

Installation Instructions
for the
FLEAT 350



R O A D S Y S T E M S , I N C .

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ADDENDUM

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The FLEAT may now be installed with **all 6'-3" post spacing**. This approval is good for a wood post system or a steel post system. Previously, the middle 12'-6" panel had 4'-2" post spacing.

Although the post spacing is now all 6'-3", the FLEAT still has 7 breakaway posts. This is because there is now a breakaway post at the 37'-6" downstream location where the flare begins.

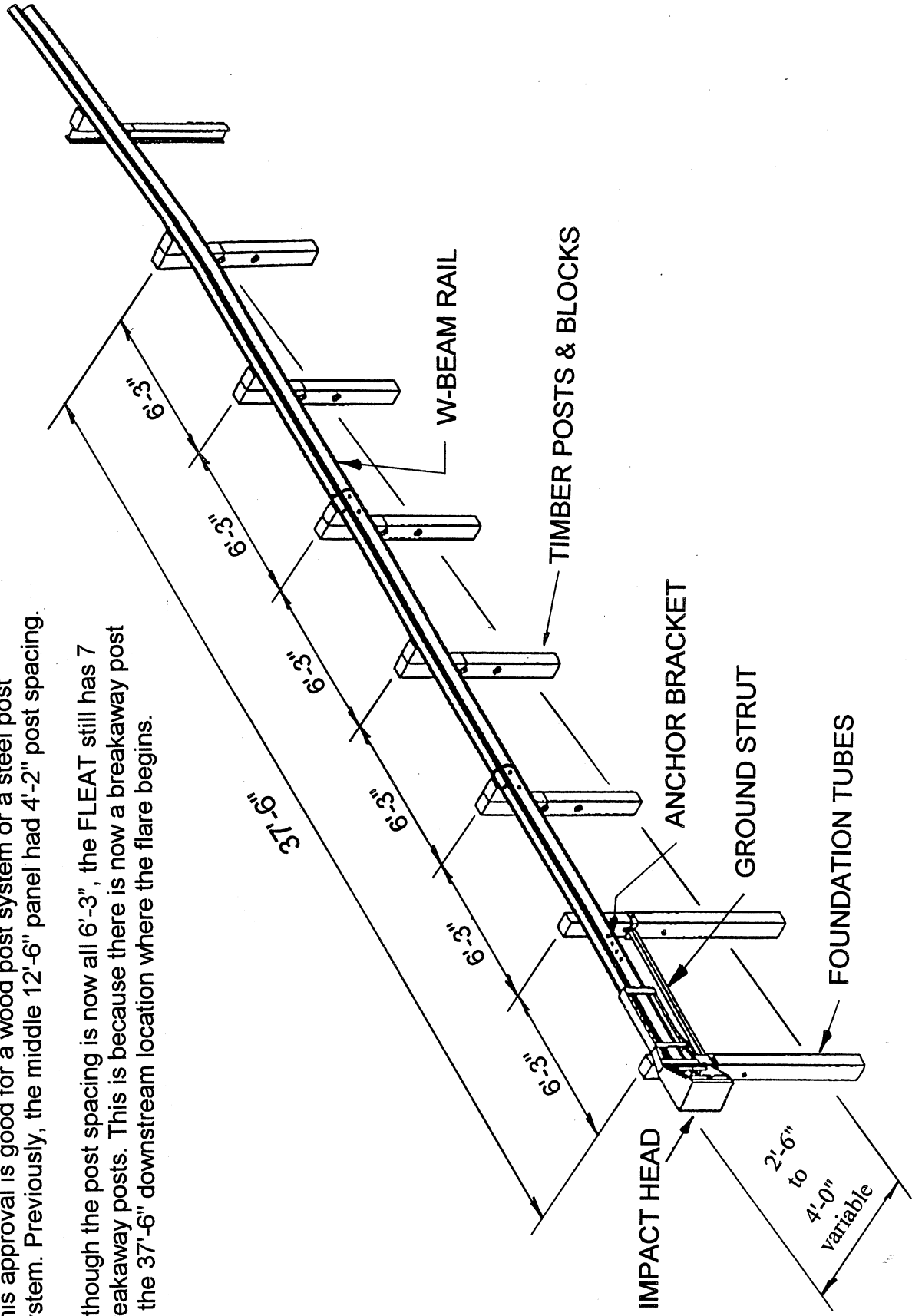


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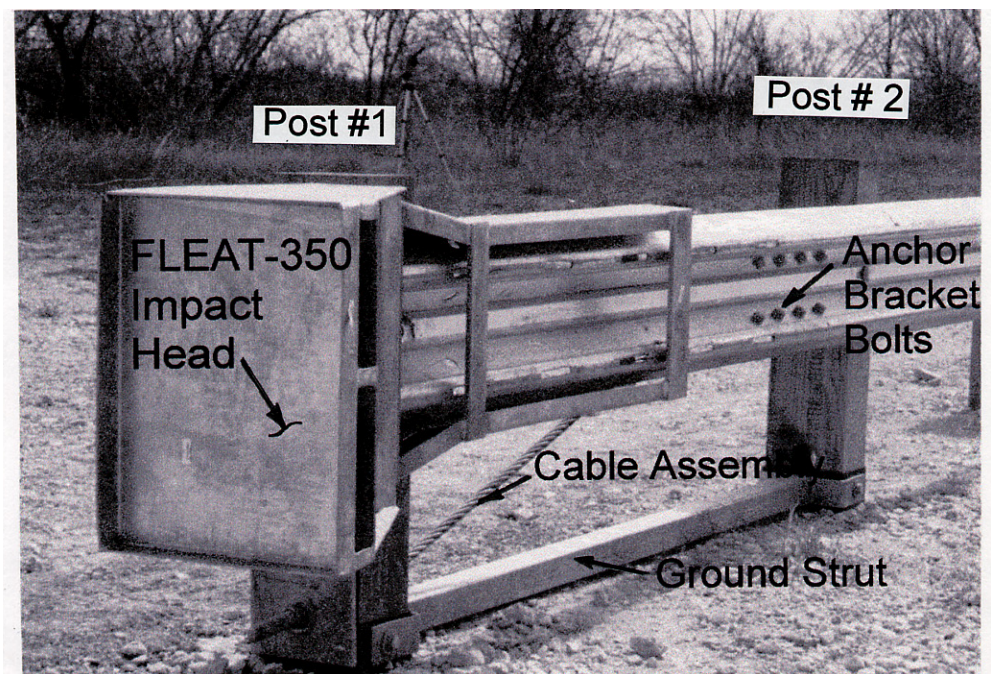
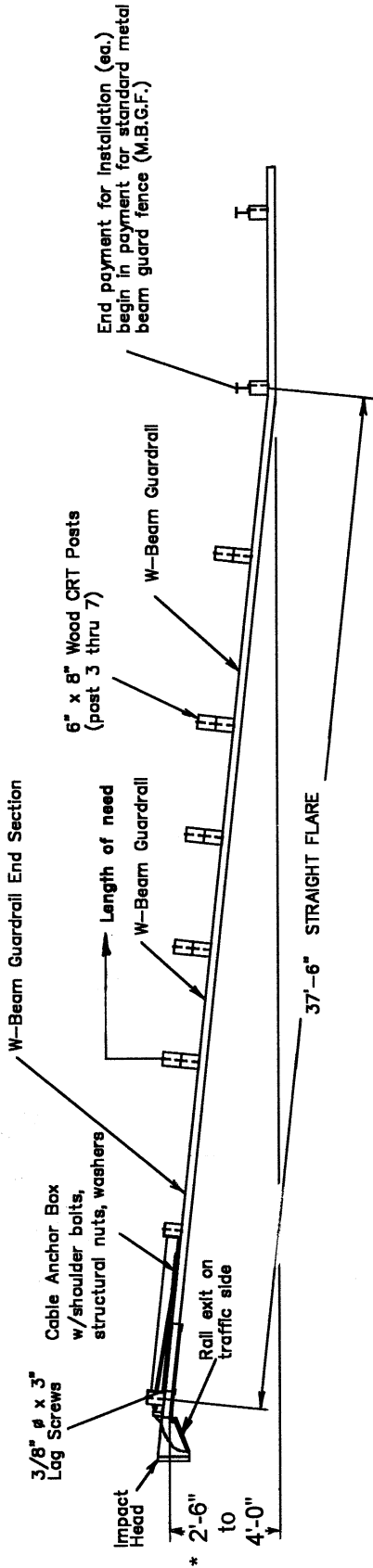
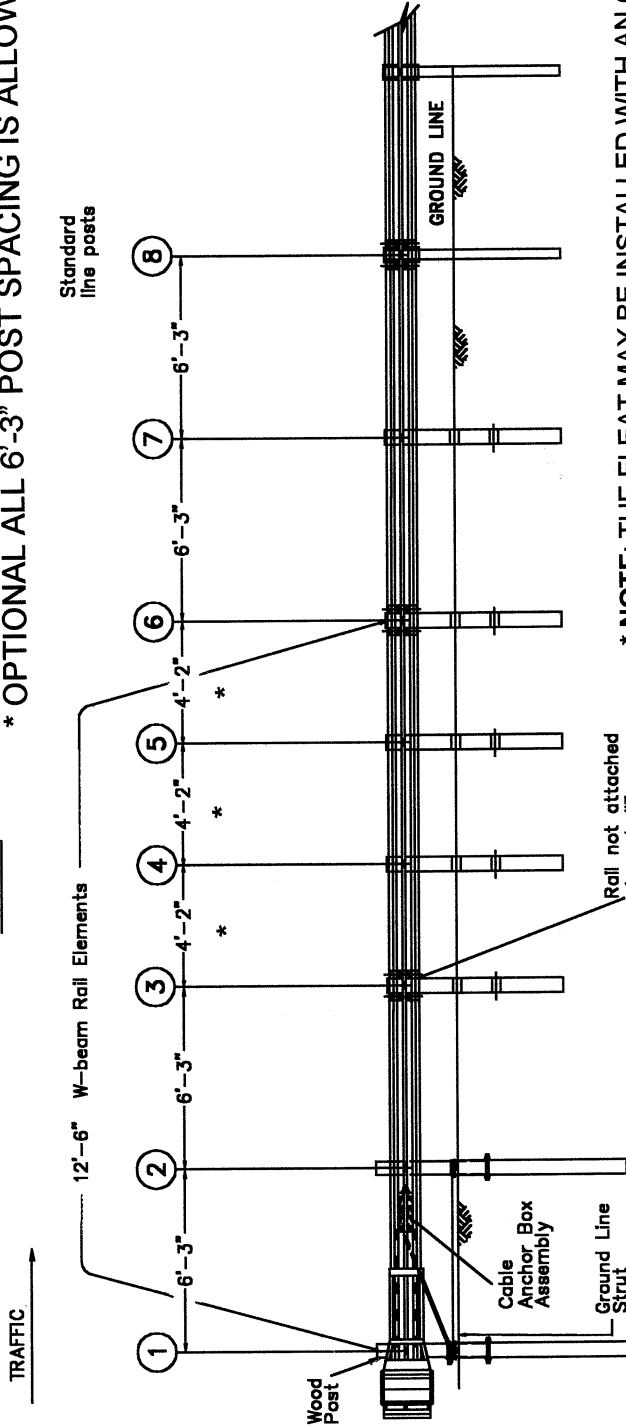


Figure 1. Isometric view of the *FLEAT 350*.



PLAN

* OPTIONAL ALL 6'-3" POST SPACING IS ALLOWABLE



ELEVATION

* NOTE: THE FLEAT MAY BE INSTALLED WITH AN OFFSET ANYWHERE BETWEEN 2'-6" AND 4'-0". REFER TO THE CONTRACT PLANS FOR THE REQUIRED OFFSET.

NOTE: Posts 1 and 3 that are not bolted through the rail should be driven with sufficient accuracy that the slot in the rail is aligned with the post bolt hole after installation.

Figure 2. Plan and Elevation Views of FLEAT 350.

Installing the *FLEAT 350*

Materials

As packaged, the *FLEAT 350* system includes all materials needed for a complete installation except for the impact face object marker. The length of the system in this configuration is 37'-6".

Design Options

There are four foundation tube options as shown in **Table 1** below.

Table 1. *FLEAT 350* Design Options

<i>FLEAT 350</i> Design Options	Total Foundation Tubes	Number of Standard BCT Posts	Number of CRT Posts	Total Number of Posts
6'-0" split Foundation Tube	2	2	5	7
6'-0" solid Foundation Tube	2	2	5	7
5'-0" or 4'-6" Foundation Tubes with soil plate	2	2	5	7

Figure 6 shows a section with the 6'-0" foundation tubes.

Figure 7 shows a section with the 5'-0" or 4'-6" foundation tubes with soil plates.

Table 2. FLEAT 350 Bill of Materials

Code #	Quantity	Description
F3000	1	Impact Head
F1303	1	W-Beam Guardrail End Section, 12 Ga., 12'-6"
F1304	1	W-Beam Guardrail, Center Section (4'-2" spacing) 12 Ga., 12'-6"
G1203	1	W-Beam Guardrail, (6'-3" spacing) 12 Ga., 12'-6"
S730	2	* Foundation Soil Tubes, 6" x 8" x 6'-0" (SEE NOTE BELOW)
E740	1	Pipe Sleeve - 2" Standard Pipe x 5-1/2"
E750	1	Bearing Plate - 8" x 8" x 5/8"
S760	1	Cable Anchor Bracket
E770	1	BCT Cable Anchor Assembly
E780	1	Ground Strut
P650	2	5-1/2" x 7-1/2" x 45" Wood Posts
P671	5	6" x 8" x 6'-0" Wood CRT Posts
P675	5	6" x 8" x 14" Timber Blockouts
Hardware		* The optional 6'-0" long split foundation tubes may be substituted with either solid 6'-0" long foundation tubes without soil plates or standard 5'-0" long or 4'-6" long foundation tubes with soil plates.
B580122	24	5/8" x 1 1/4" Splice Bolts
B580754	2	5/8" x 7 1/2" Hex Bolts
B581004	2	5/8" x 10" Hex Bolts
B581002	1	5/8" x 10" H.G.R. Post Bolt (Post 2 Only / NO BOLT USED AT POST #1)
B581802	5	5/8" x 18" H.G.R. Post Bolts (Posts 3 through 7)
N050	34	5/8" H.G.R. Nuts (Splice - 24, Soil Tubes - 4, Posts 2 to 7 - 6)
W050	10	5/8" Flat Washers (2 each at Soil Tubes + 6 Posts)
N100	2	1" Anchor Cable Hex Nuts
W100	2	1" Anchor Cable Washers
E350	2	3/8" x 3" Lag Screws
SB58A	8	Cable Anchor Bracket Shoulder Bolts
N055A	8	1/2" A325 Structural Nuts
W050A	16	1-1/16" OD x 9/16" ID A325 Structural Washers

Site Preparation

The *FLEAT 350* is installed with a **straight flare offset anywhere between 2'-6" and 4'-0"**. Refer to the contract plans for the required offset. Simply measure the offset distance over the 37'-6" length with a straight string line. This offset becomes the location of post #1. A parabolic curve is not required. Minor site grading may be necessary to prevent the foundation tubes from extending more than 4" above the ground (see Section on Installation).

Tools Required

The tools required for installation of the *FLEAT 350* system are those used to install standard highway guardrails (H.G.R.), including: 9/16", 7/8", 15/16", 1-1/4", and 1-1/2" sockets and wrenches, a drill with a 1/4" bit, and other equipment such as augers, tampers, and post pounders commonly used in driving posts.

Installation Procedures

Begin installation at the downstream end of the *FLEAT 350* (post location 8) to ensure that the terminal matches up with the standard section of guardrail. The major steps in the installation of the *FLEAT 350* are as follows:

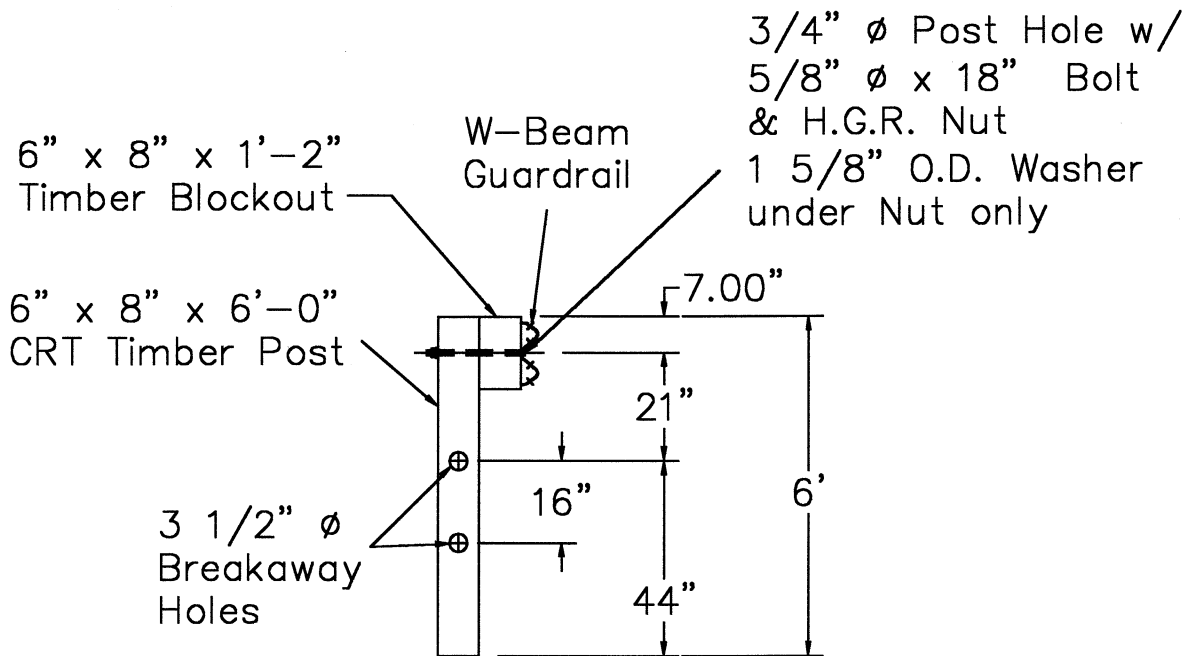
- Install posts 3 through 7,
- Install posts 1 and 2 with groundline strut,
- Install guardrail,
- Install cable anchor bracket,
- Install the *FLEAT 350* impact head, and
- Install cable assembly.

NOTE: The impact head must be placed over the rail prior to tightening the rail to post # 2.

Installing Posts 3 Through 7

Posts 3 through 7 are 6" x 8" x 6'-0" CRT posts (P671). When installed properly, the hole at the ground line of these CRT posts will be parallel to the roadway. **Figure 3** shows the section of a CRT post. The CRT post may be driven with an approved driving head. For stiff soils, drill a 6" pilot hole and force the post to the appropriate depth by impact or vibratory means with an approved driving head. The post may also be installed by augering and backfilling if the contractor so prefers. The initial hole must be large enough to allow adequate room for proper compaction of the soil during backfill. *Care must be taken to carefully compact the backfill to prevent settlement or lateral displacement of the post.*

If rock is encountered during driving or excavation, refer to appropriate State specifications. Guidelines will vary from State to State.



NOTE: THE RAIL IS NOT BOLTED TO POST # 3

SECTION TYPICAL AT POSTS 3 - 7

Figure 3. Section at CRT Post

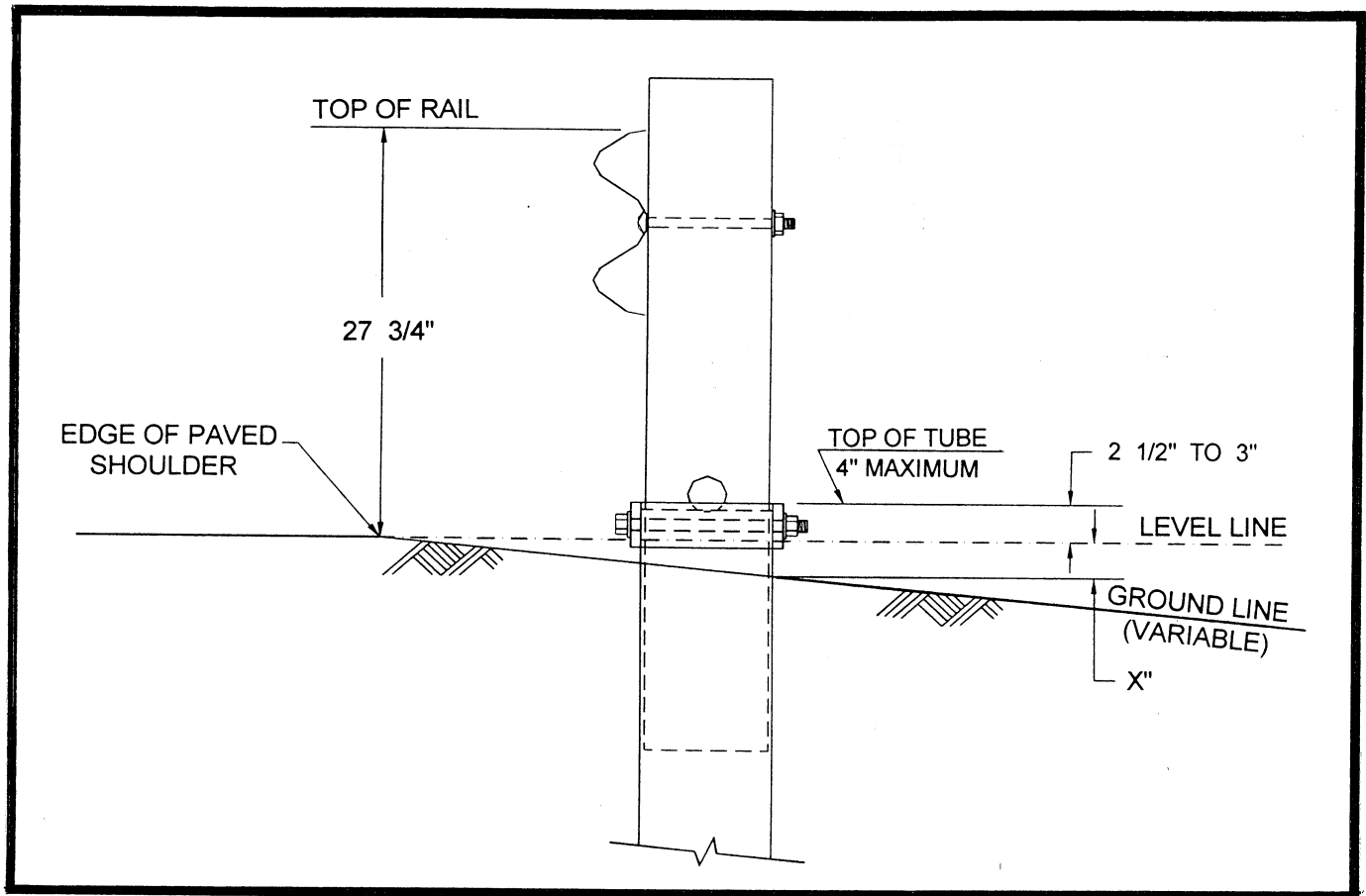


Figure 4. Proper Placement of Foundation Tubes

Figure 4 illustrates the proper placement of the foundation tubes. The top of the foundation tubes should not project more than 4" above the ground line when measured along a 5' cord, according to AASHTO specifications. Site grading may be required if the top of the foundation tubes project more than 4" above the ground line. The finished guardrail height should generally be 27-3/4" above the edge of the shoulder.

Based on a level line from the edge of the paved shoulder, the top of the foundation tube should normally be 2-1/2" to 3" above the level line. The placement of the foundation tube should be an appropriate depth below the level line in order to maintain the 27-3/4" guardrail height from the edge of the shoulder.

If the slope drops off some distance (X ") from the edge of the shoulder to the tube location, as shown in **Figure 4**, the depth of the foundation tube should be reduced by X " in order to maintain the proper guardrail height. The top of the foundation tube will project (X " + 2 1/2") to (X " + 3") above the ground. In order not to exceed the AASHTO 4" maximum projection above the ground, site grading will be necessary to assure that the " X " dimension would not be more than 1 1/2" to 1" respectively.

Installing Posts 1 and 2 with Groundline Strut

Figure 5 shows the above ground details and **Figure 6** shows the section at post locations 1 and 2. Posts 1 and 2 may be installed with either 6'-0" long split foundation tubes (S730) without soil plates, solid 6'-0" long foundation tubes (E731) without soil plates, standard 5'-0" long foundation tubes (S735) with soil plates (SP600) or 4'-6" long foundation tubes (E735) with soil plates (SP600). **Figure 7** shows the optional 5'-0" or 4'-6" foundation tubes with soil plates.

For the **6'-0" long split foundation tube**, fasten one 5/8" x 7-1/2" hex head bolt (B580754) and H.G.R. nut (N050) through the bottom hole of the foundation tube. *Do not over tighten and deform the tube.* The bolt is intended to stop the post from sliding all the way into the tube during installation.

Do not drive the foundation tube with wood post inserted. If the soil is penetrable so that the foundation tube does not deform, the foundation tube may be driven with an approved driving head. For non-penetrable soil, drill a 6" pilot hole and force the tube to the appropriate depth by impact or vibratory means with an approved driving head. The tube may also be installed by augering and backfilling if the contractor so prefers. The initial hole must be large enough to allow adequate room for proper compaction of the soil during backfill. *Care must be taken to carefully compact the backfill to prevent settlement or lateral displacement of the foundation tubes.* If rock is encountered, refer to appropriate State specifications. Guidelines will vary from State to State.

The top of the foundation tubes should not project more than 4" above the ground line when measured along a 5' cord, according to AASHTO specifications (see **Figure 4**).

The installation procedure for the **solid 6'-0" long foundation tubes** without soil plates is the same as that for the split foundation tubes.

The installation for the **standard 5'-0" long foundation tubes** with soil plates or the **standard 4'-6" long foundation tubes** with soil plates is shown in **Figure 7**. Fasten the soil plate to the foundation tube with two 5/8" x 7-1/2" hex head bolts (B580754) and H.G.R. nuts (N050) through the bottom holes of the foundation tubes. *Do not over tighten and deform the tubes.* These bolts attach the soil plate to the foundation tube and stop the post from sliding all the way into the tube during installation.

Insert the pipe sleeve (E740) into the 2 1/2" diameter hole near the base of the 5-1/2" x 7-1/2" x 45" wood post (P650) and install the post in the foundation tube at post location 1. Install the second 5-1/2" x 7-1/2" x 45" wood post in the foundation tube at post location 2, and fit the groundline strut (E780) between the two posts. Secure the post to each foundation tube with a 5/8" x 10" hex head bolt (B581004) and H.G.R. nut (N050) with a washer (W050) under both the bolt head and the nut. These bolts will serve to secure the posts and attach the groundline strut to the foundation tubes, as shown in **Figure 6**.

NOTE that there is
no Bolt at Post #1

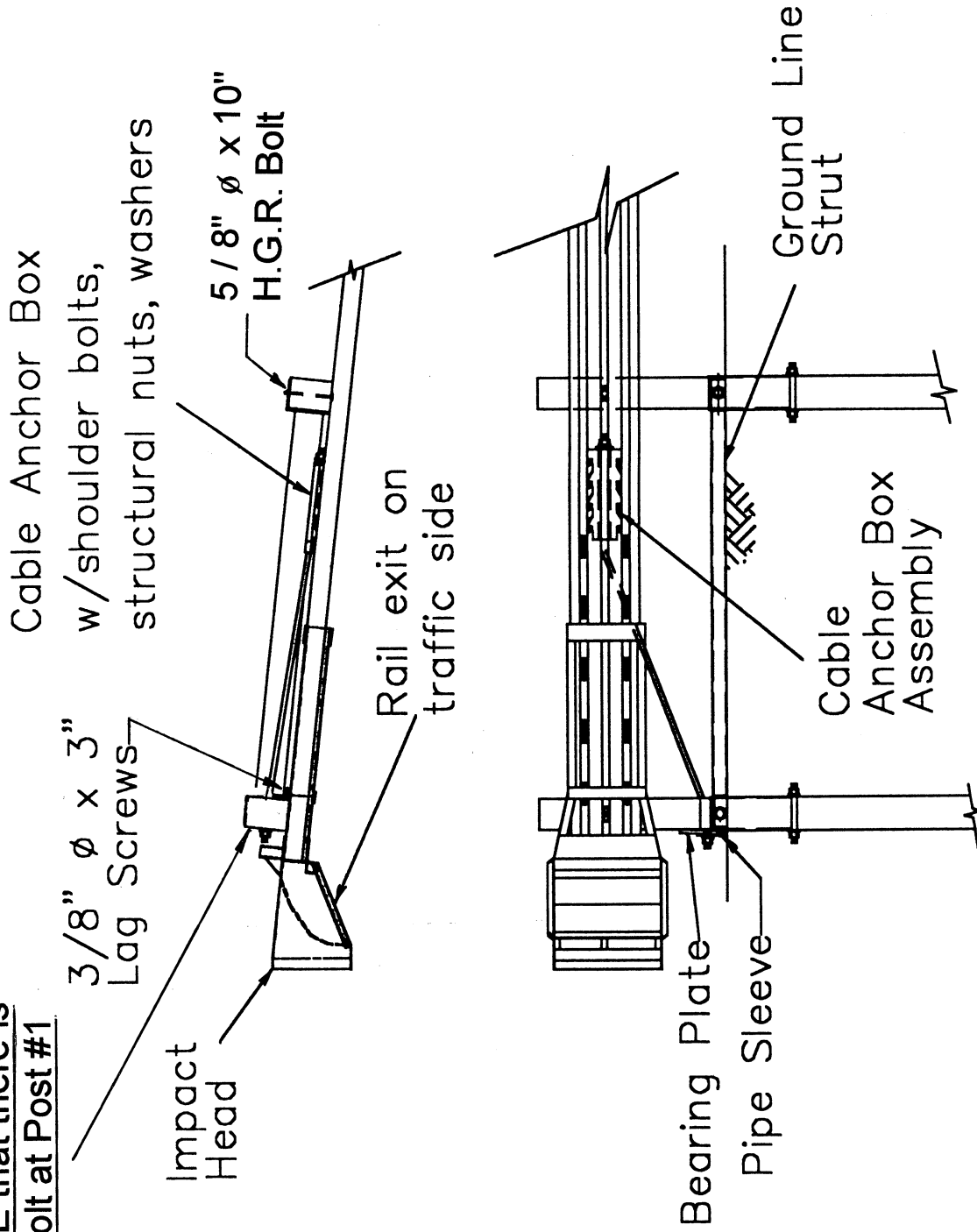
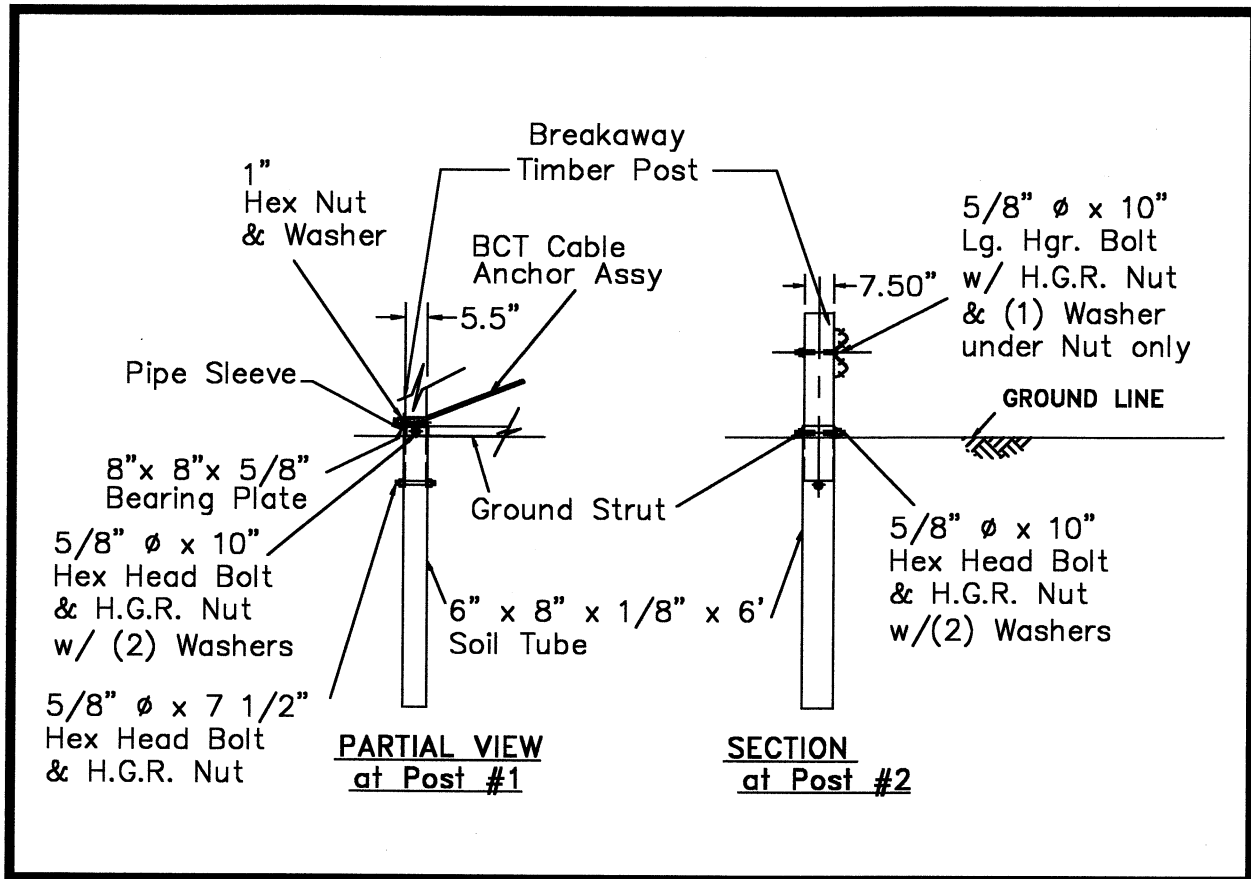


Figure 5. Above-Ground Details at Post Locations 1 and 2.



Note. The optional 6'-0" long split foundation tubes may be substituted with either solid 6'-0" long foundation tubes without soil plates or standard 5'-0" or 4'-6" long foundation tubes with soil plates.

Figure 6. Section at Post Locations 1 and 2.

Deep Beam Guardrail

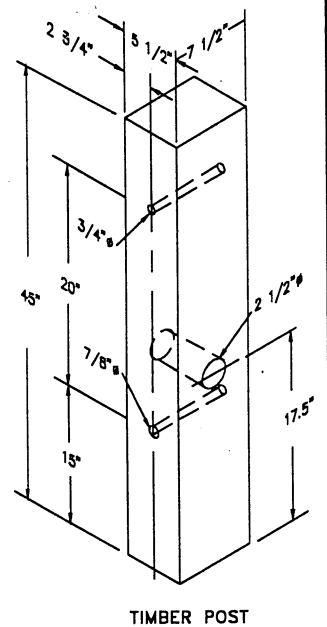
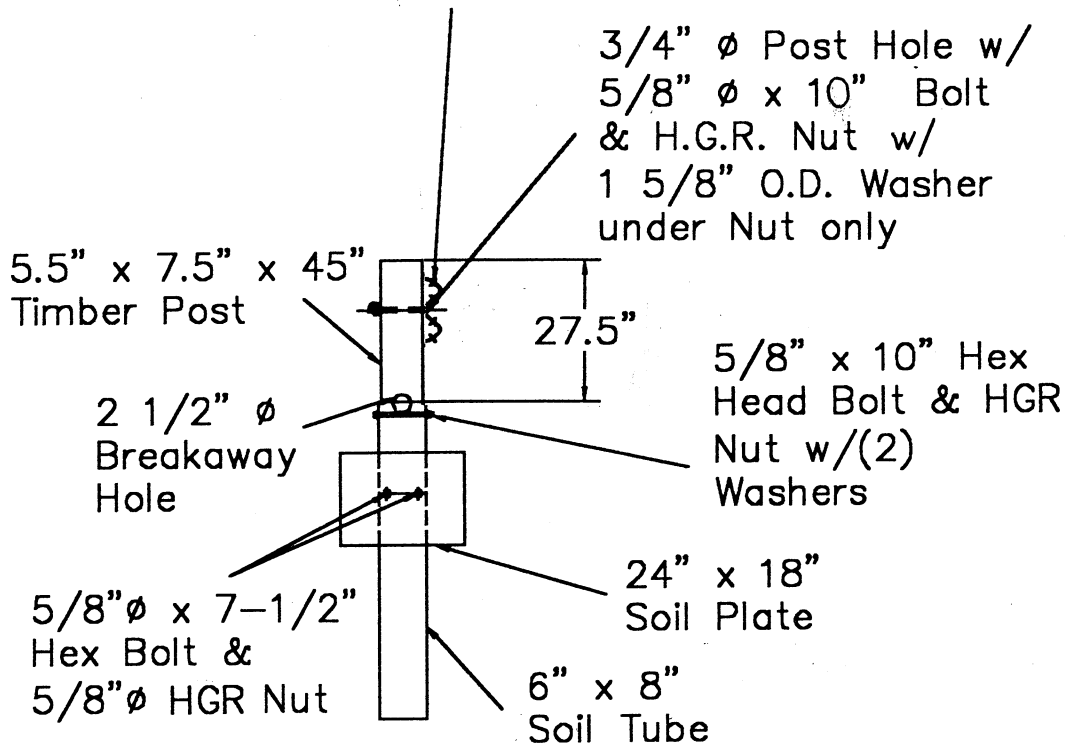


Figure 7. Optional 5'-0" or 4'-6" Foundation Tubes with Soil Plates

Installing Guardrail

The required offset is achieved by first splicing the guardrail panels together and then manually pushing the rails back. Shop curving or bending is not required.

Attach the standard 12'-6" W-beam guardrail section with 6'-3" post spacing (G1203) beginning at post 8 and spanning to post 6. Then attach the standard 12'-6" W-beam guardrail section with 4'-2" post spacing (F1304) which will span from post 6 to post 3. **Note that the rail is not bolted to post #3.** Attach the 12'-6" W-beam guardrail end section (F1303) to span from post 3 to 1. Note that the impact head must be placed over the rail prior to tightening the rail to post # 2. The rail is to be spliced with 5/8" x 1-1/4" H.G.R. bolts (B580122) and 5/8" H.G.R. nuts (N050).

For ease of installation, it is recommended to have the eight 1/2" cable anchor bracket shoulder bolts (SB58A) and the cable anchor bracket (S760) attached to the W-beam guardrail end section prior to attaching the guardrail to the posts. See Section on "Installing Cable Anchor Bracket" for details.

The rails are to be attached to posts and blockouts at post locations 4 through 7 with 5/8" x 18" H.G.R. bolts (B581802) and nuts (N050). **At post location 3, the rail is not bolted to the post.** The bolt only holds the blockout to the post. There is no blockout on posts 1 and 2, and the rail is attached to post 2 only with a 5/8" x 10" H.G.R. bolt (B581002). **Note that no bolt is used at post #1.** Be sure to place a 5/8" flat washer (W050) on the backside of posts 2 through 7 under each nut (N050).

NOTE: After the blockout is attached, drive a galvanized steel 10d common nail through the block and into the post (toe nailed) to prevent rotation if the wood shrinks.

Installing Cable Anchor Bracket

For ease of installation, it is recommended to have the eight 1/2" cable anchor bracket shoulder bolts (SB58A) and the cable anchor bracket (S760) attached to the W-beam guardrail end section prior to attaching the guardrail to the posts. If this procedure is not followed, Post #2 may interfere with attaching the bracket.

The eight 1/2" cable anchor bracket shoulder bolts (SB58A) are attached to the W-beam guardrail end section with two 1-1/16" OD x 9/16" ID structural washers (W050A), one on each side of the guardrail, and a 1/2" structural nut (N055A). The shoulders of the bolts should be on the backside of the guardrail, away from traffic, as shown in **Figure 8**.

For ease of installation, attach the cable anchor bracket shoulder bolts to the rail "finger tight" only. Then align the slots on the cable anchor bracket (S760) with the shoulder bolts and tap the cable anchor bracket onto the shoulder portion of the bolts using a hammer. Tighten the bolts with a wrench when the bracket is in place. When installed properly, the welded plate on the cable anchor bracket should be toward Post #2, as shown in **Figure 9**.

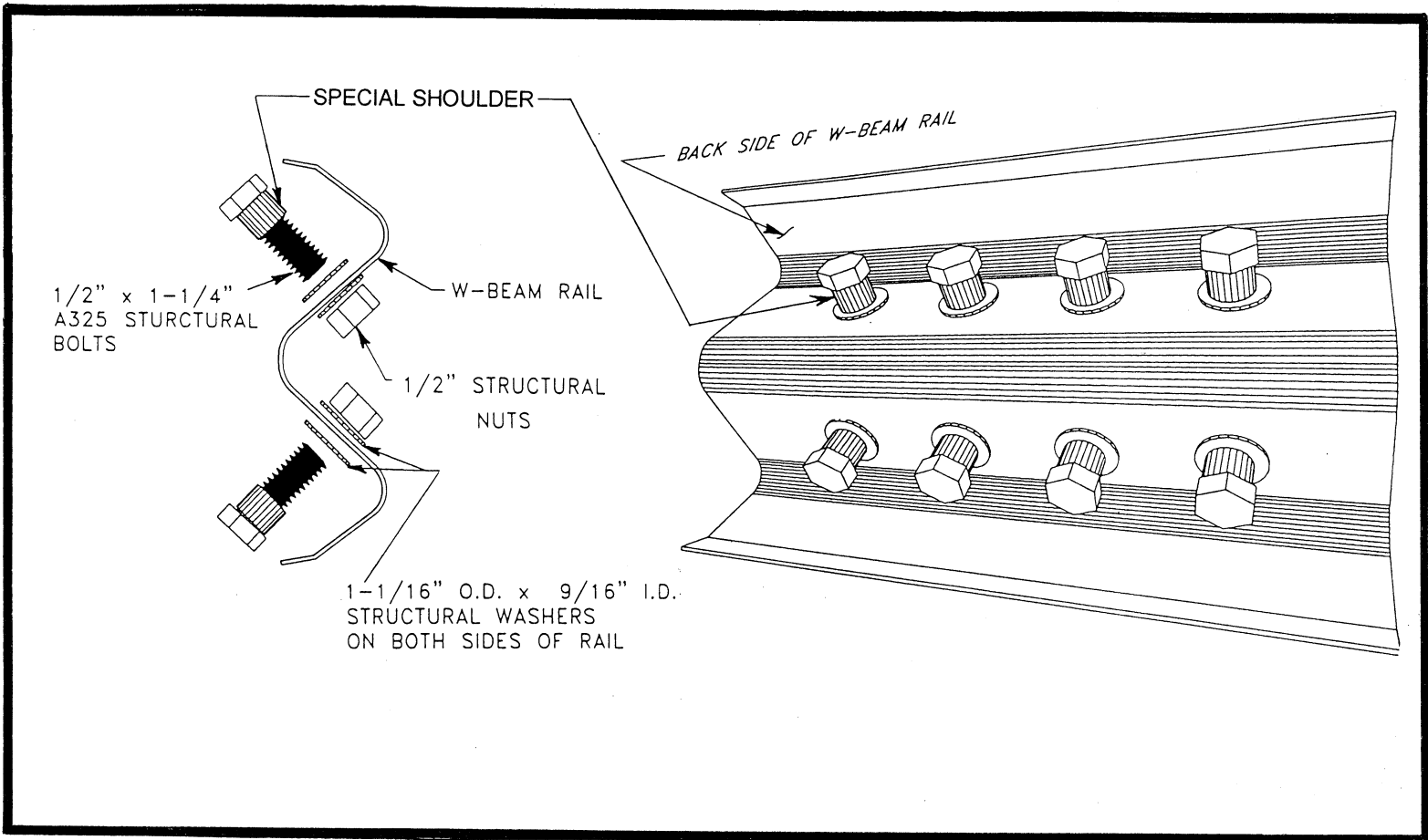


Figure 8. Installation of Cable Anchor Bracket Shoulder Bolts.

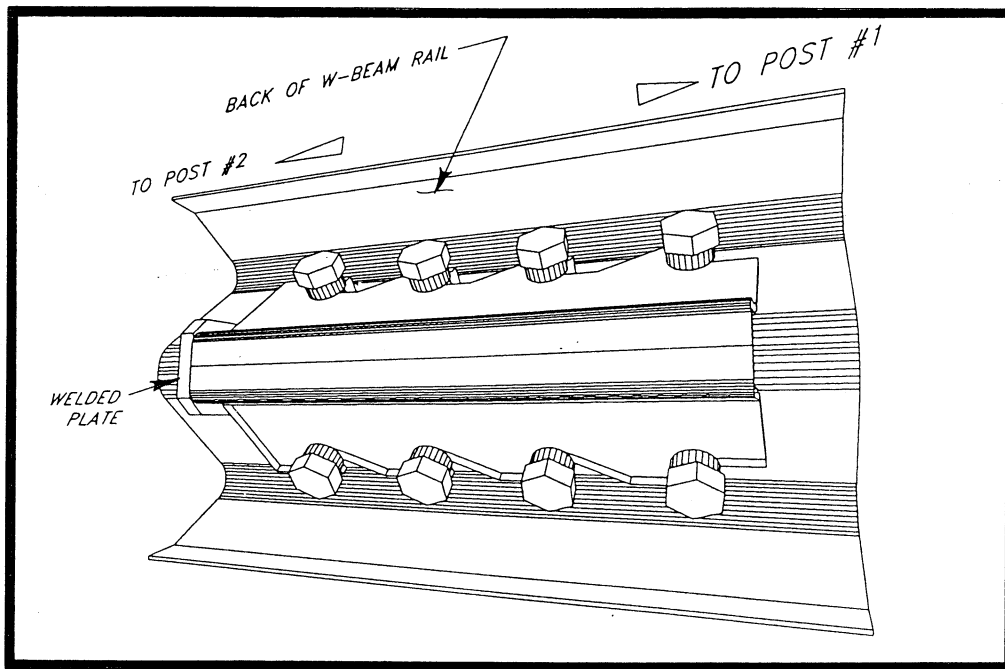


Figure 9. Installation of Cable Anchor Bracket.

Installing the FLEAT 350 Impact Head

The eight cable anchor bracket shoulder bolts and the cable anchor bracket should be attached to the W-beam guardrail end section prior to attaching the **FLEAT 350** impact head to the first post with lag screws.

Prior to tightening the rail to post # 2, place the impact head (F3000) with the guide chute over the end of the W-beam guardrail. **The exit slot will be toward the traffic side.** The impact head should be positioned so that the protruding tube is on the backside of the guardrail, away from traffic as shown in **Figure 2** and **Figure 5**. Slide the impact head forward until the post angle attachments on the impact head are aligned with the downstream side of the first post. This is the side facing post #2. Attach the impact head to the first post with two 3/8" x 3" lag screws (E350), one each for the top and bottom post angle attachments. A 1/4" pilot hole is required to avoid breaking the lag screw.

Note. It is recommended that the face of the impact head be delineated with an object marker that meets State specifications for better night visibility. However, the impact face object marker is not included as part of the shipped materials for the **FLEAT 350** unless specifically requested in the contract plans.

Installing Cable Assembly

Place the cable assembly (E770) through the cable anchor bracket and through the sleeve of post 1. Place the bearing plate (E750) at the base of post 1 with 5" dimension up and 3" dimension down. Place a nail over the bearing plate to prevent the plate from rotating. Secure both ends of the cable assembly with a 1" hex nut (N100) and washer (W100). While tightening cable, use a 2-lb hammer to tap the cable anchor bracket from the downstream end to ensure that it is securely interlocked with the bolts. Restrain the cable at the end being tightened to avoid twisting the cable.

Upon completion of the installation, the cable should be taut and the cable anchor bracket should be fully seated on the shoulder portion of the cable anchor bolts. *It is very important that the cable anchor bracket be fully seated on the shoulder portion of the cable anchor bolts.*

FLEAT 350 Installation Checklist

State: _____

Date: _____

Project #: _____

Location: _____

- The rail height is in accordance with the plans (generally 27-3/4" above the edge of the shoulder).
- The rail at post #1 is placed at a straight flare (offset between 2'-6" & 4'-0") over the 37'-6" terminal length.
- The rail is not attached to the post at post location #3 or post location #1.
- The foundation tubes do not protrude more than 4" above the ground line (measured by the AASHTO 5' cord method). Site grading may be necessary to meet this requirement.
- The bolts at the top of the foundation tubes are not over-tightened, deforming the walls of the tubes.
- The guide chute of the impact head is parallel to the top of the rail and the exit slot of the impact head is facing traffic.
- The two lag screws holding the impact head to post 1 are snug.
- The 8" x 8" bearing plate at post 1 is correctly positioned with the 5" dimension up & the 3" dimension down. The anchor cable is taut and correctly installed. A nail has been placed over the bearing plate to prevent rotation.
- The cable anchor bracket shoulder bolts are properly attached to the W-beam guardrail and the cable anchor bracket is fully seated on the shoulder portion of the bolts.
- Posts #1 and #2 are installed in foundation tubes and have the 2-1/2" breakaway hole located parallel to the roadway with the bottom of the hole at the top of the tube.
- CRT posts at locations 3 through 7 have two 3-1/2" breakaway holes (checked prior to installation) located parallel to the roadway with the center of the top hole located at the ground line.
- If the posts were augered, be sure the backfill material around the posts is compacted.
- No washers are used on the face of the rail except at the cable anchor bracket bolts.

Additional notes: _____

Inspection performed by: _____

Repairing the *FLEAT 350*

Equipment Needed for Repair Operation

- Acetylene torch to cut off the damaged rail,
- S.A.E. wrench or socket sizes 9/16", 7/8", 15/16", 1-1/4", and 1-1/2",
- Vice grip or channel lock pliers,
- Sledge hammer,
- Post remover tool (see **Figures 10 and 11**),
- Other normal guardrail tools.

General Repair Procedures

After an end-on impact occurs with the *FLEAT 350*, it will normally require replacement of the 12'-6" end section of rail and any other damaged rail section(s), any broken post(s) and potentially the impact head. For a traffic face impact, the damage will be to the downstream rail section(s) and associated posts.

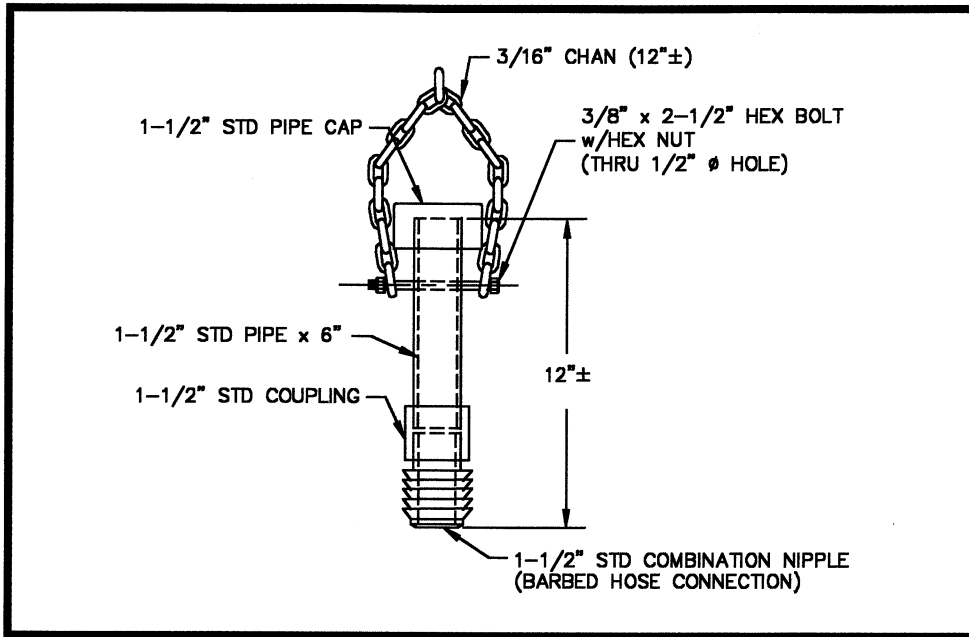
The general step-by-step procedure for repairing a damaged *FLEAT 350* terminal is as follows:

- (1) Check the impact head for damage.
- (2) Check the cable anchor bracket and cable assembly for damage. The bearing plate, nuts, washers, cable anchor bracket, and the special cable anchor bracket shoulder bolts are rarely damaged.
- (3) Check the number of broken posts and wood blockouts that need to be replaced, along with any damaged bolts. Inventory and pick up the reusable parts.
- (4) Torch off the kinked rail near the outlet of the impact head. The impact head should be able to be removed by hand at this point. If not, the impact head is probably not reusable.
- (5) Disconnect and remove the damaged rail from the posts.
- (6) Remove the broken posts from the foundation tubes using one of the two post removal tools (see **Figures 10 and 11**) assembled from "off the shelf hardware" items. Pound the steel pipe or screw the lag screw into the top of the broken post stub and remove the remains of the broken post by pulling on the chain. Use a pry bar as a lever if necessary.
- (7) Reinstall the system following the procedures listed in this manual.

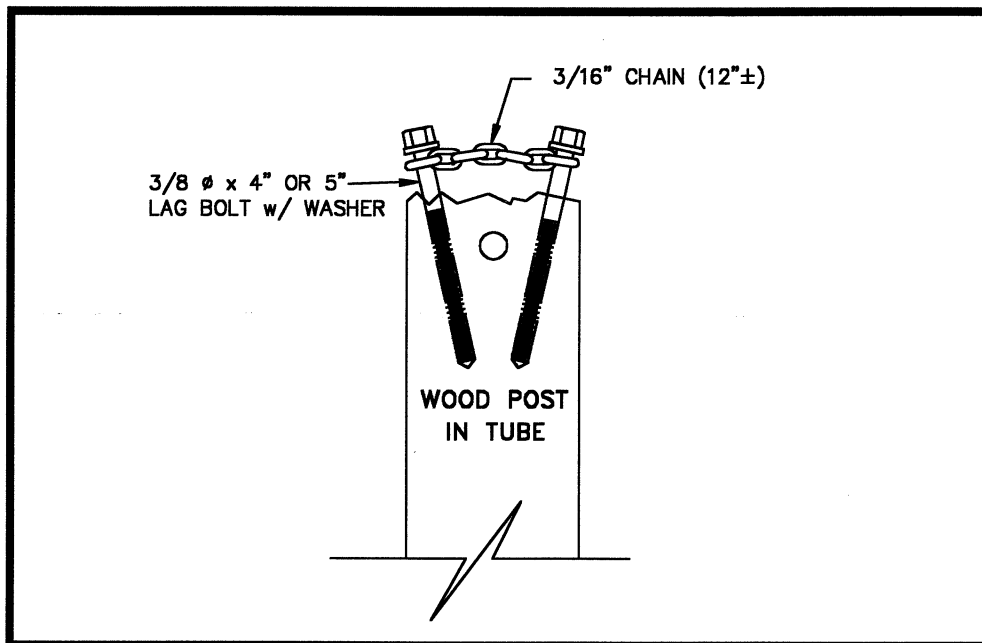
Procedures Immediately Following an Accident (Temporary)

If no repair parts are readily available immediately following an accident, the following procedure should be used to provide temporary protection of the guardrail end. It should be noted that this repair is only for temporary purposes, and the anchor cable cannot be installed to provide tension in the rail for redirection impacts.

- (1) Remove damaged rail and impact head from the roadway or shoulder area.
- (2) Using an acetylene torch, cut the kinked rail off at the outlet of the impact head and inspect the head for any damage.
- (3) Remove the impact head by hand.
- (4) Locate the first post downstream of any damaged rail and cut this rail off about 9" in front of the post. If the post is at a splice, simply unbolt the damaged rail.
- (5) Install the impact head on the rail and attach it to the post with lag bolts.
- (6) Warning signs should be used where appropriate.



**Figure 10. Wood Post Pulling Tool
(Pipe Option)**



**Figure 11. Wood Post Pulling Tool
(Lag Screw Option)**



