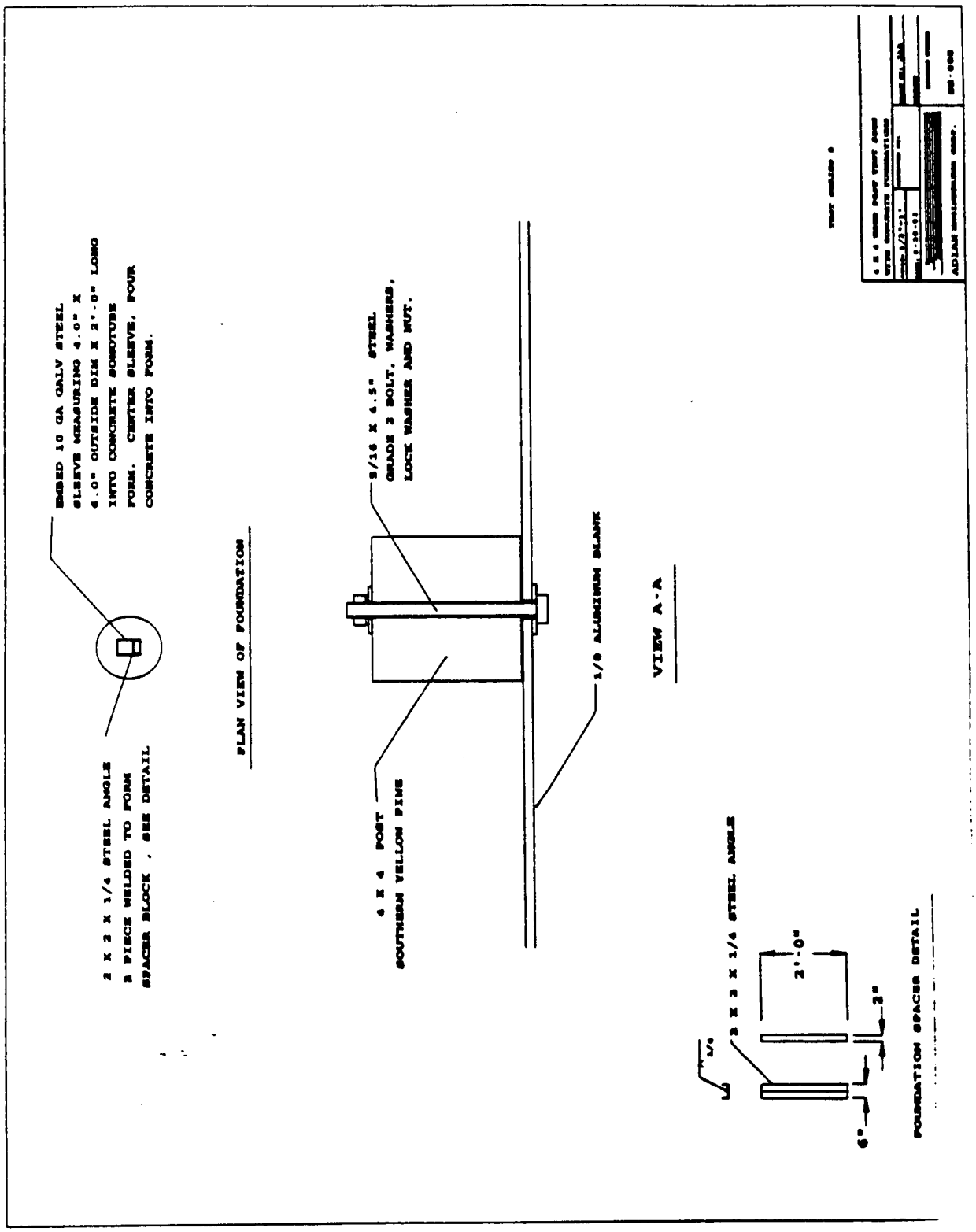

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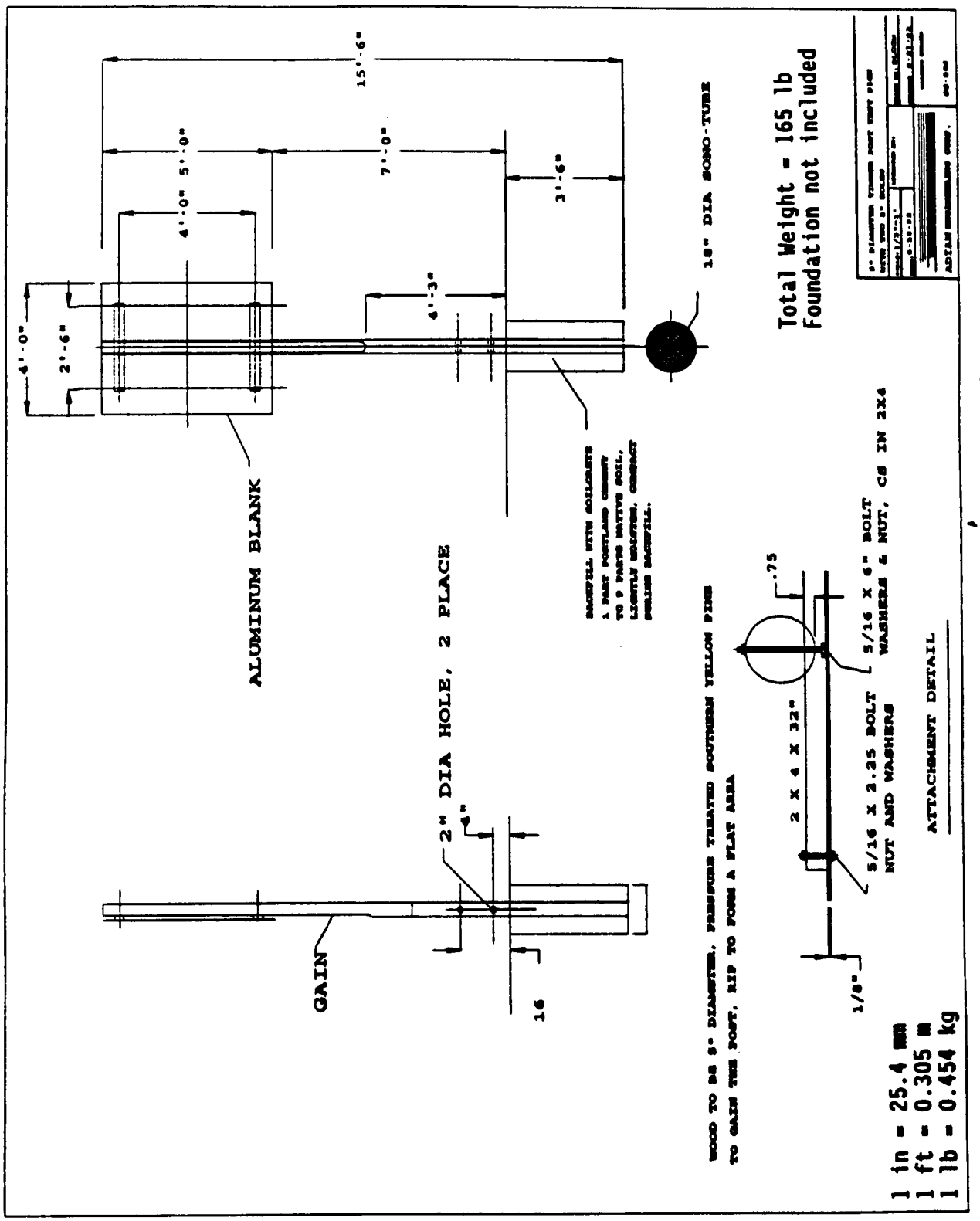

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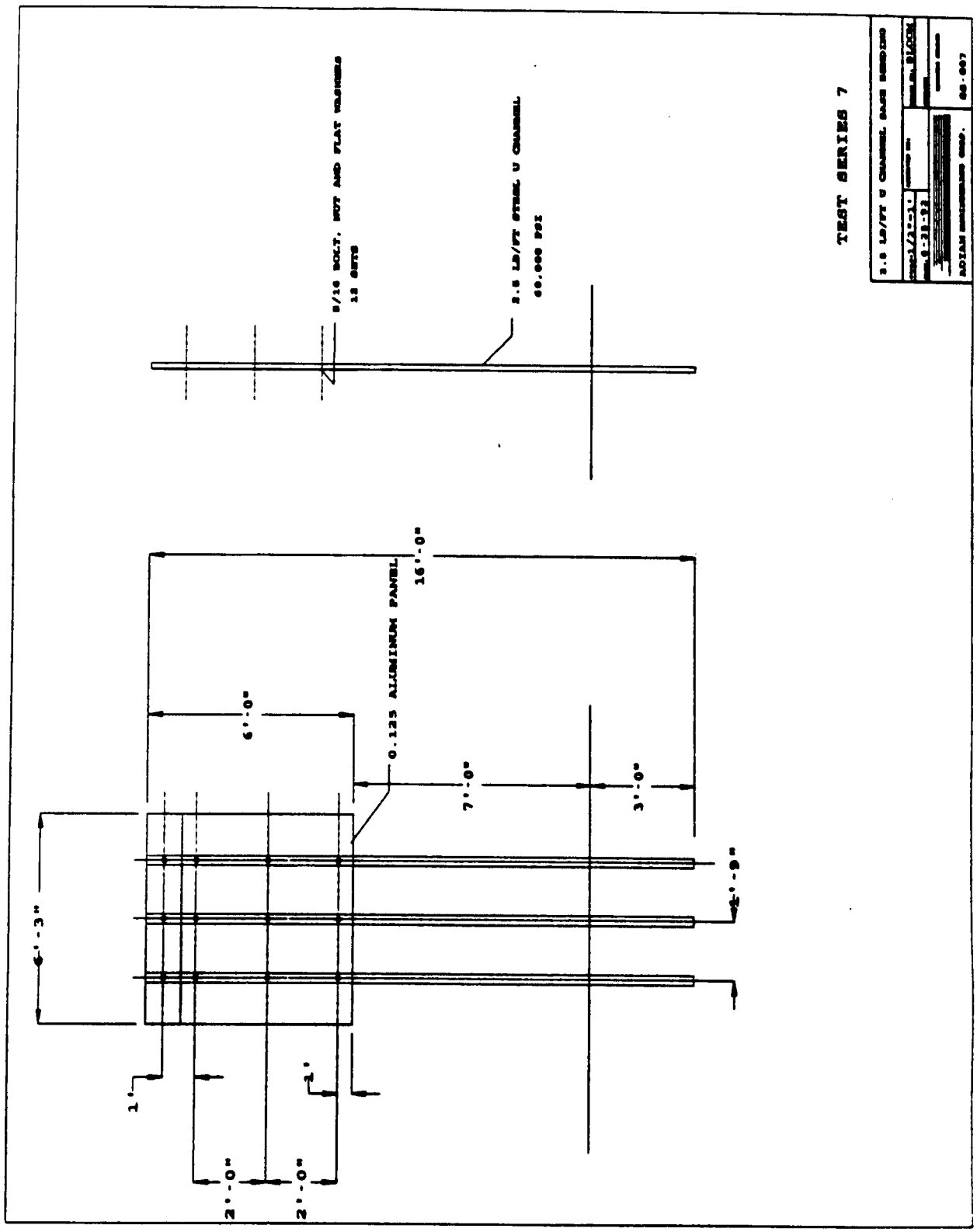

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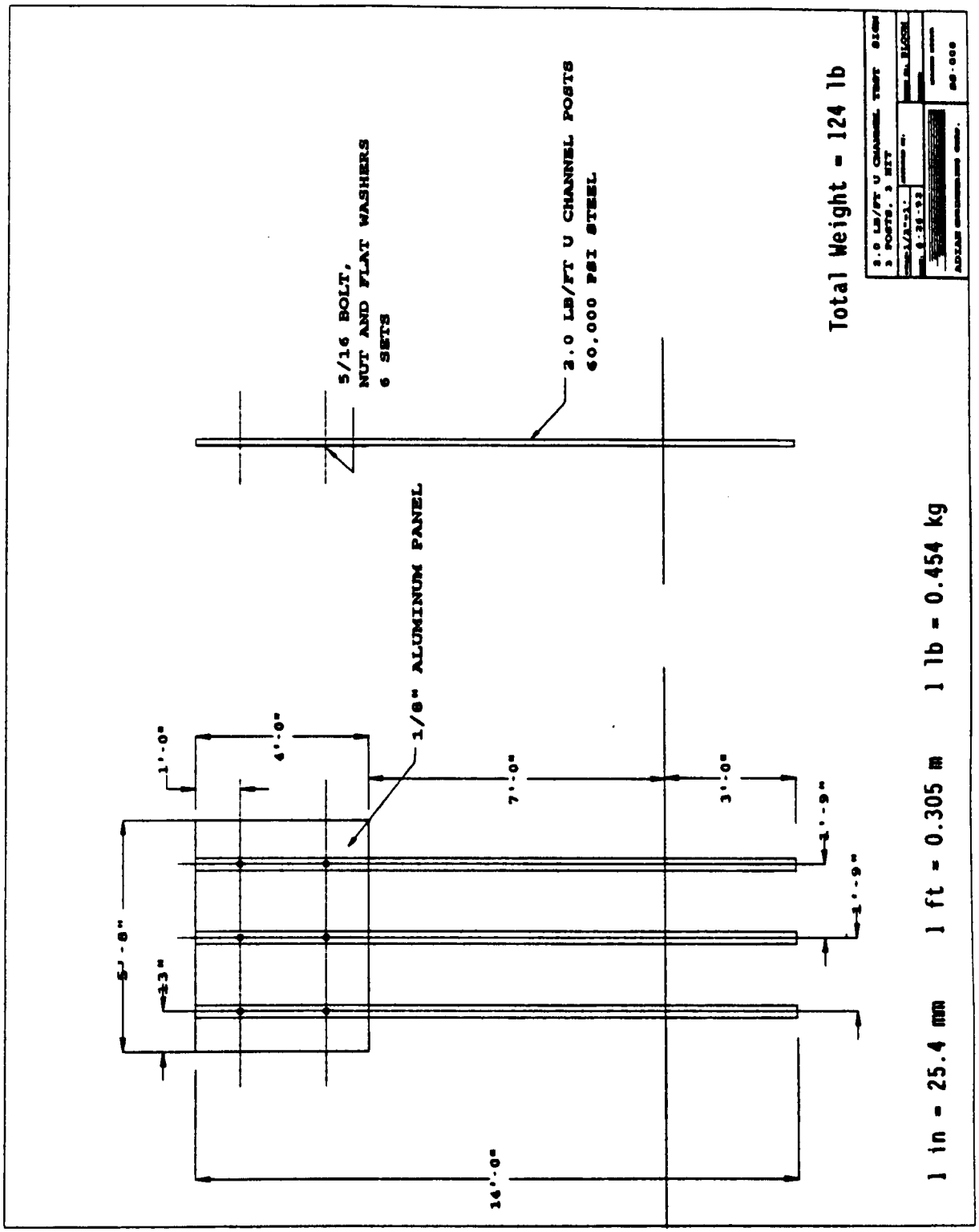

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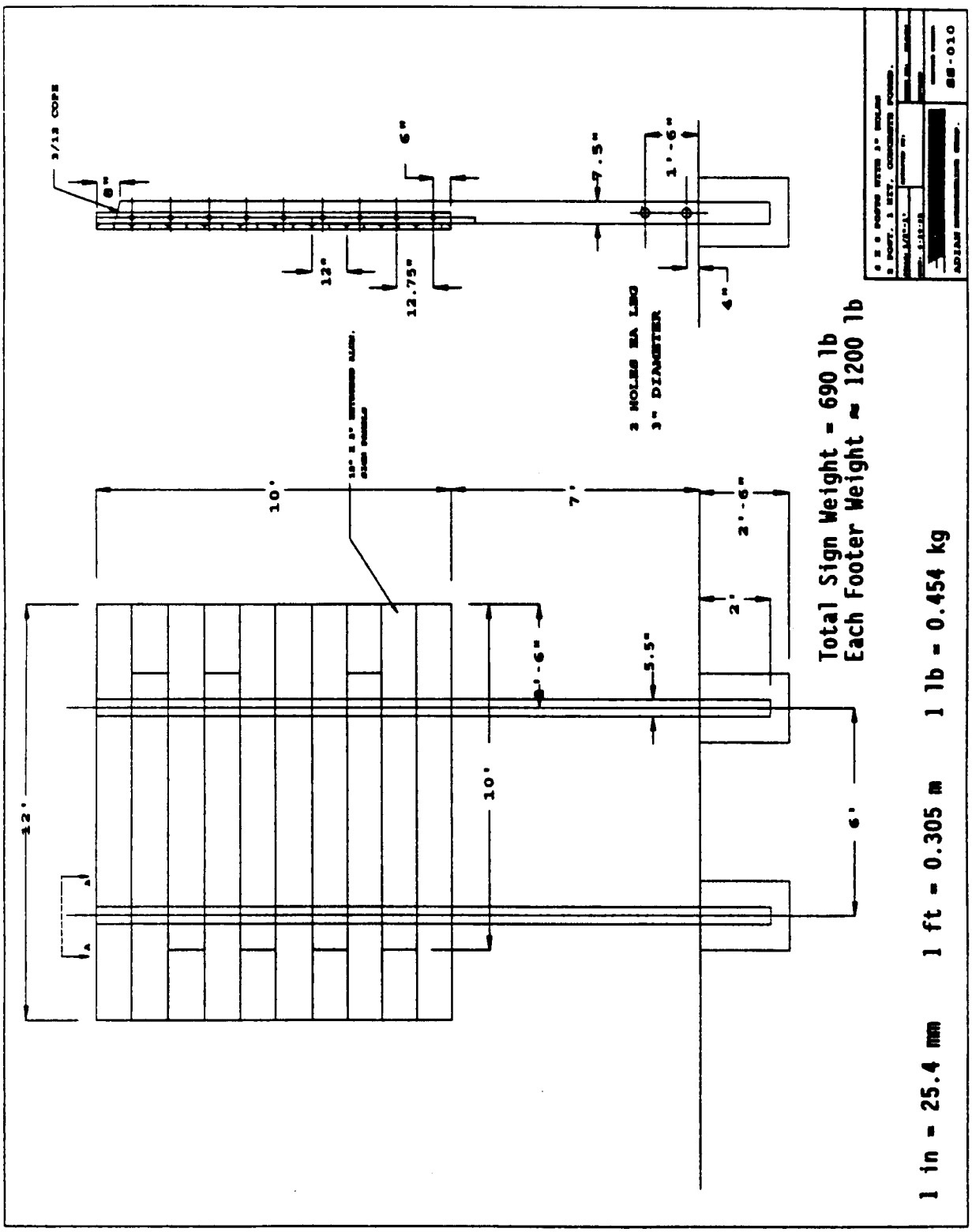


Figure 3. Sketch of small sign support.

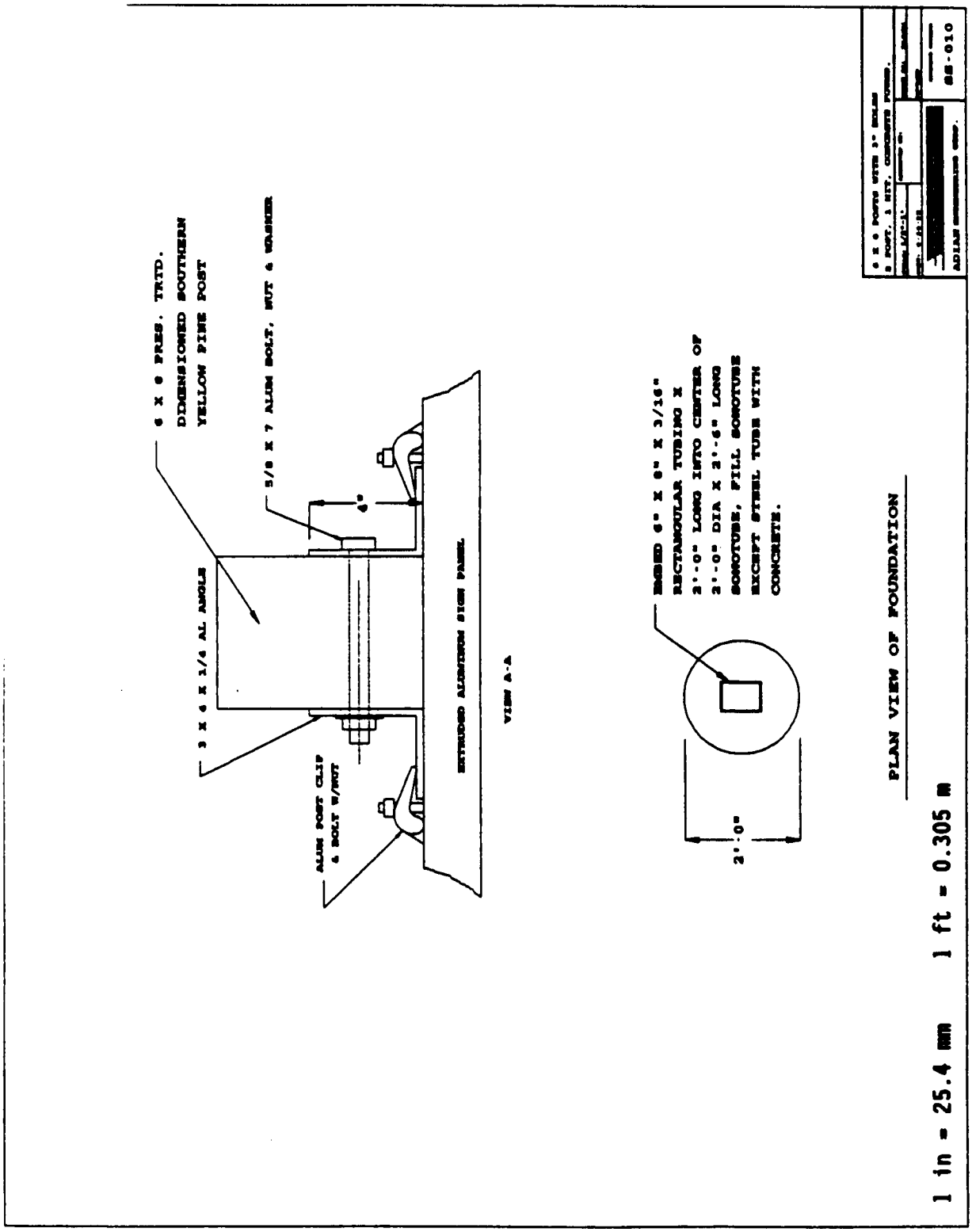
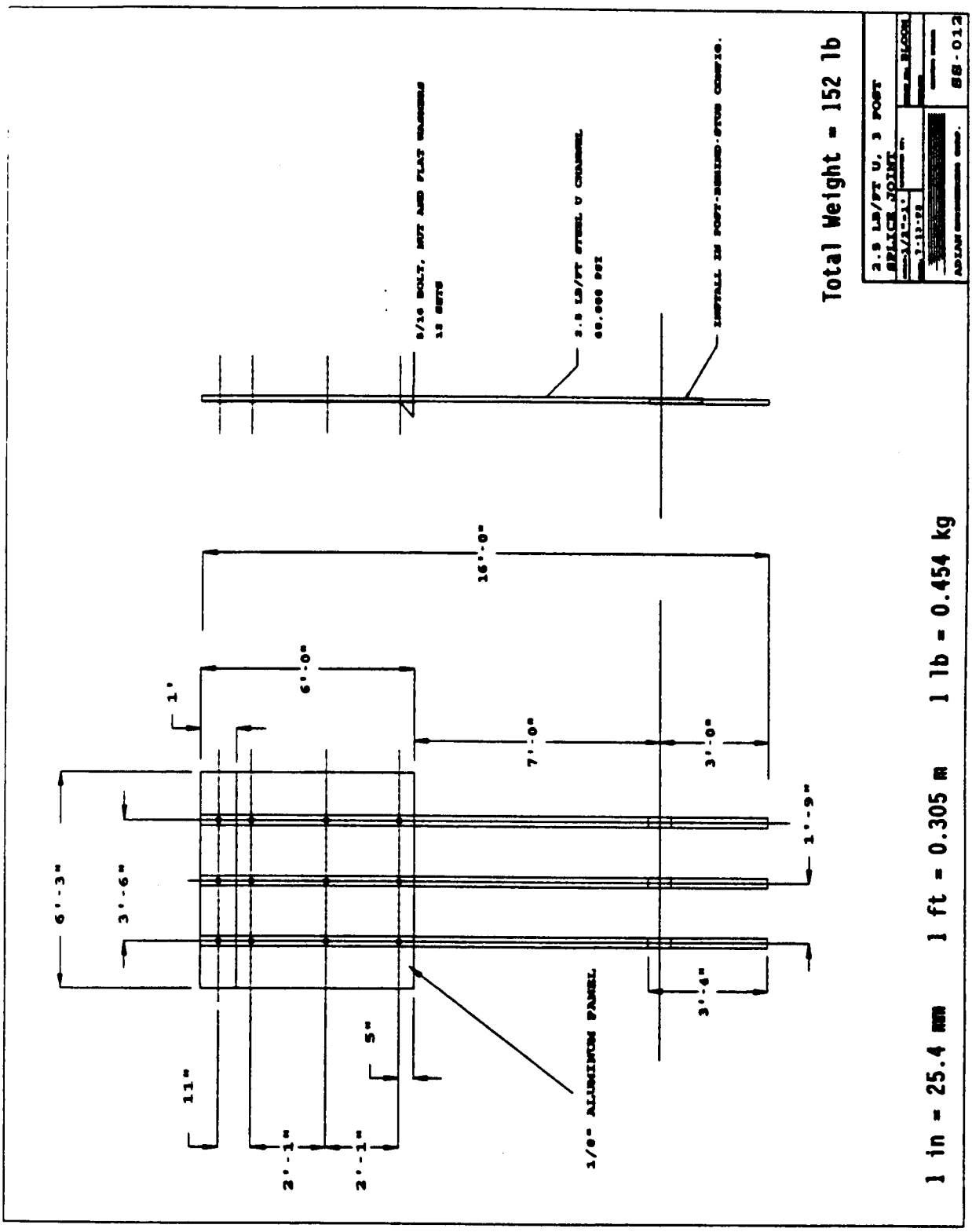


Figure 4. Sketch of small sign support attachment detail.



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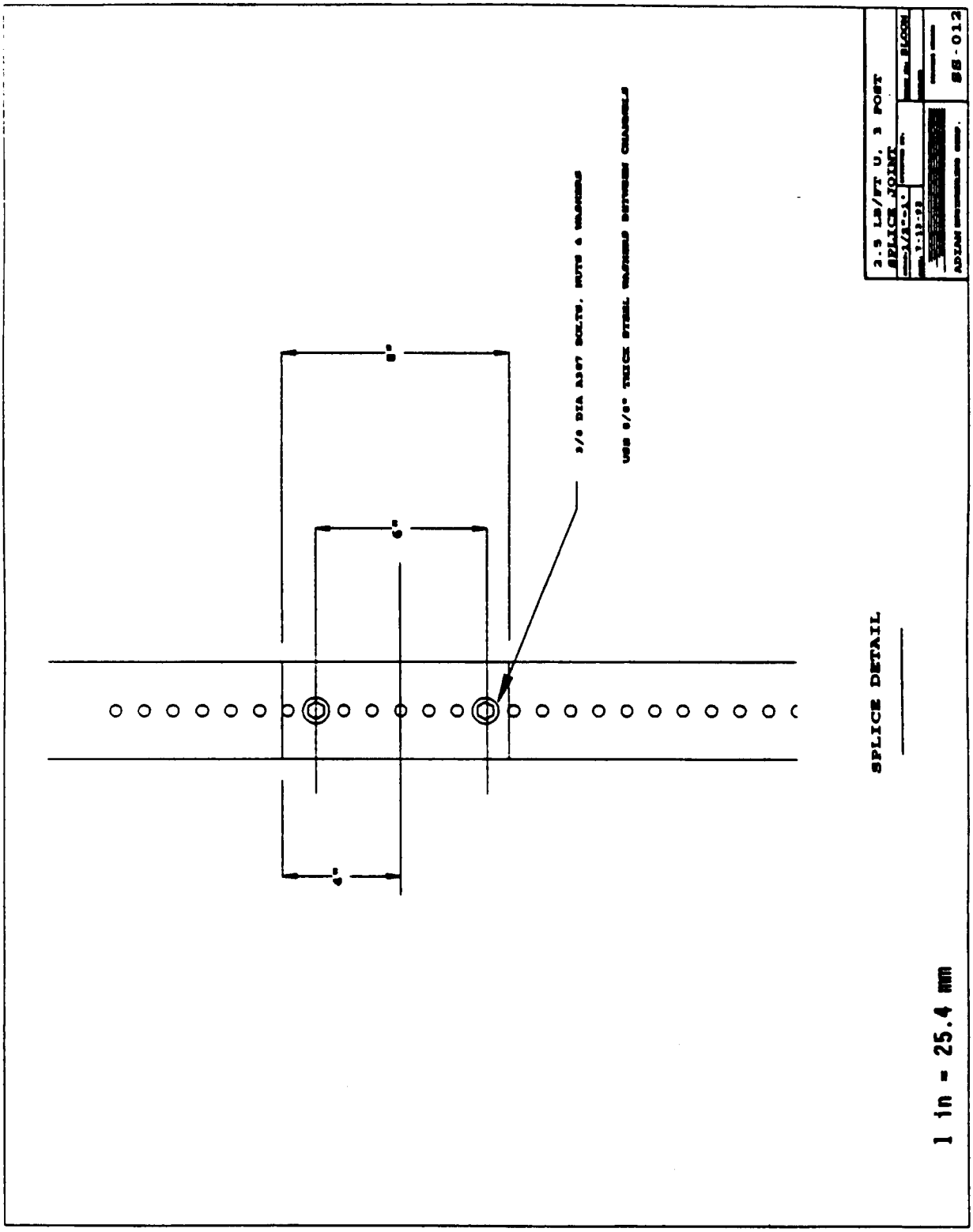
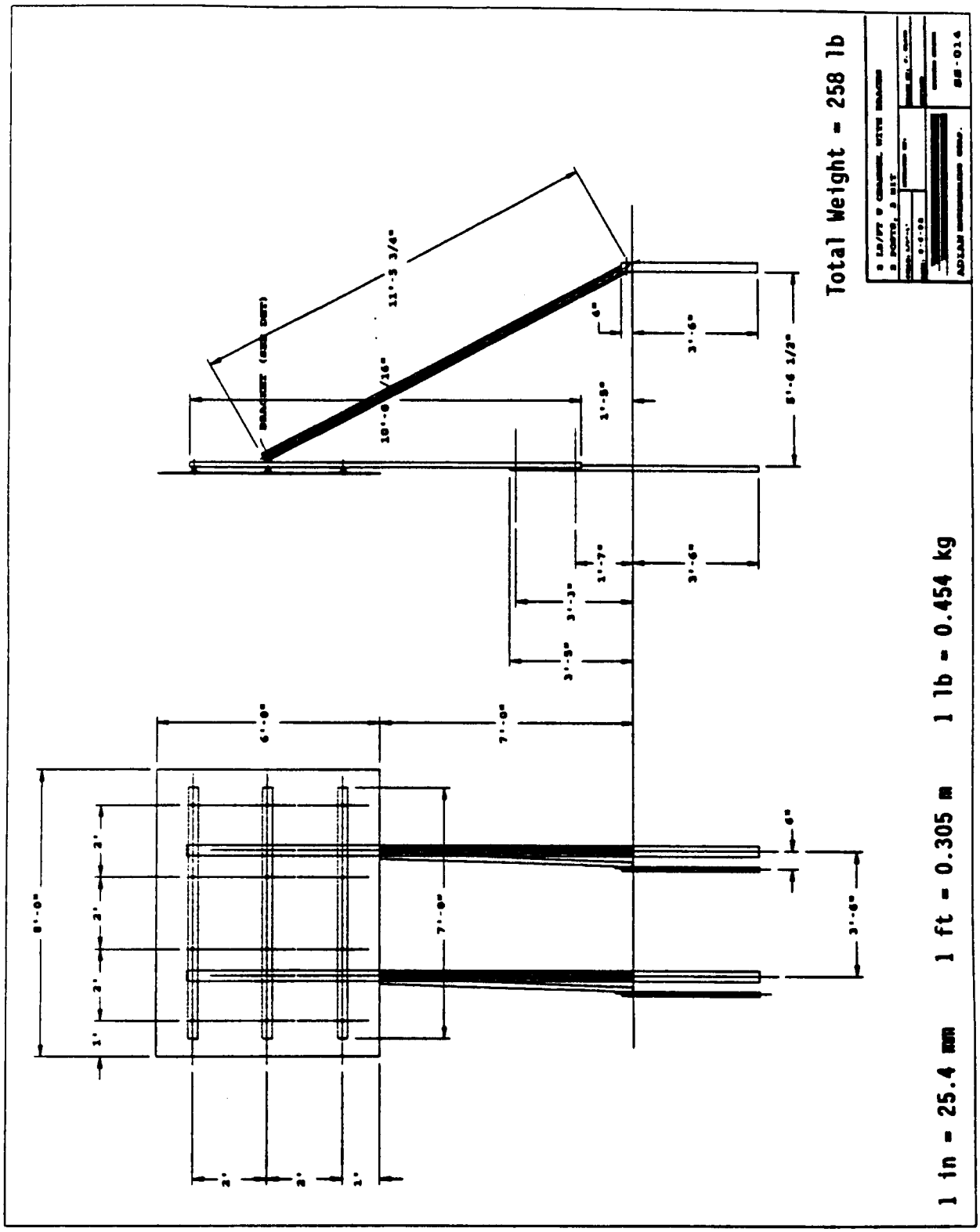


Figure 2. Sketch of small sign, splice detail.



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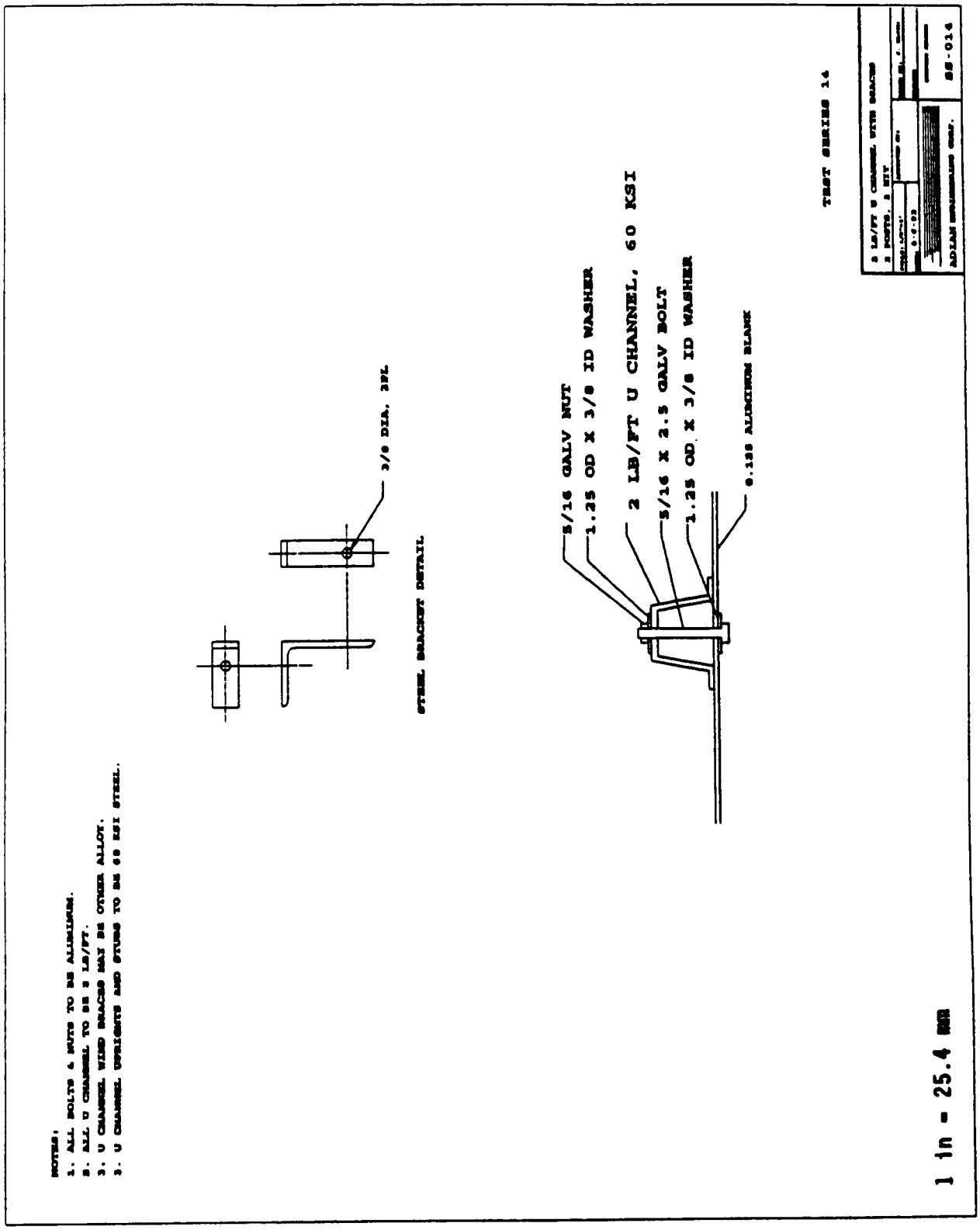


Figure 2. Sketch of small sign support, attachment detail.

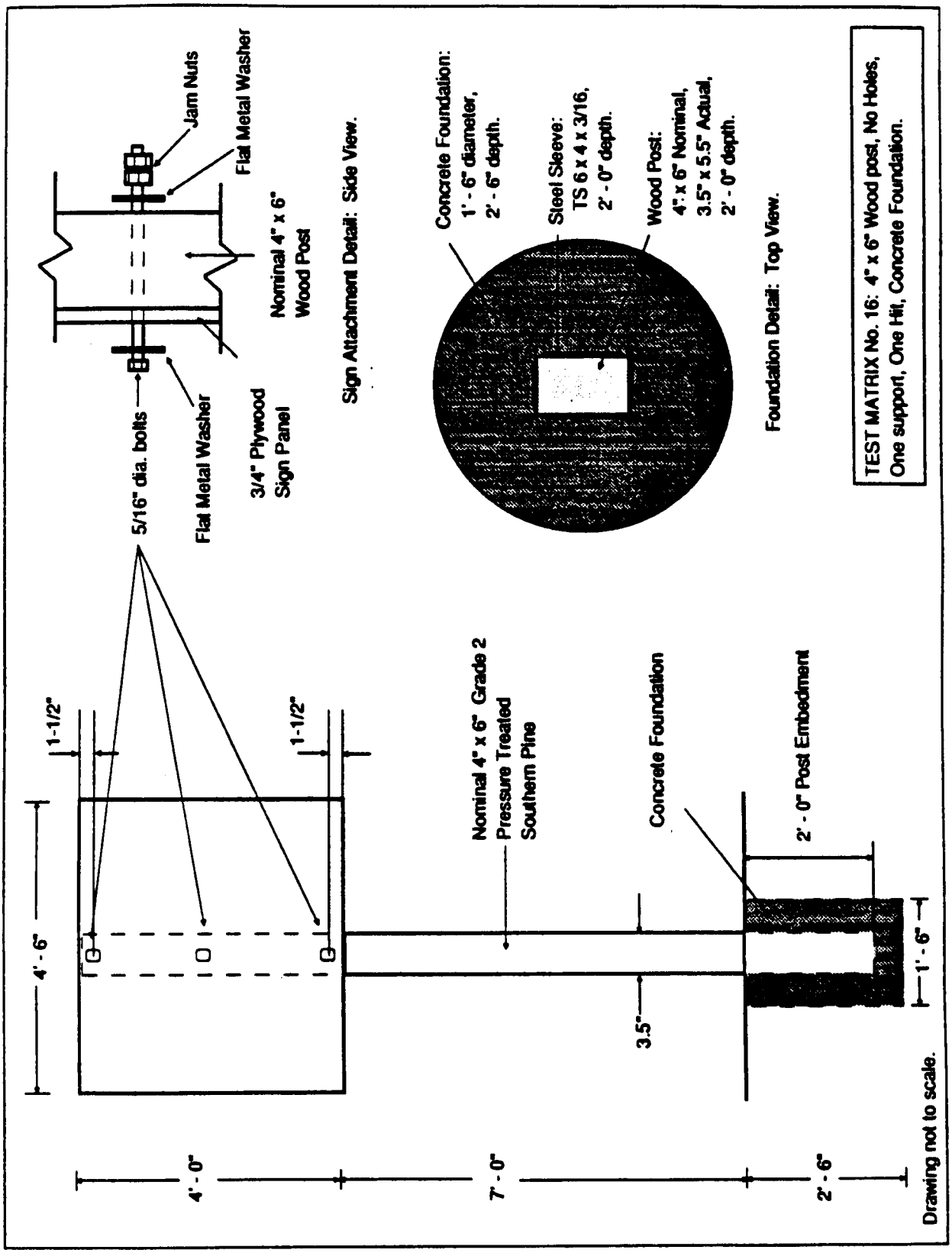
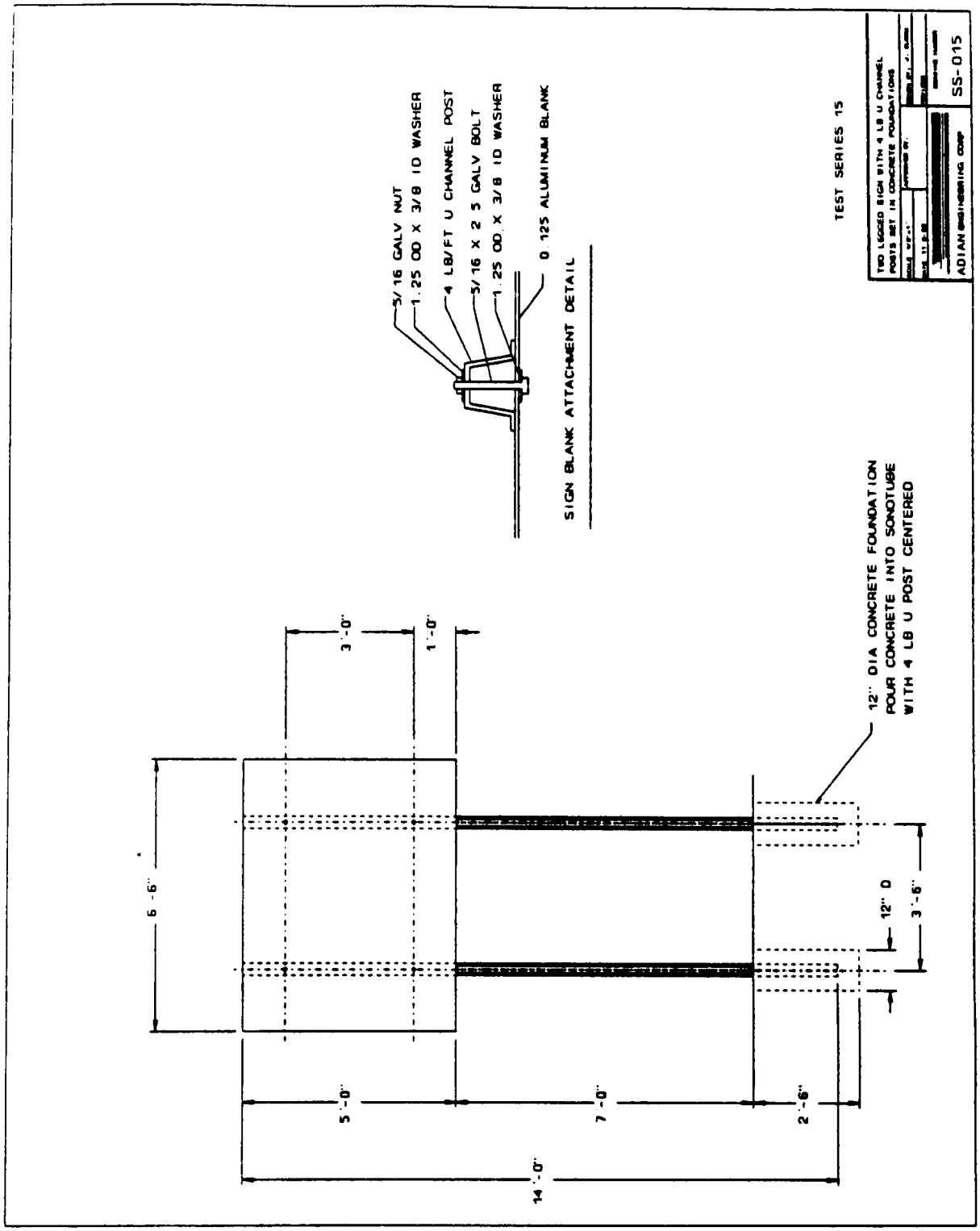


Figure 1. Sketch of the sign support system.



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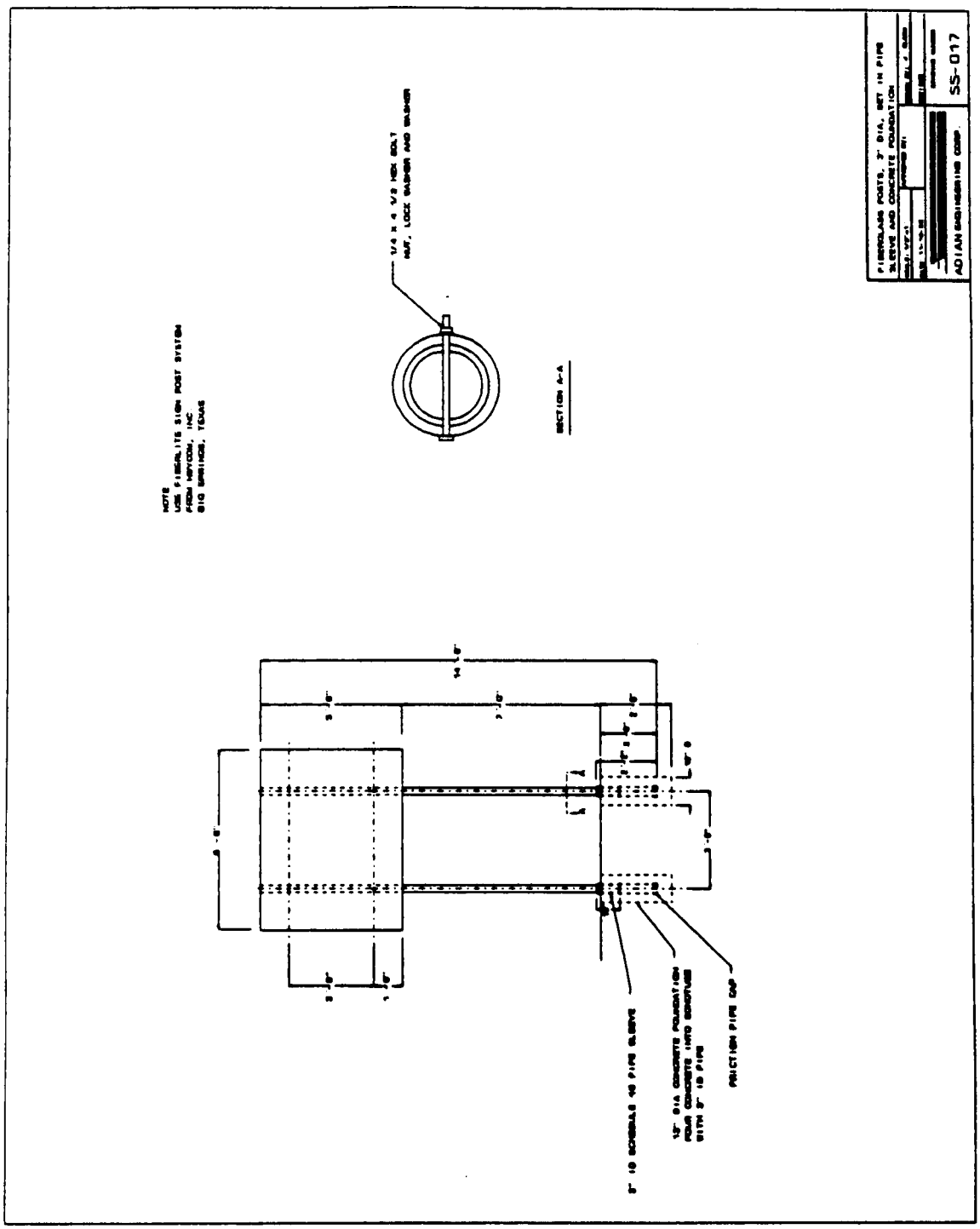
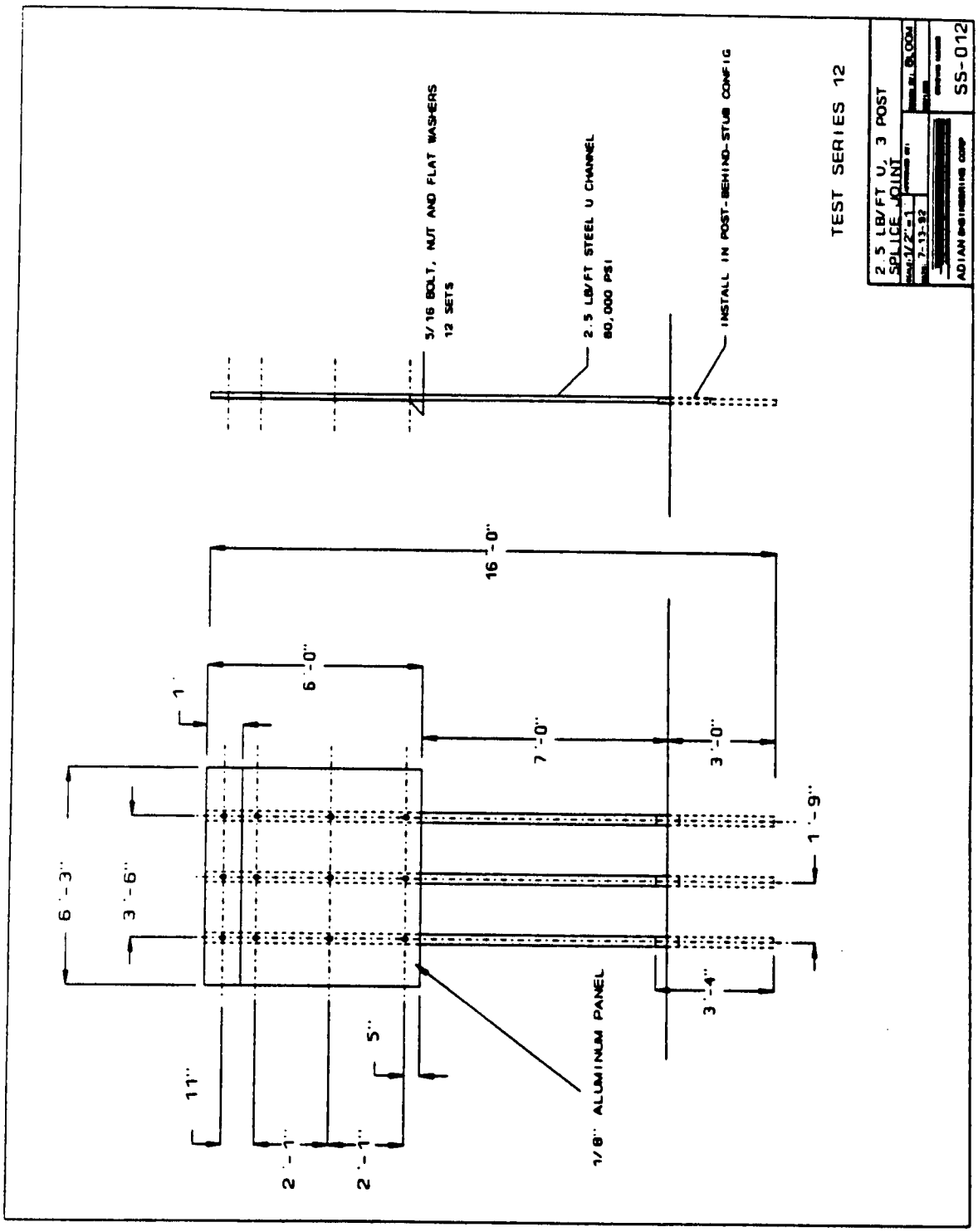


1 in = 25.4 mm 1 ft = 0.305 m

Figure 1. Sketch of small sign support.



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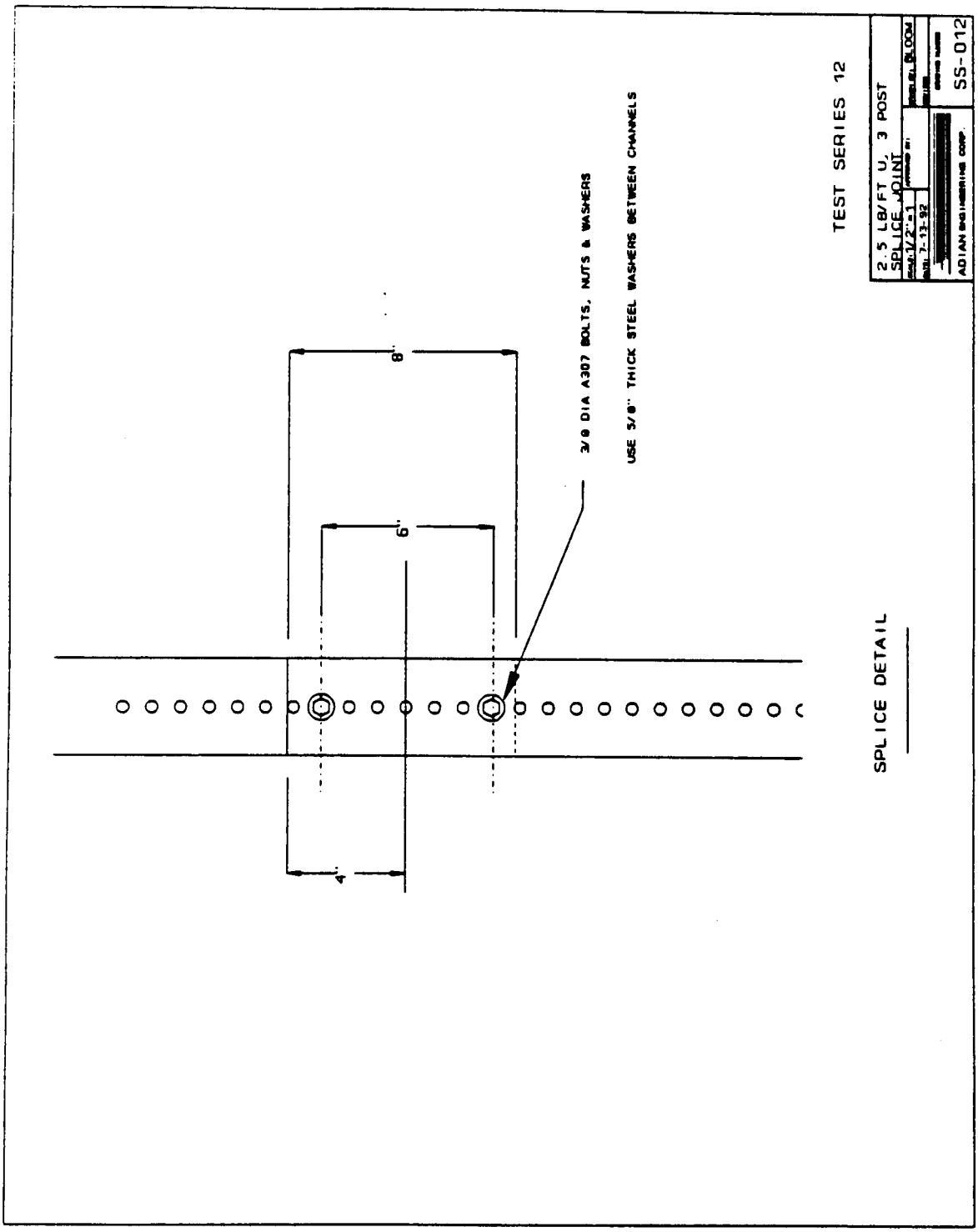

Figure 2. Sketch of small sign, splice detail.

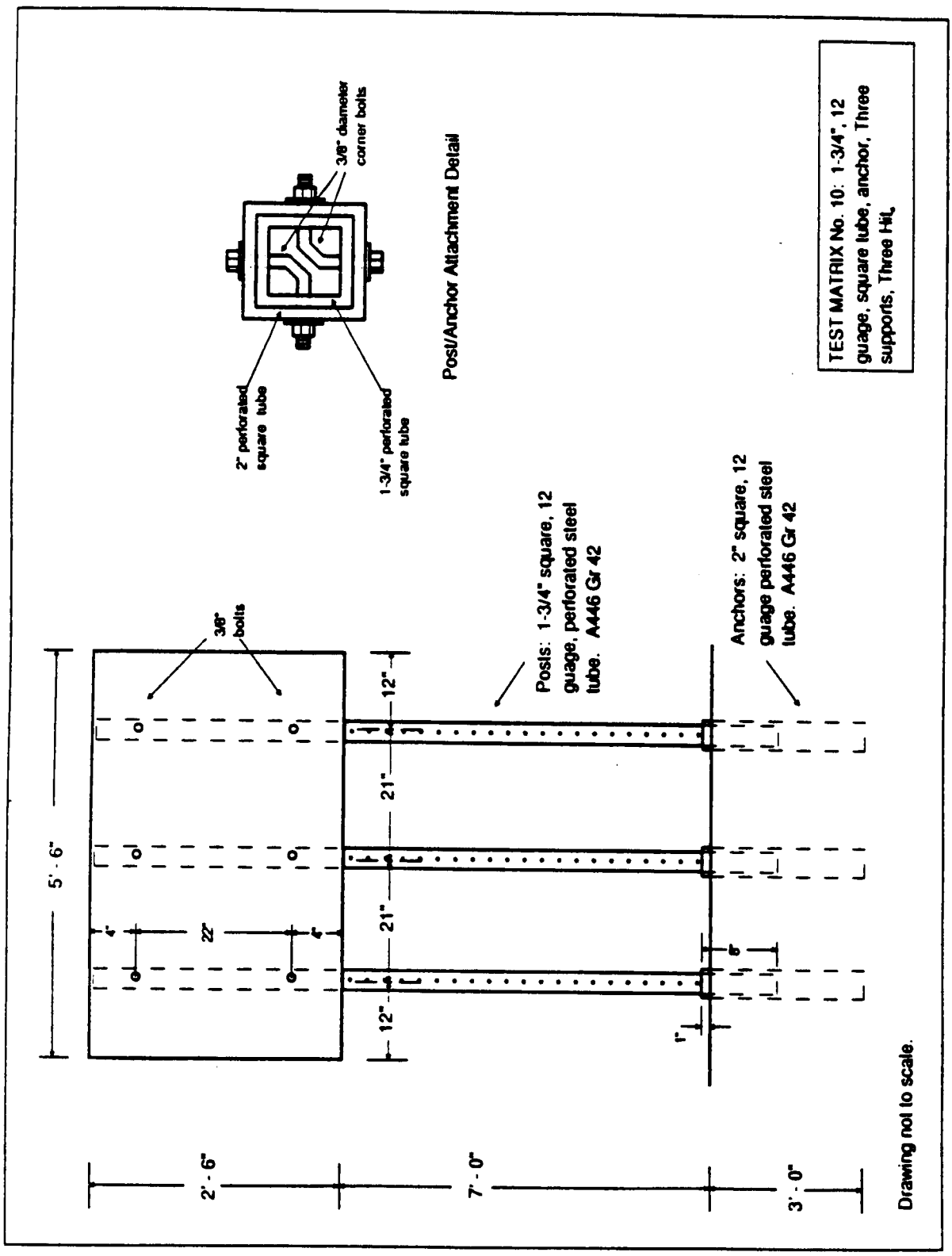

Figure 1. Sketch of small sign support.

Appendix B: Summary of Sign Support Systems Tested and/or Accepted

Wood Post Systems

Size	# of Posts	Hole Size	OK In All Soils?	OK in S-1 Soil?	OK W/Conc.Fndn?	Test Numbers
4" x 4"	2	None	Yes	Yes	No *	90F015,050,054,055,92F015
4" x 6"	1	None	No	Not Tested	Yes *	90F037, 91F032, 033
4" x 6"	2	1.5"	Yes	Yes	Not Tested	92F009, 010
4" x 6"	2	None	No	Not Tested	No *	90F037, 92F014
6" x 8"	1	3"	Yes	Yes	Yes *	90F045, 046, 92F020, 021
5" Top Diameter	1	2"	Not Tested	Not Tested	Yes, Soilcrete	92F016, 026

* Wood posts placed in cylindrical concrete foundation with steel sleeve. Foundation set in S-2 soil.

Steel U-Channel Systems

Size	# of Posts	Splice	OK In All Soils?	OK in S-1 Soil?	OK W/Conc.Fndn?	Test Numbers
2 PPF Spliced,Braced	2	24" Lap	Yes	Yes	Not Tested	92F024, 025
2 PPF Spliced	3	"Florida"	No	Yes (see 2.5PPF)	Not Tested	92F023, 92F037, 038
2 PPF Direct Bury	3	None	No	No	Not Tested	92F019
2.5 PPF Spliced	3	"Florida"	No	Yes	Not Tested	92F022, 037, 038
2.5 PPF Direct Bury	3	None	No	No	Not Tested	92F017
3 PPF Direct Bury	2	None	No	Yes	Not Tested	92F012; 7024-22**,-23**
2 PPF BtoB Direct Bury	2	None	No	No	Not Tested	90F048
4 PPF Spliced	2	"Arizona"	No	Yes	Not Tested	92F011; 1122-6A**, 1122-7**
4 PPF Direct Bury	2	None	No	No	No *	90F047, 92F034

"Arizona" splice uses special Grade 9 bolts spaced at 4"
"Florida" splice uses SAE Grade 2 bolts spaced at 6"
*Steel U-posts cast in concrete foundation set in S-2 soil.
** Tests conducted at Texas Transportation Institute

Slip Base Systems*

Slip Base Type	Post Type	# of Posts	Bolt Torque	Acceptable?	Test Numbers
Inclined, 4-Bolt	S7X15.3	1 hit of 2	55 Ft-Lb	Yes	91F016, 91F017
Inclined, 4-Bolt	8X4 X 3/16"	1	50 Ft-Lb	Yes	91F019, 91F031
Horizontal, 4-Bolt	W6X12	2 hit of 2	55 Ft-Lb	Yes	90F043, 90F044
Omni-Directional, 3-Bolt	W6X12	1 hit of 2	95 Ft-Lb	Yes	91F020, 91F030
Omni-Dir. 3-Bolt, w/riser	8X8X 0.19"	1	90 Ft-Lb	No	91F018

* Acceptance is limited to slip base hardware mounted to rigid concrete foundations.

Other Sign Support Systems

Sign Support System Type	# of Posts	Breakaway	OK in all Soils?	OK in S-1 Soil?	OK with Conc.Fndn?	Test Numbers
2" Sched 40 Steel Pipe	1	None	No	No	Not Tested	90F051, 90F053, 90F056, 90F057
Sq. Perf Steel Tube, 1.75"	3	Telescope	Yes	Yes	Not Tested	91F010, 92F039, 92F040
3" Diam. Fiberglass Posts	2	None	Not Tested	Not Tested	Yes	92F035, 92F036

1 inch = 25.4 mm 1 pound = 0.45 kg 1 foot = 0.348 m

ORIGINAL MATRIX
ANNOTATED WITH RESULTS

DTFH61-89-C-00100
1367

Matrix for Testing Small and Large Sign Supports

	Order	Support	Number of Supports	Description	Note
P	1	Rect Slip Base	2 post/ 2 posts hit	W 6 x 12, concrete	♦
P	2	Incl Slip Base	2 post/ 1 post hit	S7 x 15.3, concrete	
Pfa	3	Rect Slip Base	2 post/ 1 post hit	W10 x 45, concrete	♣
F	4	Wood	1 post/ 1 post hit	4 x 6, no holes, soil	
			2 post/ 2 posts hit		
Pfa	5	Incl Slip Base	2 post/ 2 posts hit	S4 x 7.7, concrete	♠
P	6	Wood	2 post/ 2 posts hit	4 x 4, no holes, soil	●
P	7	Wood	2 post/ 1 post hit	6 x 8, 3" holes, soil	
A	8	Wood (2" holes)	2 post/ 1 post hit	6 x 6, 1½" holes, soil	●
F	9	Omni Slip Base	1 post/ 1 post hit	8 x 8 tube, conc	
P	10	Small tube, anchor	3 post/ 3 post hit	1 3/4 x 12g, soil	
F	11	Channel-basebend	2 post/ 2 posts hit	4 lb/ft, soil	
F	12	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, b-to-b, soil	
NT	13	Incl Slip Base	1 post/ 1 post hit	8" pipe, conc	
P	14	Omni Slip Base	2 post/ 1 post hit	W 6 x 12, conc	
F	15	Channel-splice	2 post/ 2 posts hit	4 lb/ft, soil	
P	16	Wood	1 post/ 1 post hit	4 x 6, no holes, conc	
F			2 post/ 2 posts hit		
NT	17	Rect Slip Base	2 post/ 1 post hit	tube, conc	
F	18	Wood	2 post/ 2 posts hit	4 x 4, no holes, conc	●
P	19	Timber	1 post/ 1 post hit	5", 1" hole, soil-crete	
F	20	Channel-basebend	3 post/ 3 post hit	2½ lb/ft, soil	
F	21	Channel-basebend	3 post/ 3 post hit	2 lb/ft, soil	●
F	22	Channel-basebend	3 post/ 2 post hit	4 lb/ft, soil	
F	23	Pipe-basebend	1 post/ 1 post hit	2", soil	
P	24	Wood	2 post/ 1 post hit	6 x 8, 3" holes, conc	
A	25	Wood (2" holes)	2 post/ 1 post hit	6 x 6, 1½" holes, conc	●
FWPS	26	Channel-splice	3 post/ 3 posts hit	2½ lb/ft, soil	
FWAS	27	Channel-splice	3 post/ 3 posts hit	2 lb/ft, soil	
P	28	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, braced, soil	
F	29	Channel-basebend	2 post/ 2 posts hit	4 lb/ft, conc	▸
NT	30	Channel-basebend	3 post/ 2 posts hit	4 lb/ft, conc	▸

♦ This is a larger section than originally proposed as requested by three states.

♣ This is being tested under separate contract. The post is slightly smaller than originally proposed.

♠ TTI ran two tests on two W 8 x 12 posts on inclined slip bases in March 1990 for Louisiana. This system may be satisfied under these tests.

● If test of larger size passes, tests of this system will not be required.

▸ Test of strong soil may be evaluated as acceptable for this case. If so, tests on this system will not be required.

Matrix for Testing Small and Large Sign Supports

	Order	Support	Number of Supports	Description	Note
NT	31	Large fiberglass	2 post/ 1 post hit		
P	32	FRP fiberglass	2 post/ 2 posts hit	,soil	
NT	33	Round Slip Base	1 post/ 1 post hit	8 x 6 x ¼, conc	
NT	34	Channel-basebend	3 post/ 3 posts hit	2½ lb/ft, conc	▸
NT	35	Channel-splice	2 post/ 2 posts hit	4 lb/ft, conc	▸
NT	36	EZE-Erect	3 post/ 3 posts hit	4 lb/ft, soil	
NT	37	Channel-splice	3 post/ 3 posts hit	2½ lb/ft, conc	▸
NT	38	Channel-basebend	3 post/ 3 posts hit	2 lb/ft, conc	●,▸
NT	39	Channel-basebend	2 post/ 2 posts hit	2 lb/ft, b-to-b, conc	▸
NT	40	V-Loc	2 post/ 2 posts hit	3 lb/ft, 18", conc	
NT	41	POZ-LOC	2 post/ 2 posts hit	2 3/8" x 13g, soil	♪
NT	42	Channel-splice	3 post/ 3 posts hit	2 lb/ft, conc	●,▸
NT	43	V-Loc	2 post/ 2 posts hit	3 lb/ft, 30", soil	

● If test of larger size passes, tests of this system will not be required.
▸ Test of strong soil may be evaluated as acceptable for this case. If so, tests on this system will not be required.
♪ Only weak soil tests required for this system.

Results at Completion of Testing
Legend for First Column

P: Passed and acceptable
F: Failed and not acceptable
A: Acceptable based on other testing
Pfa: Previously found acceptable
FWPS: Failed weak soil test, Passed strong soil test
FWAS: Failed weak soil test, acceptable in strong soil
NT: Not tested, therefore no longer acceptable as breakaway

Listing of FHWA Accepted Breakaway Sign Supports *

Code	Acceptance Letter Date	Manufacturer/ Supplier	Description of Device
SS-1	7/14/86	Southwestern Pipe, Inc.	POZ-LOC anchor system - 2 3/8 in. O.D. posts, max .095 in. wall thickness. **
SS-2	8/19/86	Trus Joist Corp.	MICRO=LAM - 14 7/8 X 7 7/8 in. box section plywood post. Tested in S-2 soil.
SS-3	10/3/86	Allied Tube & Conduit Corp.	QWIK-PUNCH tube system - max size 2 1/4 x 2 1/4 in. x 12 ga. post set in reinforced sleeve base.
SS-4	1/29/87	Minute Man Anchors, Inc.	Breakaway coupling for use with 3 lb/ft steel flanged channel post (superseded by new hardware on 3/10/88. See SS-6) **
SS-5	6/15/87 (Memo to Regions)	-----	a.Perforated square steel tube - 2 x 2 in.x 0.105 wall thick. max size.** b.Single 3 lb/ft steel U-post. ** c.Dual 3 lb/ft steel U-post. ** d.Ariz. dual legged slip base S4x7.7 post e.Texas dual leg slip base, W12x45 post f. to g. repeated SS-1 to SS-4 above
SS-6	3/10/88	Minute Man Anchors, Inc.	Breakaway coupling for use with steel flanged channel supports. **
SS-7	9/1/88 (Region 5 Memo)	-----	Wisconsin Large Sign Support System - slip base w/no upper hinge,sign attachment clips provide for release, W12x22 posts tested
SS-8	3/31/89	Unistrut Corp.	TELSPAR small sign supports - max size 2 1/2 x 2 1/2 in. x 12 ga.
SS-9	3/16/89 4/7/89	Franklin Steel	EZE-Erect Sign Posts - max 4.0 lb/ft flanged channel posts.
SS-10	5/11/89	HwyCom Corp.	3-Inch Diameter, 1/8 in. wall, fiber-reinforced plastic post. (see SS-12)
SS-11	5/18/89	Allied Tube & Conduit	Quick-Punch post - Max size 2.25 x 2.25" x 14 ga. in unreinforced 12 ga. sleeve base.
SS-12	8/3/89	HwyCom Corp.	Dual post installations of 3-inch FRP.
SS-13	8/31/89 10/2/89 12/27/91	Marion Steel	Single to triple 3 ppf and single or dual 4 ppf Rib-Bak post installations with ground splice. ** Project by project acceptance of Florida's splice in both soil types
SS-14	10/27/89	Marion Steel	Rib-Bak Post with Minuteman Coupling **
SS-15	12/12/89 (Memo to Region 1)	----	Single 3" and 4" diameter Aluminum, 3/16" wall, direct burial tube. ** **SEE SS-26 4" Tube Rescinded for S-2**
SS-16	12/29/89	Minute Man Breakaway	MMB-1HD breakaway device for use with 3 #/ft. steel flanged channel "U"-posts.
SS-17	1/8/90	Transpo Industries	Type A and Type B breakaway couplings.(If installed by direct burial, then Type AUX for S-1 soil only.) (Posts limited to 45 #/ft below the hinge.)
SS-18	6/19/90	Minute Man Breakaway	MMB-1HD breakaway device for use with two 3 #/ft flanged channel "U" posts in strong soil. (see SS-21 for weak soil acceptance letter)
SS-19	7/31/90	Allied Tube and Conduit	Square-Fit signpost systems.
SS-20	9/20/90	Franklin Steel	2 to 3 pound-per-foot flanged channel "U" posts.
SS-21	12/26/90	Minute Man Breakaway	MMB-1HD breakaway device with two 3 #/ft flanged channel "U" posts in both strong and weak soil.
SS-22	1/4/91	Trus Joist Corporation	Type "L" MICRO=LAM with revised saw cut
SS-23	3/14/91 (memo to Reg.1)	---	New Jersey Breakaway Couplings
SS-24	5/1/91	Unistrut Corp.	Triangular Slip Bases for Square Tube Sign Supports.

SS-25	6-4-91 --- (memo to Regions)	a.Single or dual 4"x4" wood, undrilled b.Single 6"x8" wood with 3.0" holes c.Single 6"x6" wood with 2.0" holes d.Single 4"x6" wood with 1.5" holes e.Dual W6x12 steel post on slip base (up to 18 ppf for dual supports OK)
SS-26	2/11/92 Unistrut Corp.	Telspar square perf. tube small sign supports without sleeve around base post.
SS-27	5/15/92 Montana D.O.T.	Round wood post supports
SS-28	5/26/92 --- (memo to Region 4)	3 1/2" Diam. Thin Walled Aluminum Tube Single Spliced (6" c-c) Marion Steel or Franklin Steel 4 ppf U-channel post
SS-29	7/15/92 A.B. Chance	Helical Screw Foundations for Motorist Aid Callboxes
SS-30	7/20/92 Hapco Division 10/5/92	Cast Aluminum Shoe Base for Motorist Aid Callbox Supports
SS-31	10/22/92 Allied Tube and Conduit	Single Perforated Square Steel Tube 2 1/2" 12 ga in 7 ga anchor
SS-32	10/28/92 --- (memo to Region 7)	Western Red Cedar for Breakaway Wood Supports
SS-33	10/29/92 Transpo Industries, Inc.	201C and 301C Pole-Safe couplings for Motorist Aid Call Box Supports
SS-34	3/20/93 Louisiana DOTD	Omni Directional Slip Base, 3.5" diameter post
SS-35	5/28/93 Imperial, Inc	Aluminum tube 2.375" diameter
SS-36	9/3/93 --- (Memo to Regions)	Large and Small Sign Supports (See memo for details on various Wood, U-Channel, Perf.Sq.Steel Tube, Slip Base, FRP posts.)
SS-37	8/13/93 Greenline	Recycled Thermoplastic Delineator Posts

* Supports conform to FHWA breakaway requirements based on the 1985 AASHTO Standard Specifications for Structural Supports for Highway Signs,Luminaires and Traffic Signals. After May 1993, velocity change permitted is 5.0 m/s (16.4 ft/s) per NCHRP Report 350.

** These small sign supports were only tested in NCHRP Report 350 "Standard" soil (Report 230 S-1 "Strong" soil.) Should a state wish to install this hardware in "weak" soil, further crash testing is recommended.

Revised September 6, 1993