U.S. Department
of Transportation
Federal Highway Administration

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

DEC 19 1996

Refer to: HNG-14

Mr. E. Scott Walter
President
Roadway Safety Service, Inc.
80 Remington Blvd.
Ronkonkoma, New York 11779

Dear Mr. Walter:

Your September 5 letter requested the Federal Highway Administration's (FHWA) acceptance of the REACT 350 with an anchorage system intended for temporary use in work zones. In support of this request you sent us a copy of a Texas Transportation Institute (TTI) report dated October 1995, entitled "Crash Testing a Reusable Polyethylene Narrow Impact Attenuator System (REACT 350)." This report documents the results of a non-instrumented test with a 2000-kg pickup truck impacting at 20.8 degrees and 87.7 km/h into the side of a REACT 350 with the work zone anchorage system. The post-crash vehicle trajectory was satisfactory and the occupant compartment deformation was acceptable (less than 25 mm). We have also received supplementary information from your consultant, Mr. Dean C. Alberson of Safety Quest, Inc., on the installation of the feature tested at TTI and your current installation recommendations. In addition to being a response to your request for acceptance of the work zone anchorage for the REACT 350, this letter includes comments on the basic requirements for a transition between a REACT 350 and the object it shields.

Since in the test of the work zone anchorage the vehicle speed was below 100 km/h and the occupant impact and 10-millisecond ride down accelerations were not measured, we cannot accept the work zone REACT 350 as a TL-3 device. However, we will consider it a TL-2 attenuator when it is anchored as tested, which means the 3/4-inch x 8-inch (19.1-mm x 203-mm) concrete expansion bolts used in the version of the REACT 350 accepted by our March 3, 1995, letter to Mr. John F. Carney, III, (our acceptance letter CC-26) will be replaced with 3/4-inch diameter x 14-inch (19.1-mm x 356-mm) long AREA (American Railway Engineering Association) Washer-Head Timber Drive Spikes driven into 1/2-inch (12.7-mm) diameter holes drilled through 280 mm (11 inches) of

asphalt concrete, which in the test was continuous under the crash cushion and extended over 1.5 m outside the perimeter of the crash cushion and was placed over a compact sub-base (soil). We understand that you are recommending that the asphalt concrete extend a minimum of 600 mm (2 feet) outside the footprint of the crash cushion, which we accept as being equivalent to the tested condition. The locations of the drive spikes are the same as those of the concrete expansion bolts, resulting in 20 spikes in the rear anchor plate, nine in each of the two front anchor plates, and eleven in each of the two side support railings (five spaced near the back of each railing and six spaced approximately 3000 mm closer to the front). In addition, the drive spikes will be supplemented by six steel anchor stakes, one against both longitudinal sides of the rear anchor plate and about a third of the length of the plate forward of the back of the plate, one outside and near mid-length of each side rail, and one against the outside and at about mid-length of each front anchor plate. The drive spikes and these 915-mm long hold-down stakes (made from a 76.2 mm x 76.2 mm x 6.35 mm (3-inch x 3-inch x 1/4-inch) angle with a short, gusset-stiffened piece of the same size angle attached to the top with a 3/4-inch (19.1-mm) diameter ASTM A325 bolt) and their locations are shown in the enclosed drawings.

Our acceptance of the work zone REACT 350 is based in large part on our previous acceptance of the REACT 350 as a permanent TL-3 crash cushion under the National Cooperative Highway Research Program Report 350 guidelines and the understanding that only the anchorage design has been changed for temporary installations. Since the actual test speed for the temporary installation version was 87.7 km/h (approximately 55 mph), this nominal TL-2 version should be appropriate for use in most work zones.

We also understand that you have developed an alternative anchor stake that is made from a C 75 mm x 7.4 kg/m x 915 mm (C 3" x 5 lb/ft x 36") channel with a leg of a 38.1-mm (1 1/2-inch) long L 76 mm x 76 mm x 9.5 mm (L 3" x 3" x 3/8") angle welded to the inside of the web of the channel and the other leg passing over the web to form a head on the back side of the top of the stake. We further understand that you are now recommending that these stakes be driven so that they toe under the rails or plates they anchor at an angle of 10° to 15° from vertical. A drawing of this stake is included as one of the enclosed drawings. We consider both the alternative stake and the alternative drive angle acceptable.

Related issues addressed in your September 5 letter concern the appropriate treatment to use when the REACT 350 shields the ends of two diverging runs of temporary concrete barrier. Your proposed use of a pre-cast concrete transition piece, if properly

configured and adequately reinforced and pinned or embedded in the ground to prevent lateral movement when impacted, would be a satisfactory solution.

In considering the question of what would be an acceptable configuration for the convergent end of diverging safety shaped concrete barriers, we reviewed the qualification crash test videos for the permanent REACT 350. In this review we noted that the shielded concrete barrier was not contacted by the test vehicle during the NCHRP Report 350 test 3-38 (the transition test). Thus, while shielded under the prescribed test conditions, the actual location of the change from crash cushion to shielded barrier was not tested. Impacts that would bring a front corner of a vehicle into that location would produce a much different result than that seen in the transition test. Therefore, we believe it is essential, with both the permanent and temporary REACT 350s, that a smooth, structurally substantial connection be made between the face of the shielded object and the road side of the back anchor post of the REACT 350 and, in addition to having the structural and lateral restraint already mentioned, that the configuration of the side of the shielded object should be crashworthy throughout the length within which it can be struck. This criterion would suggest that the road side of the barrier be vertical at the crash cushion end and that the surface transitions be no more abrupt than 15 to 1 (20 to 1 preferred) relative to the center line of the crash cushion. This would require at least a 6096-mm (20-foot) long section to transition from a vertical face adjacent to the crash cushion to a standard New Jersey barrier shape at the end of the transition. Of course, other configurations would be acceptable, provided the basic principles of blocking the gap between the crash cushion and the shielded object and of providing a gentle, smooth transition in the alignment and cross section of the shielded object are met. The barrier end configuration shown in the drawings you provided does not meet these criteria. We would also point out that where the REACT 350 is installed on the trailing end of a barrier the transition between the barrier and the REACT 350 must be crashworthy. If there is a chance that the direction of the traffic past the crash cushion will be reversed during the life of the installation, a transition that is crashworthy for traffic in both directions will be needed.

Your recommendation to transition from a metal-beam median barrier to a section of concrete safety shape barrier before shielding the approach end with a REACT 350 is acceptable, provided the safety shape barrier is adequately reinforced and pinned or embedded in the ground to prevent lateral movement when

impacted, the concrete barrier provides adequate anchorage for the metal beam barrier, and, wherever reverse-direction hits are a possibility, the w-beam or thrie-beam transition to the concrete barrier is crashworthy for such hits.

By copies of this letter, our field offices will be informed of the aforementioned critical installation details and of our acceptance of the REACT 350 as a temporary crash cushion under the above-stated conditions.

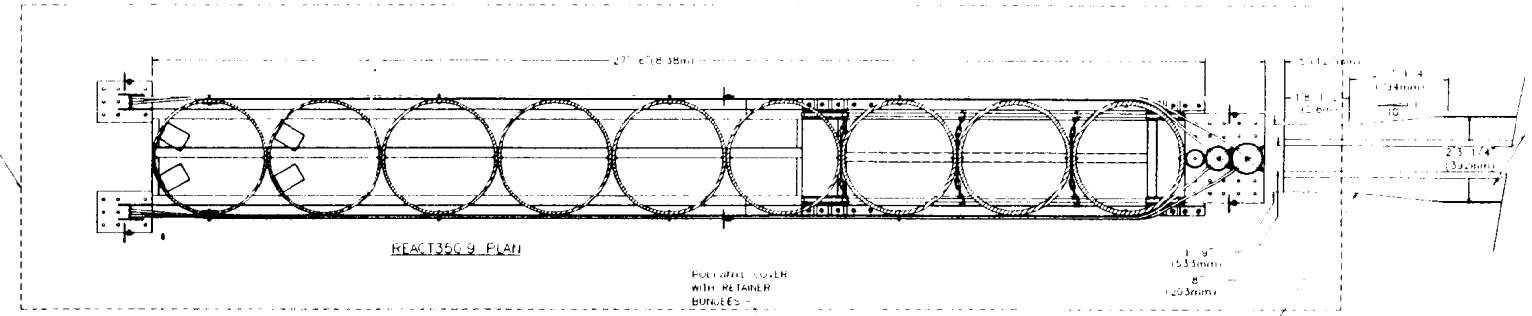
Sincerely yours,

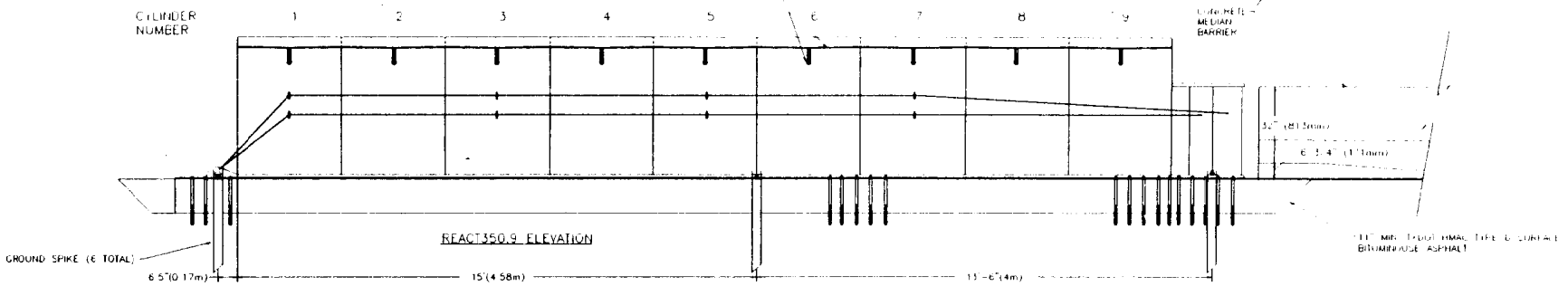
Dwight A. Horne

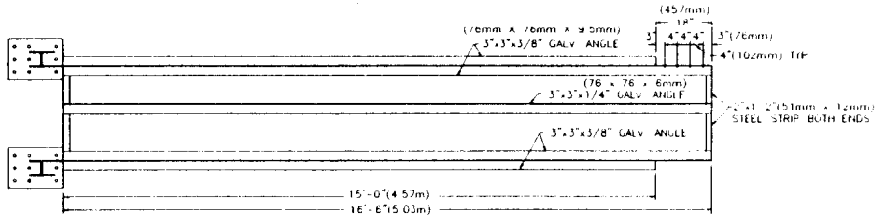
Dwight A. Horne, Chief
Federal-Aid and Design Division

Enclosure

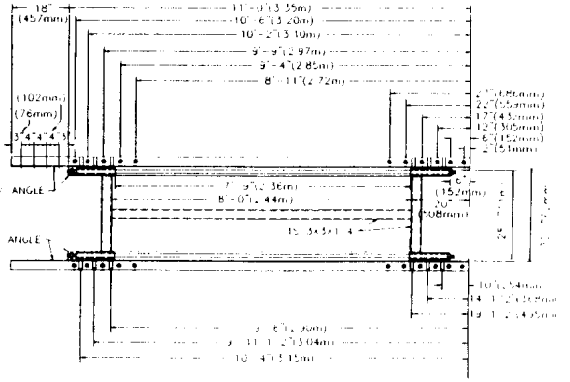
Supplement No. 4 to Geometric and Roadside Design Acceptance Letter CC-26



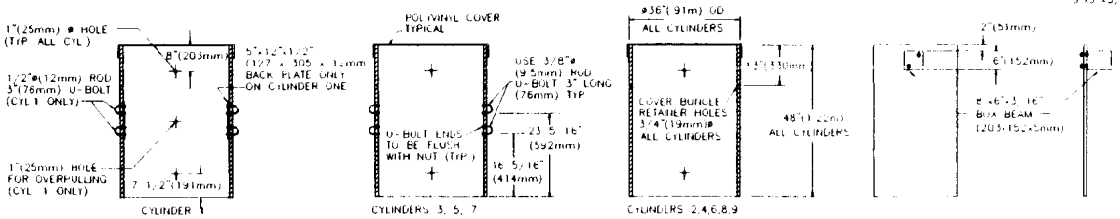


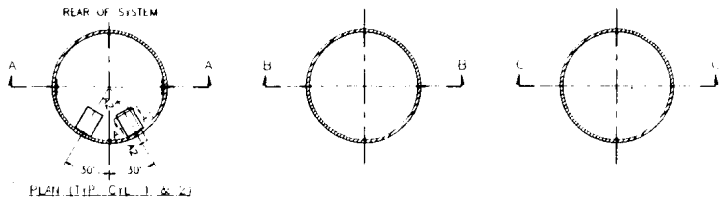


FRONT SECTION OF RAILING (REACT350.9)



BACK SECTION OF RAILING
REACT350.9, 350.6, 350.4





PLAN (TYP. CYL 1 & 2)

WALL THICKNESS SCHEDULE

REACT 350.9

CYL. No.	THICKNESS
1	0.81(20mm)
2	0.81(20mm)
3	0.81(20mm)
4	0.91(23mm)
5	1.0(25mm)
6	1.0(25mm)
7	1.109(28mm)
8	1.385(35mm)
9	1.385(35mm)

REACT 350.6/350.4

CYL. No.	THICKNESS
1	0.91(23mm)
2	0.91(23mm)
3	1.0(25mm)
4	1.0(25mm)
5	1.385(35mm)
6	1.385(35mm)
7	1.731(44mm)
8	1.731(44mm)
9	1.731(44mm)

NOTE: METRIC CONVERSIONS ARE (ROUNDED) AFTER IMPERIAL

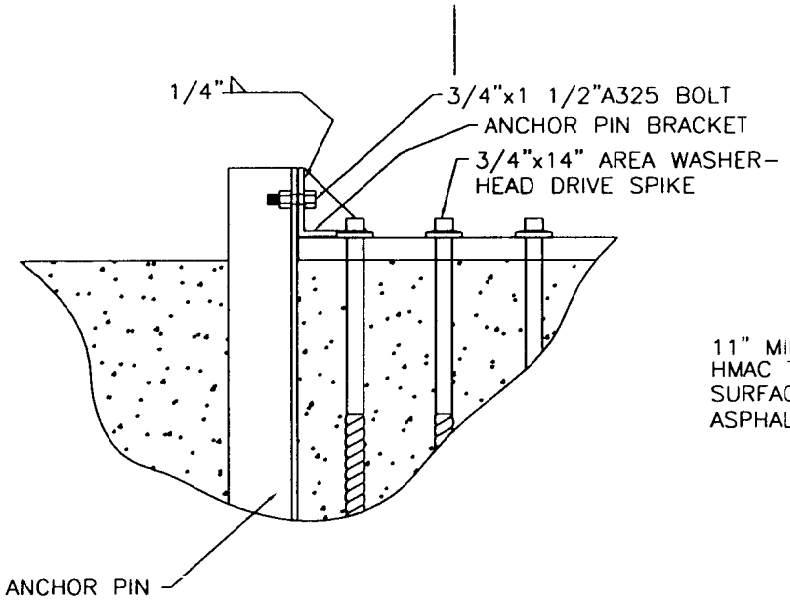
ROADWAY ARTS GROUP, INC.
80 REMINGTON BLVD, RONKONKOMA, NY 11779

REACT 350

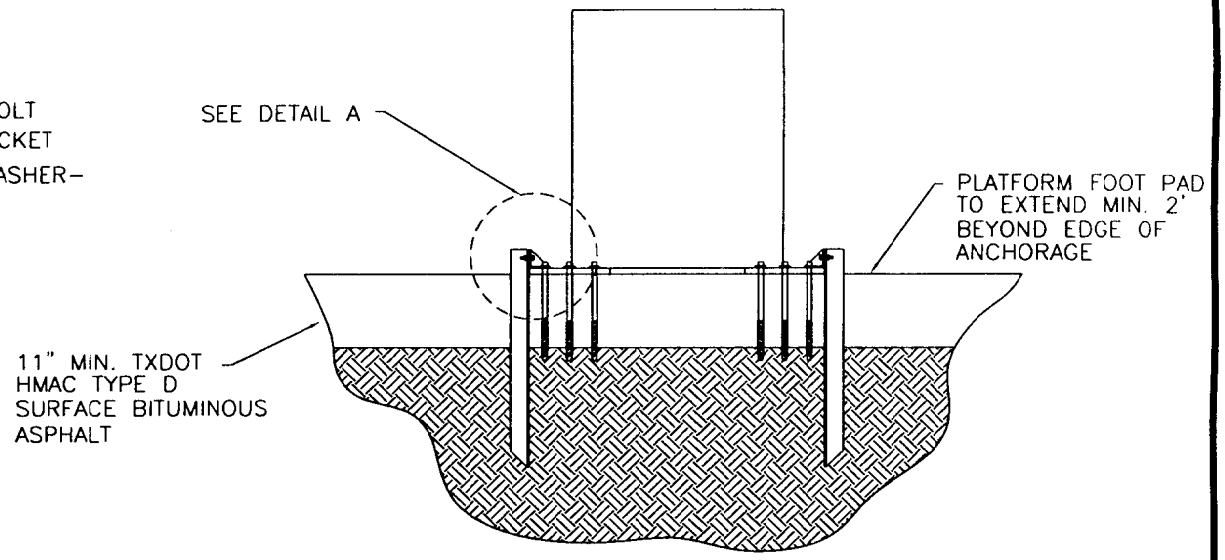
SCALE: 3/4" = 1'-0"

ISSUE DATE: 25 NOV. 1996

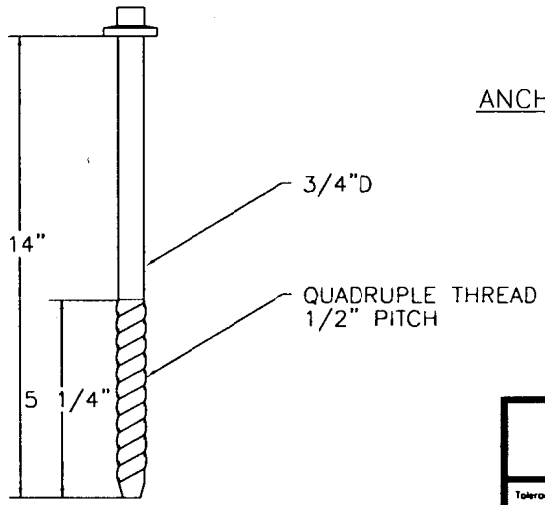
DRAFTED by: J. & M. Ferraro
REVISED by: P.K. Feder / E.N. Campbell



DETAIL A



ANCHOR PIN SECTION

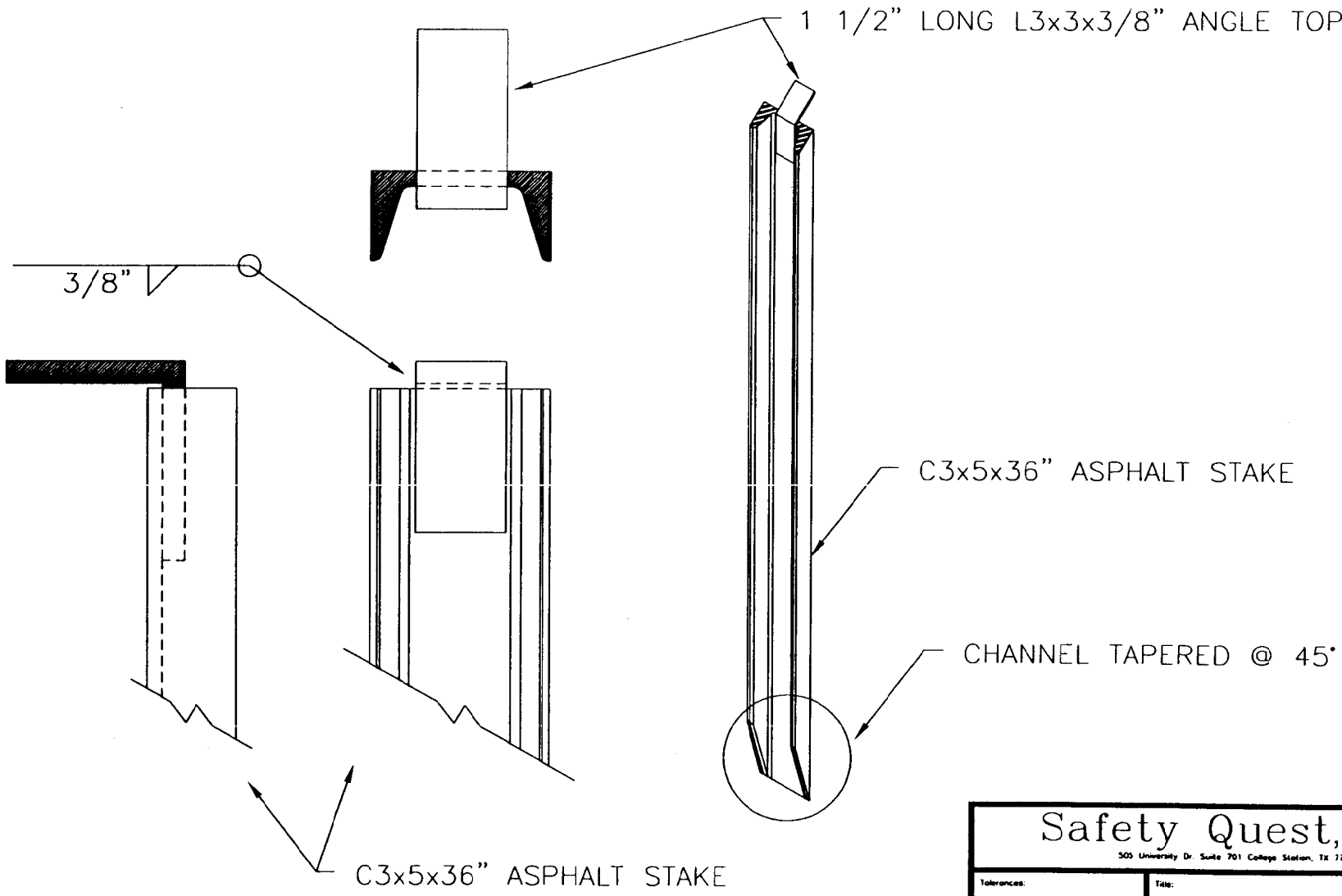


DRIVE SPIKE
(3/4"x14" AREA WASHER-HEAD DRIVE SPIKE)

NOTES:

1. USE 3"x3"x1/4" ANGLE FOR ANCHOR PIN
2. USE 1/4" STEEL FOR ANCHOR PIN BRACKET
3. DRIVE SPIKES ARE TO BE DRIVEN IN 1/2" ø HOLES DRILLED INTO HMAC TYPE D SURFACE BITUMINOUS ASPHALTIC CONCRETE

Safety Quest, Inc.		
505 University Dr. Suite 701 College Station, TX 77840		
Tolerances: Fractional= ±1/4 Angle= ±1/2°	Title: ANCHOR PIN SECTION	
	Drawn: C. Karpathy	Approved: D. Alberson
Date: 11/18/96	Scale: None	Sheet: 1 OF 1



NOTE:
STAKES SHALL BE DRIVEN BETWEEN
5° & 10° RELATIVE TO VERTICLE

Safety Quest, Inc.		
505 University Dr. Suite 701 College Station, TX 77840		
Tolerances: Fractional ±1/4 Angles ±1/2°	Title: CHANNEL STAKE AND TOP CLAMP	
	Drawn: C. Karpathy	Approved: D. Alberson
Date: 11/20/96	Scale: None	Sheet: 1 OF 1