

Installation Instructions for BEAT-BP

Box Beam Bursting Energy Absorbing Terminal Bridge Pier



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Installation Instructions for the BEAT-BP Bridge Pier System

Introduction

The **BEAT-BP** system consists of an energy absorbing crash cushion at both approach ends of bridge pier and 6"x 6" box beam rail sections to enclose the pier (or piers) or other fixed objects adjacent to the travel way (collectively referred to as piers for the remainder of this manual). The crash cushion consists of breakaway steel posts, a cable anchor system and an impact head that causes the 6"x 6" box beam rail sections to burst when impacted end-on. The appropriate positioning of the crash cushion ends, the support posts and box beam rail elements relative to the rigid structure (and the travel way) is very important to insure proper performance of the **BEAT-BP**. The required layout will vary with the number of piers, the relationship of the piers and the travel way and possibly the diameter (or width) of the piers if larger than 4-ft.

As packaged, the **BEAT-BP** system includes all materials needed for a complete installation. The overall length of the **BEAT-BP** system will vary with the number of piers.

Refer to design drawings to determine the exact layout and placement of the **BEAT-BP** system. Each **BEAT-BP** installation is site specific. The approximate overall lengths of the system are shown below.

- For 1-Pier protection system – 79-ft.
- For 2-Pier protection system – 103-ft.
- For 3-Pier protection system – 115-ft.
- For 4-Pier protection system – 151-ft.

General Notes

Begin the layout of the **BEAT-BP** at the longitudinal centerline of the pier (or piers) where the system will be placed and work toward both ends where the impact head joins with post #1. The installation steps for the **BEAT-BP** are detailed on the following pages.

Site Preparation

The **BEAT-BP** is installed with an enclosed area that surrounds the bridge piers and has a straight energy-absorbing leading segment at both ends of the piers. The approach area in front of the **BEAT-BP** system shall be free of fixed objects and have a fill slope or cut slope of 10:1 or flatter. Measure the layout as described in this manual. Post spacing varies and is shown on the design drawings and/or in this manual.

Tools Required

The tools required for installation of the **BEAT-BP** system are similar to those used to install standard highway guardrails, including sockets and wrenches for 1/4" 5/16", 1/2", 5/8", 3/4", and 1" bolts and a drill. Other equipment such as augers, tampers, and post pounders commonly used in driving posts is also needed. In addition, it may be helpful to use clamps to prevent the box beam rail tubing sections from rotating.

BEAT-BP Bridge Pier Installation Procedure and Notes:

- A. Begin the layout of the **BEAT-BP** at the longitudinal centerline of the pier (or piers) where the system will be placed and work toward both ends where the impact head joins with post #1. Each **BEAT-BP** system is sized to enclose a particular pier application. **Refer to design drawings** to determine the number of Rail Sections (Item N) and the number of Extended Blocks (Item P) required. Site conditions may vary but typical requirements are:
- For 1-Pier protection system – 4 Rail Sections (Item N) & 2 Extended Blocks (Item P).
 - For 2-Pier protection system – 8 Rail Sections (Item N) & 4 Extended Blocks (Item P).
 - For 3-Pier protection system – 10 Rail Sections (Item N) & 6 Extended Blocks (Item P).
- B. When laying out around the piers or poles in the enclosed center portion of the **BEAT-BP**, the system may or may not be perfectly centered depending on site constraints. For any given installation, the minimum distance between the backside of the Standard Steel Posts (Item K) and the object being shielded is 8 inches. In addition, the Extended Blocks (Item P) must effectively shield the leading edge of the pier. This means that the Extended Blocks shall extend upstream beyond the hazard.

The Installation Steps for the BEAT-BP are as Follows:

1. Layout the main system envelope surrounding the piers to establish proper location and ensure appropriate clearances. This layout will include all the Rail Sections (Item N), the Internal Splices (Item S) the “Y” Connections (Item Q) and the Bent Splices (Item R). Use of a string line will help to keep rail sections aligned.
2. Install the two 8'-0" long (W6 x 15#) Interior Anchor Posts (Item C) at the two interior locations of the **BEAT-BP** system. The location of these anchor posts is near post location #10 and is described in this Installation Manual under the Interior Anchor Post Detail.
3. Using the Rail Sections (system envelope) as a guide, install the 6'-0" long Standard Steel Posts (Item K) with their front faces offset 6" from the back of the Rail Section in the enclosed center portion of the **BEAT-BP**. This 6" will allow for the blockouts.
 - For 1-Pier protection system – Item K is post locations #7-12 at both sides of the pier.
 - For 2-Pier protection system – Item K is post locations #7-20 at both sides of the piers.
 - For 3-Pier protection system – Item K is post locations #7-24 at both sides of the piers.

All of the interior Standard Steel Posts (Item K) should be laid out in a straight line as described in the applicable design drawing. It should be noted that the installation should be generally parallel to traffic. These Standard Steel Posts (Item K) are spaced at 3'-0" centers and shall be in-line with the Breakaway Posts (Item J) at locations #2-6. This will allow alignment with the 16'-2 ½" long Second Rail Tube (Item M).

The two interior Standard Steel Posts supporting the Diagonal Tubes (Item N) at each end of the main system envelope surrounding the piers are also spaced at 3'-0". These posts should be aligned with the Diagonal Tube and also offset 6" from the back from the tube.

4. Install Rail Support Brackets (Item V) at the interior posts that support the 10-ft long Extended Blocks (Item P) in front of the piers. These are bent plate brackets.

5. Install Rail Support Brackets (Item L) at the interior posts that do **“not”** support the 10-ft long Extended Blocks in front of the piers. These bent plate brackets have a short section of tube welded to them.
6. Install the 10-ft long Extended Blocks (Item P) on both sides of the system in front of all of the piers. The Extended Blocks shall extend upstream beyond the hazard.
7. Connect Internal Splice Plates (Item S) to the ≈12-ft long Rail Sections (Item N). (This does not apply for 1-pier protection system). Place the Rail Sections on the interior Standard Steel Posts (Item K). It may be helpful to use clamps to prevent the rail sections from falling prior to bolting.
8. Connect the Bent Splice Connection (Item R) to the two downstream Rail Sections (Item N).
9. Install the ≈12-ft long Diagonal Tubes (Item N) at both ends of the enclosed center portion using the Bent Splice Connections (Item R).
10. Connect the “Y” Splice Connection (Item Q) to the two upstream Rail Sections (Item N) and to the Diagonal Tube (Item N). Note that the Diagonal Tube will slip past the bolt holes on the Y Splice Connection making it easier to get the rail on the Bent Splice Connection.
11. Install the 6'-0" long (W6 x 9#) Breakaway Plug Welded Posts (Item J) at locations #2-6 at both ends. These posts shall be installed in-line with the interior Standard Steel Posts (Item K).
12. Install the 8'-0" long (W6 x 15#) Lower End Post #1 (Item C) section at both ends.
13. Install the 1'-9 ½" long (W6 x 9#) Upper End Post #1 (Item B) section at both ends.
14. Install Rail Support Brackets (Item L) at post locations #2-6. These bent plate brackets will have a short tube welded to it.
15. Attach Anchor Plate (Item X) at the underside of the ≈12-ft long Rail Section (Item N) near post #10 at both sides of the system. Use hardware from the Internal Splice Plates (Item S).
16. Attach 3 ½" x 11 ½" Tie Plates (Item W) at posts that support the 10-ft long Extended Blocks (Item P) in front of the piers.
17. Install the 16'-2 ½" long Second Rail Tube (Item M) at posts #3-6 at both ends.
18. Install the 8'-0" long End Rail (Item H) at posts #1 & 2.
19. Install the 4" x 2" x 4" long Support Bracket (Item D) at post #1 at both ends.
20. Connect the End Rail tube to the Second Rail tube using End Splice Channel (Item T).
21. Install **BEAT-BP** Box Beam Impact Head (Item A) at both ends.
22. Install Post Breaker (Item E) at both ends.
23. Install Tether Cable (Item U) at both ends.
24. Install Cable Anchor Assembly (Item F) with Bearing Plate (Item G) at post #1 (total 2 places).
25. Install Cable Anchor Assembly (Item F) and at lower interior end posts (total 2 places).

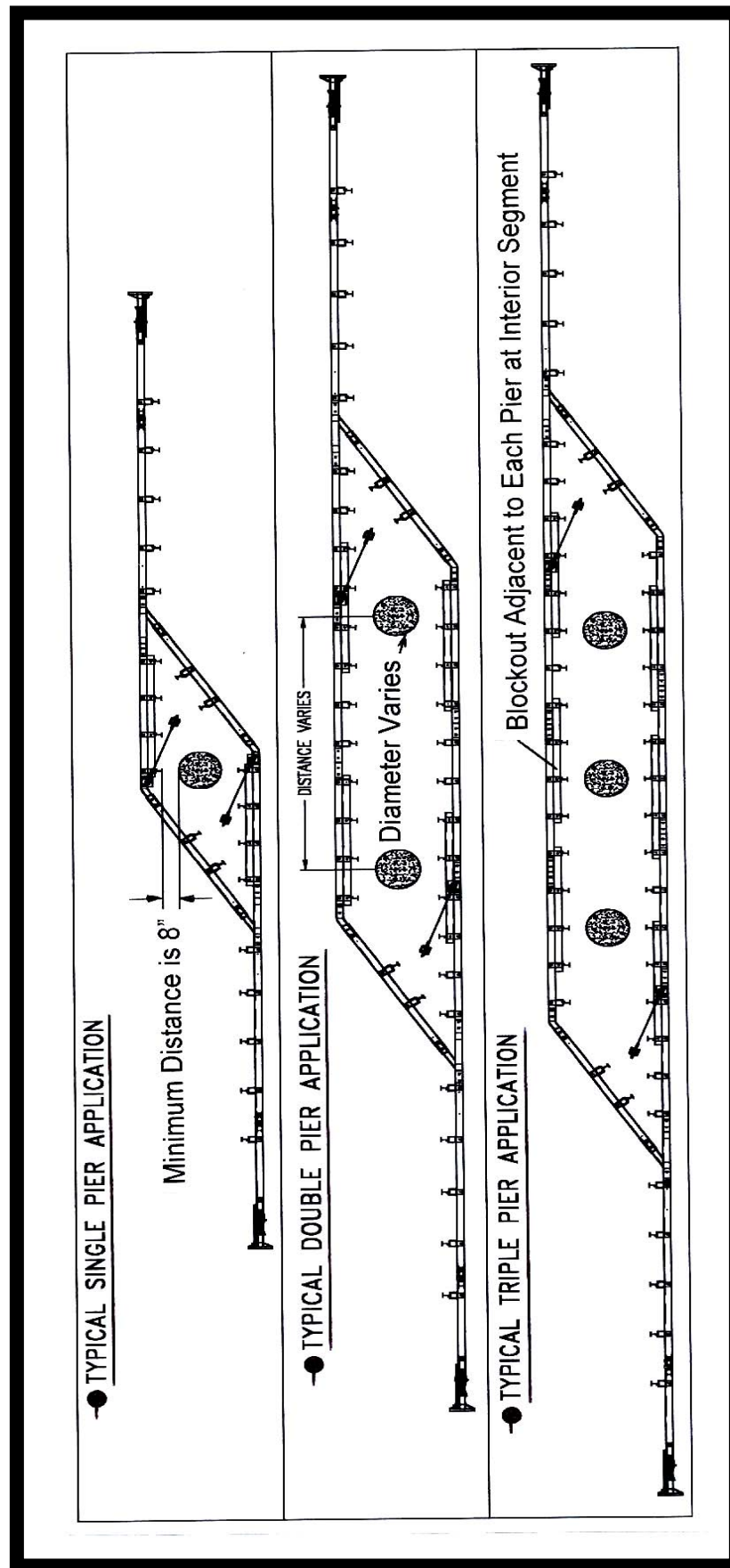


Figure 1. BEAT-BP Typical Pier Applications for 1, 2 & 3 Piers

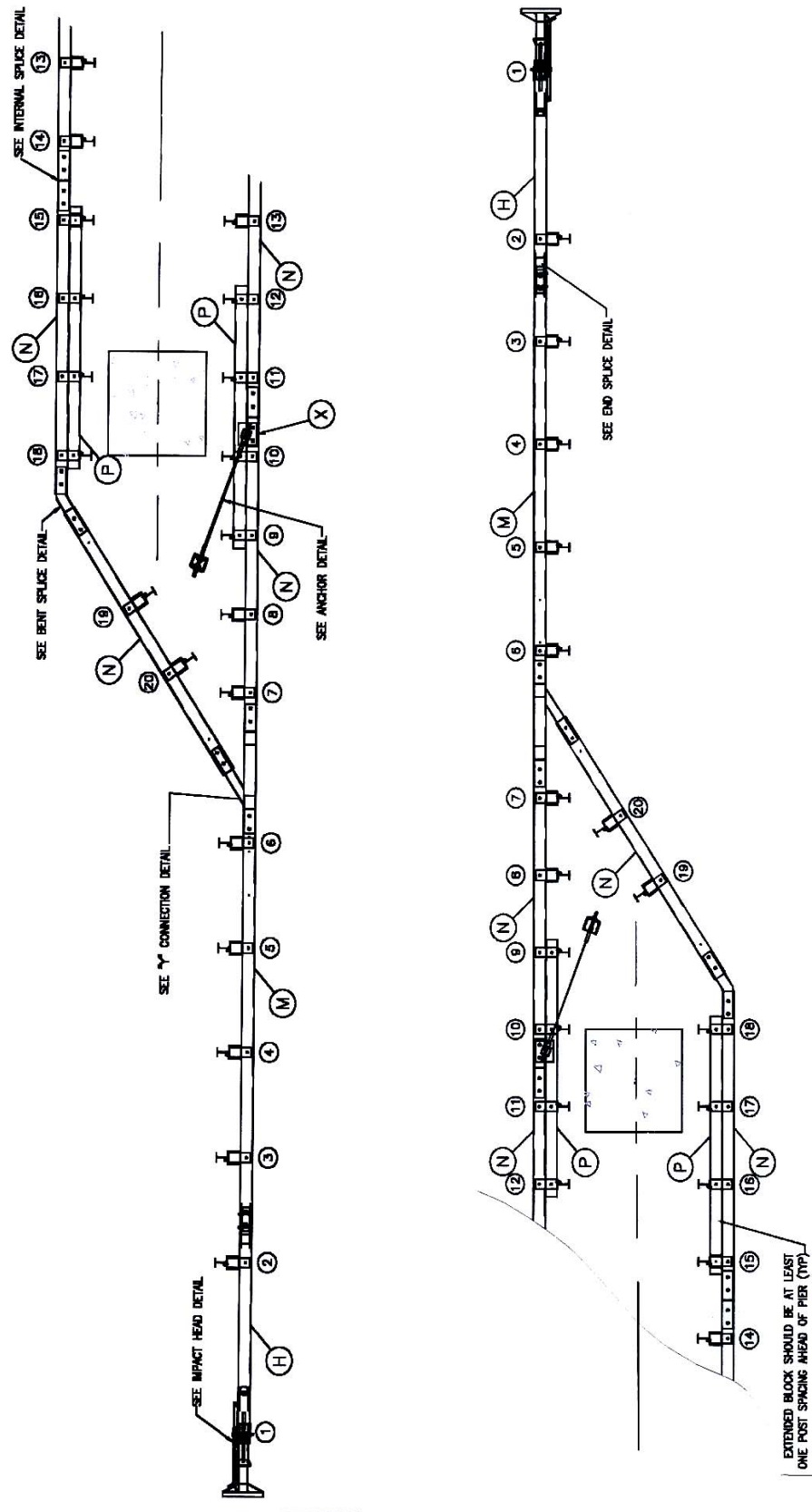


Figure 2. Plan View of the BEAT-BP (2 Pier Application)

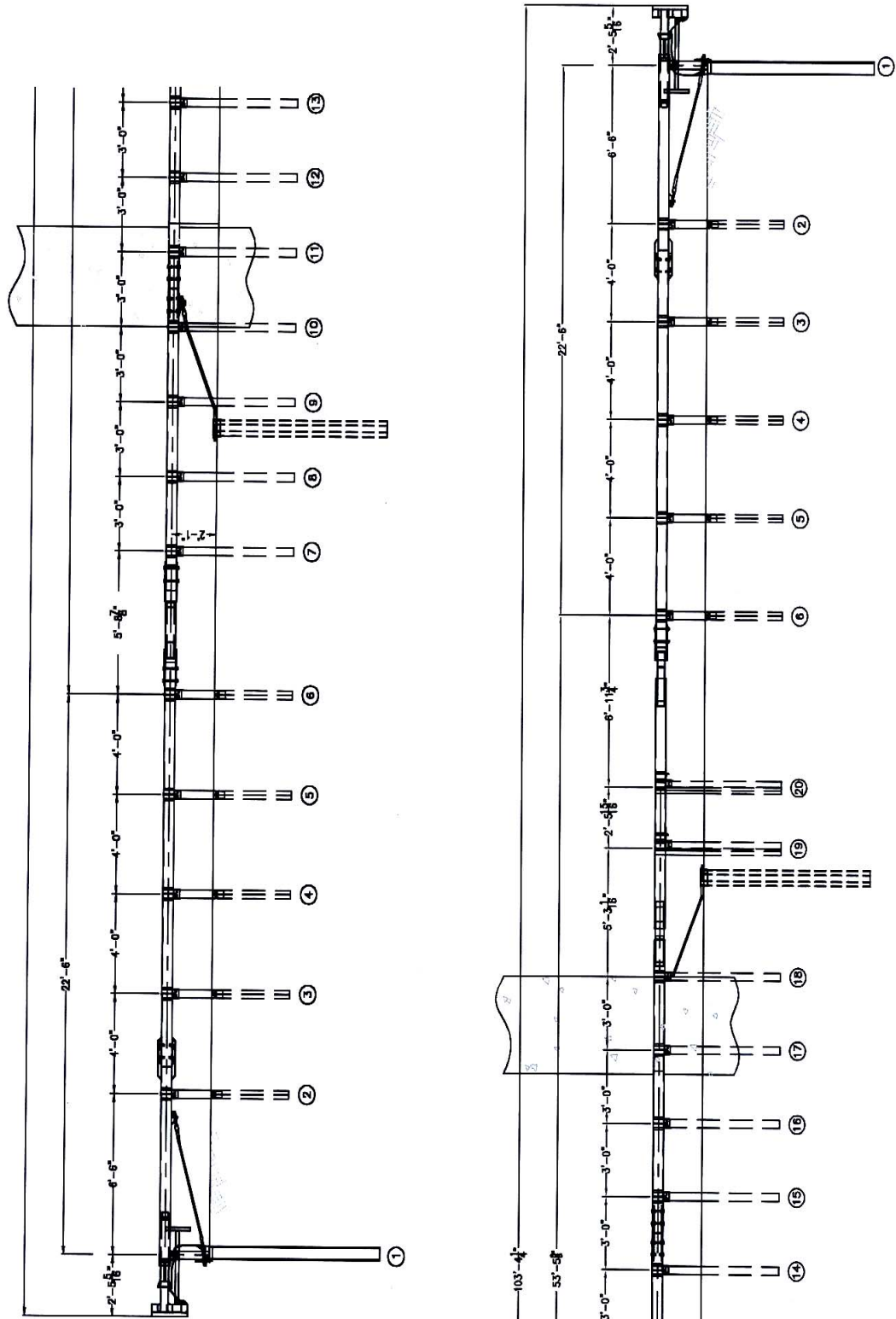


Figure 3. Elevation View of the BEAT-BP (2 Pier Application)

ITEM	QTY	DESCRIPTION
A	2	Box-Beam Impact Head
B	2	Upper End Post W6x9# x 21 1/2"
C	4	Lower End Post W6x15# x 8'-0"
D	2	Support Bracket L 4" x 2" x 4" LG.
E	2	Post Breaker Welded TS 2" x 2" x 1/4"
F	4	Cable Anchor Assembly
G	2	Cable Anchor Bearing Plate
H	2	End Tube Rail 8'-0" LG. x 1/8" THICK
J	10	Steel Breakaway Post W6x9# x 6'-0"
K**	28	Standard Steel Post W6x9# x 6'-0"
L**	22	Support Bracket TS 6" x 6" w/ Bent PL.
M	2	Second Rail 16'-2 1/2" LG.
N**	8	BP-Rail Section 11' - 11 1/2" LG.
P**	4	Extended Block 10' LG.
Q	2	"Y" Connection
R	2	Bent Splice
S**	8	Box Beam Splice Plates w/Nuts (2 per splice)
T	4	End Section Splice Channel Bent PL.
U	2	3/8" GALV. Cable 20' LG.
V**	16	Support Bracket
W**	16	Tie Plate
X	2	Anchor Plate
HARDWARE		
a	2	1/4" x 3" Hex Bolt
b	2	1/4" Hex Nut
c	4	1/4" Washer
d**	56	5/16" x 7 1/2" Hex Bolt Grade 5
e**	56	5/16" Hex Nut
f**	112	5/16" Washer
g	2	1/2" x 2" Hex Bolt Grade 2
h	2	1/2" x 5" Hex Bolt Grade 5
i	4	1/2" Hex Nut
j	4	1/2" Washer
k**	38	5/8" x 1 1/2" Hex Bolt Grade 5
m	8	5/8" x 2" Hex Bolt Grade 5
n	2	5/8" x 3" Hex Bolt Grade 5
p	8	5/8" x 6" Hex Bolt Grade 5
q	2	5/8" x 8" Hex Bolt Grade 5
r**	66	5/8" Hex Nut
s**	74	5/8" Washer
t**	32	3/4" x 2" Hex Bolt Grade 5
u	12	3/4" x 7" Hex Bolt Grade 5
v	8	3/4" x 8" Hex Bolt Grade 5
w	20	3/4" Hex Nut
x	8	1" Hex Nut Grade 5
y	8	1" Washer Grade 5
z	4	Cable Tie

** Indicates Those Items Which the Quantities Typically Vary if the BEAT-BP System is at a Location Having More or Less Than 2 Piers

Figure 4. BEAT-BP Bill of Material (2 Pier Application)

BEAT-BP Installation Procedure

[1]. Layout the Main System Envelope Surrounding the Piers

Begin the layout of the **BEAT-BP** at the longitudinal centerline of the pier (or piers) where the system will be placed and work toward both ends where the impact head joins with post #1. Each **BEAT-BP** system is sized to enclose a particular pier application. **Refer to design drawings** to determine the number of Rail Sections (Item N) and the number of Extended Blocks (Item P) required. Also see **Figure 1**. Site conditions may vary but typical requirements are:

- For 1-Pier protection system – 4 Rail Sections (Item N) & 2 Extended Blocks (Item P).
- For 2-Pier protection system – 8 Rail Sections (Item N) & 4 Extended Blocks (Item P).
- For 3-Pier protection system – 10 Rail Sections (Item N) & 6 Extended Blocks (Item P).
- For 4-Pier protection system – 16 Rail Sections (Item N) & 8 Extended Blocks (Item P).

When laying out around the piers or poles in the enclosed center portion of the **BEAT-BP**, the system may or may not be perfectly centered depending on site constraints. For any given installation, the minimum distance between the backside of the Standard Steel Posts (Item K) and the object being shielded is 8 inches. In addition, the Extended Blocks (Item P) must effectively shield the leading edge of the pole or post. This means that the Extended Blocks shall extend upstream beyond the hazard. See **Figure 2**.

Layout the main system envelope surrounding the piers to establish proper location and ensure appropriate clearances. This layout will include all the Rail Sections (Item N), the Internal Splices (Item S) the “Y” Connections (Item Q) and the Bent Splices (Item R). Use of a string line will help to keep rail sections aligned.

[2]. Install the Two 8'-0" long (W6 x 15#) Interior Anchor Posts

Install the two interior W6x 15# beam 8'-0" long Lower End Posts (Item C) at the two interior locations of the **BEAT-BP** system. The location of these anchor posts is near post location #10. Be sure to position the post to be aligned with the direction the anchor cable will be placed. See **Figure 5** for positioning details.

Be sure the post is installed with the 1 ¼" diameter hole on the top of the post located on the front upstream side which would be opposite the pier. It may be driven with a guardrail post pounder. For non-penetrable soil, drill a pilot hole and force the post to the appropriate depth by impact or vibratory means with an approved guardrail post pounder. The post may also be installed by augering and backfilling if the contractor so prefers. If augering the hole, 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.* See section in back of this manual for “Installation Recommendations When Rock is Encountered”.

[3]. Install the 6'-0" long Standard Steel Posts

Using the Rail Sections (system envelope) as a guide, install the 6'-0" long Standard Steel Posts (Item K) with their front faces offset 6" from the back of the Rail Section in the enclosed center portion of the **BEAT-BP**. This 6" will allow for the blockouts.

- For 1-Pier protection system – Item K is post locations #7-12 at both sides of the pier.
- For 2-Pier protection system – Item K is post locations #7-20 at both sides of the piers.
- For 3-Pier protection system – Item K is post locations #7-24 at both sides of the piers.
- For 4-Pier protection system – Item K is post locations #7-36 at both sides of the piers.

All of the interior Standard Steel Posts (Item K) should be laid out in a straight line as described in the applicable design drawing. Note that the installation should be generally parallel to traffic. These Standard Steel Posts (Item K) are spaced at 3'-0" centers and shall be in-line with the Breakaway Posts (Item J) at locations #2-6. This will allow alignment with the 16'-2 ½" long Second Rail Tube (Item M). . **Refer to design drawings** to determine placement of posts.

The two interior Standard Steel Posts supporting the Diagonal Tubes (Item N) at each end of the main system envelope surrounding the piers are also spaced at 3'-0". These posts should be aligned with the Diagonal Tube and also offset 6" from the back from the tube.

The posts should be driven with a guardrail post pounder. For stiff soils, drill a pilot hole and force the post to the appropriate depth by impact or vibratory means with a guardrail post pounder. The post may also be installed by augering and backfilling if the contractor so prefers. If augering the hole, 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.*

[4]. Install Rail Support Brackets Supporting Extended Blocks

Install Rail Support Brackets (Item V) at the interior posts (Item K) that support the 10-ft long Extended Blocks (Item P) in front of the piers. These are bent plate brackets. This assembly will provide a shelf to place both the Extended Blocks and Rail Sections in front of the piers. The support brackets are attached to the posts with a 5/8"x 1 ½" hex bolt, nut and washer.

See **Figure 6** for details.

[5]. Install Support Brackets NOT Supporting Extended Blocks

Install Rail Support Brackets (Item L) at the interior posts that do **"not"** support the 10-ft long Extended Blocks in front of the piers. These bent plate brackets have a short section of tube welded to them. This assembly will create a 6" offset from the post to the box beam rail section and provide a shelf to place the Rail Sections in front of the piers. The support brackets are attached to the posts with a 5/8"x 1 ½" hex bolt, nut and washer. See **Figure 7** for details.

[6]. Install Extended Blocks

Place the 10-ft long Extended Blocks (Item P) on both sides of the system in front of all of the piers. The Extended Blocks shall extend upstream beyond the hazard at least 1 full post spacing. These rail sections will be attached to the post Support Brackets (Item V) with a Tie Plate (Item W) in a later step (step 16). See **Figure 8** for details.

[7]. Connect Internal Splice Plates and Standard Rail Sections

Connect Internal Splice Plates (Item S) to the ≈12-ft long Rail Sections (Item N). Note that this does not apply for 1-pier protection system since there is only one Rail Section (Item N) per side. Place the Rail Sections on the interior Standard Steel Posts (Item K). The Splice Plates have 3/4" hex nuts welded on. Use 3/4" x 2" hex bolts to make the connection. It may be helpful to use clamps to prevent the rail sections from falling prior to bolting. See **Figure 9** for details. Connect the tubes to the Support Brackets. The connection is made using 5/16" x 7 ½" hex bolts, nuts and 2 washers.

[8]. Connect Bent Splice Connection

Connect the Bent Splice Connection (Item R) to the two downstream Rail Sections (Item N). Use 3/4"x 7" hex bolts and nuts to make the connection. See **Figure 10** for details.

[9]. Install Diagonal Tubes

Install the ≈12-ft long Diagonal Tubes (Item N) at both ends of the enclosed center portion using the Bent Splice Connections (Item R). Use 3/4"x 7" hex bolts and nuts to make the connection. See **Figures 10 & 11** for details.

[10]. Connect the “Y” Splice Connection

Connect the “Y” Splice Connection (Item Q) to the two upstream Rail Sections (Item N) and to the Diagonal Tube (Item N). Note that the Diagonal Tube will slip past the bolt holes on the Y Splice Connection making it easier to get the rail on the Bent Splice Connection. Use 3/4"x 8" hex bolts and nuts to make the connection to Rail Sections (Item N). Use 3/4"x 7" hex bolts and nuts to make the connection to Diagonal Tube (Item N). See **Figures 11 & 12** for details.

[11]. Install the 6'-0" long (W6 x 9#) Breakaway Posts

Install the 6'-0" long (W6 x 9#) Breakaway Plug Welded Posts (Item J) at locations #2-6 at both ends. These posts shall be installed in-line with the interior Standard Steel Posts (Item K). Layout a string line and mark off the required post spacing. See **Figures 2 & 13** for layout.

The posts should be driven with a guardrail post pounder. For stiff soils, drill a pilot hole and force the post to the appropriate depth by impact or vibratory means with a guardrail post pounder. The post may also be installed by augering and backfilling if the contractor so prefers. If augering the hole, 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.*

[12]. Install the 8'-0" long (W6 x 15#) Lower End Post #1

Install the 8'-0" long (W6 x 15#) Lower End Post #1 (Item C) section at both ends. The first post is spaced 6'-6" from post #2 and consists of an upper and lower section. The lower section is a W6x 15# beam 8'-0" long. Post #1 must be positioned in-line with the centerline of the 6"x 6" box beam rail sections. The centerline of post #1 will be offset 12" from the centerline of post #2.

Be sure the lower post is installed with the $\frac{3}{4}$ " diameter holes on the top of the post located on the front upstream side opposite post #2. See **Figure 14** for details. It may be driven with a guardrail post pounder. For non-penetrable soil, drill a pilot hole and force the post to the appropriate depth by impact or vibratory means with an approved guardrail post pounder. The post may also be installed by augering and backfilling if the contractor so prefers. If augering the hole, 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.* See section in back of this manual for "Installation Recommendations When Rock is Encountered".

[13]. Install the 1'-9 ½" long (W6 x 9#) Upper End Post #1

Install the 1'-9 ½" long (W6 x 9#) Upper End Post #1 (Item B) section to the Lower End Post #1 (Item C) section at both ends of the **BEAT-BP** system. Align the $\frac{3}{4}$ " diameter holes in the upper and lower post sections and attach the upper post section to the lower post section using one 5/8"x 8" hex bolt, nut and washer. See **Figure 14** for details.

[14]. Install Rail Support Brackets at Post Locations #2-6

Install Rail Support Brackets (Item L) at post locations #2-6. These bent plate brackets will have a short tube welded to it. This assembly will create a 6" offset from the post to the box beam rail section and provide a shelf to place the box beam rail. The support brackets are attached to the posts with a 5/8"x 1 ½" hex bolt, nut and washer. See **Figure 15** for details.

[15]. Attach Anchor Plate at the Underside of Rail Section

Attach Anchor Plate (Item X) at the underside of the ≈12-ft long Rail Section (Item N) which is located near post #10 at both sides of the system. Use the 3/4" x 2" hex bolts from the Internal Splice Plates (Item S) to make the connection. The Splice Plates have 3/4" hex nuts welded on. See **Figure 5** for details.

[16]. Attach Tie Plates at Posts Supporting Extended Blocks

Attach 11 ½" x 3 ½" x 3/16" Tie Plates (Item W) at posts that support the 10-ft long Extended Blocks (Item P) in front of the piers. These tie plates are used at the top of the tubes to connect the tubes to the Support Bracket. The connection is made using 5/16" x 7 ½" hex bolts, nuts and 2 washers. See **Figure 16** for details.

[17]. Install the 16'-2 ½" long Second Rail Tube

Install the 16'-2 ½" long Second Rail Tube (Item M) at posts #3-6 at both ends. This tube will connect to the "Y" Splice Connection (Item Q) using ¾"x 8" hex bolts and nuts. Attach this rail to the support brackets that are bolted to posts #3 to #6 using 5/16"x 7 ½" hex bolts, nuts and 2 washers. See **Figure 13** for details.

[18]. Install the 8'-0" long End Rail

Install the 8'-0" long End Rail (Item H) at posts #1 & 2. This end tube section is a specially fabricated 1/8" thickness tube as supplied by the manufacturer and has notches cut at the approach end where the impact head is placed. At this point all of the downstream 6"x 6" box beam barrier and posts should be in place. Attach the 8 foot long 6"x 6" x 1/8" end tube section to the 6"x 6" x 3/16" second rail tube section as described below in step 20. Attach the end tube to post #2 support bracket using a 5/16"x 7 ½" hex bolt, nut and 2 washers. See **Figure 13**.

[19]. Install Support Bracket at Post #1

Install the 4" x 2" x 4" long Support Bracket (Item D) at post #1 at both ends. The end tube is attached to post #1 using this 4"x 2" x 4" long bent plate Support Bracket and a 5/16"x 7 ½" hex bolt, nut and 2 washers. This support bracket is attached to post #1 with a ½"x 2" hex bolt, nut and 2 washers. See **Figure 14**. Do not attach the end tube to the support bracket until the impact head is installed as the bolt also passes through the impact head.

[20]. Connect the End Rail Tube to the Second Rail

Connect the End Rail tube (Item H) to the Second Rail tube (Item M) using End Splice Channel (Item T). This splice uses 4 each 5/8"x 2" hex bolts with (2) nuts and (2) washers at the inside of the second rail tube connection. Install this double-nutted splice section to the leading end of the Second Rail tube (Item M) prior to putting the first rail section into place. Connect the bent plates welded to the end of the End Rail tube (Item H) using 5/8"x 6" hex bolts, nuts and (2) washers. See **Figure 17** for additional details.

[21]. Install **BEAT-BP** Box Beam Impact Head

Install **BEAT-BP** Box Beam Impact Head (Item A) at both ends. Place the impact head inside the End Rail tube (Item H). The impact head should be positioned so the holes at the end of the tube and the hole in the impact head are aligned. Also be sure the impact head is inserted into the end tube section with the large triangular gusset plates facing down. Attach the end tube to impact head using a 5/16"x 7 ½" hex bolt, nut and 2 washers. See **Figure 14**.

Note. It is recommended that the front face of the impact head be delineated with an object marker that meets local specifications for better night visibility. The impact face object marker is included as part of the shipped materials for the **BEAT-BP**.

[22]. Install Post Breaker

Install Post Breaker (Item E) at both ends. Attach the post breaker to the back (non-traffic) side of post #1 with a 5/8"x 3" hex bolt, nut and washer and a 1/4"x 3" hex bolt, nut and washer. See **Figure 14**.

[23]. Install Tether Cable

Install Tether Cable (Item U) at both ends. The tether cable will arrive bundled into a "figure-8" with two free ends that each has swaged loops. **DO NOT CUT THE TIE ON THE CABLE.** Attach the shorter free end ($\approx 28"$) to the lower backside of the impact head by putting the end loop through the slot in triangular gusset plates and passing a 1/2"x 5" hex bolt through the loop. Secure the bolt with a nut. Attach the "figure-8" to the back of the impact head using the provided cable ties passing through the upper and lower gusset notches as shown in **Figure 14**. Finally, pass the longer free end of the bundle ($\approx 50"$) above the post-breaker around post one and pass the anchor cable through the end loop prior to attaching the anchor through post #1, as shown in **Figure 14**.

[24]. Install Cable Anchor Assembly and Bearing Plate at Post #1

Install Cable Anchor Assembly (Item F) with Bearing Plate (Item G) at post #1 (total 2 places). Place the cable assembly through the lug welded to the underside of the end tube near post #2. See **Figure 18**. The other end of the anchor cable will pass through the tether cable loop and through post #1. (See above for **tether cable** attachment). Place the bearing plate at the base of post #1 with the 5" dimension up and the 3" dimension down. Secure both ends of the cable assembly with a 1" hex nut and washer. While tightening the nuts at the end of the cable, restrain the cable at the end being tightened to avoid twisting the cable.

[25]. Install Cable Anchor Assembly at Lower Interior End Posts

Attach one end of Cable Anchor Assembly (Item F) to the Anchor Plate (Item X) at the underside of the ≈ 12 -ft long Rail Section (Item N) near post #10. The other end of the anchor cable will pass through the 1 1/4" hole at the top of the interior anchor post. Secure both ends of the cable assembly with a 1" hex nut and washer. While tightening the nuts at the end of the cable, restrain the cable at the end being tightened to avoid twisting the cable. See **Figure 5**.

Upon completion of the installation, the cable should be taut.

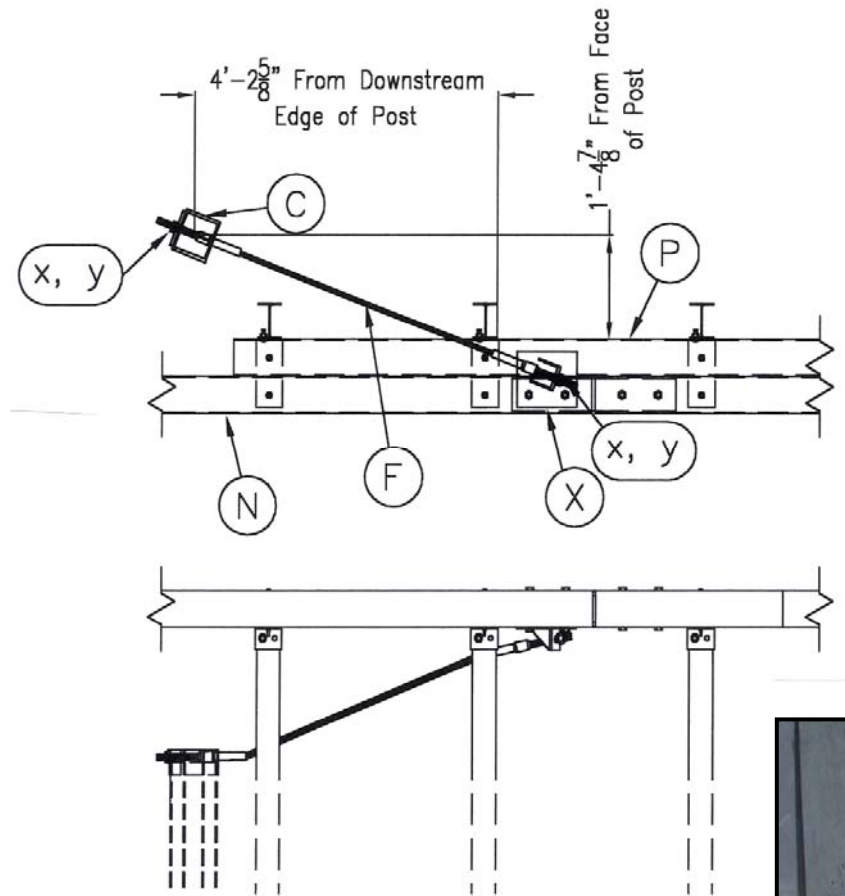


Figure 5. Interior Anchor Detail for the BEAT-BP

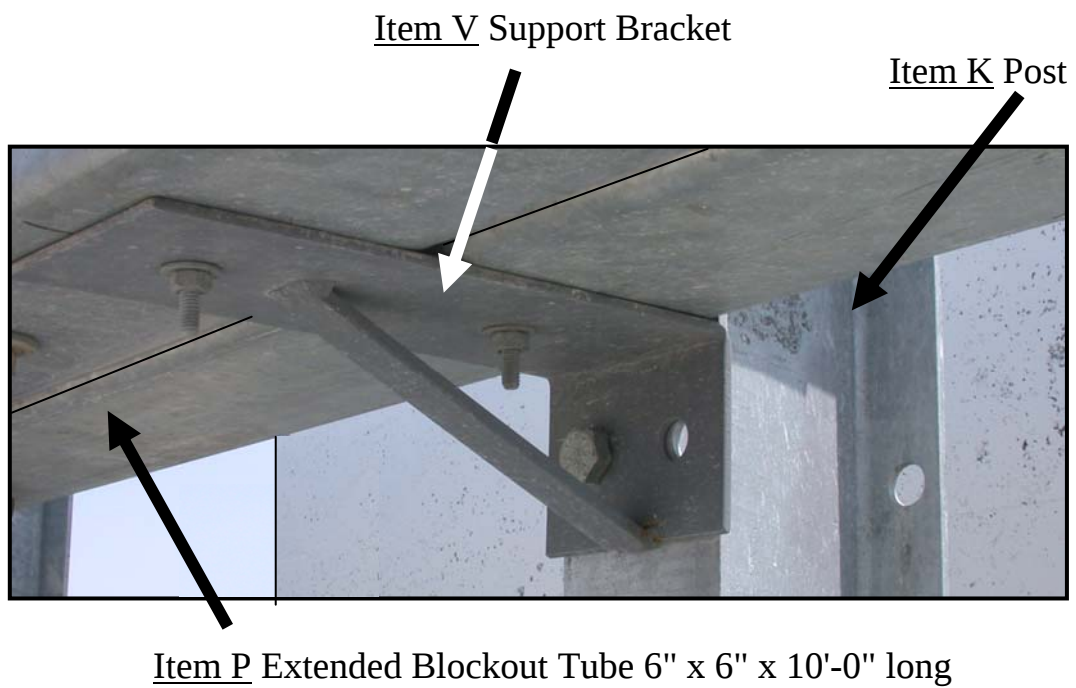
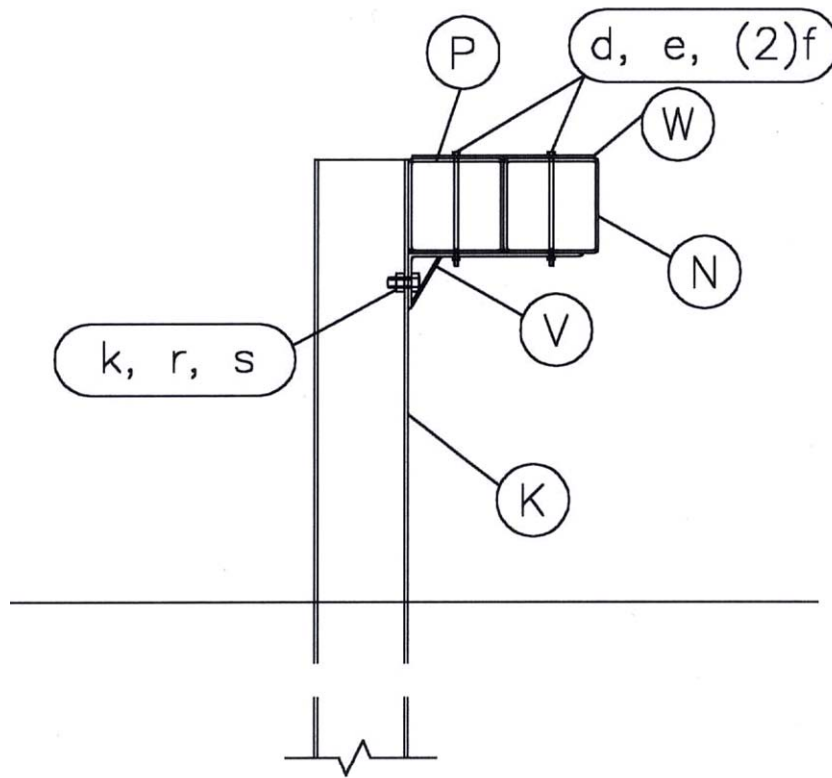
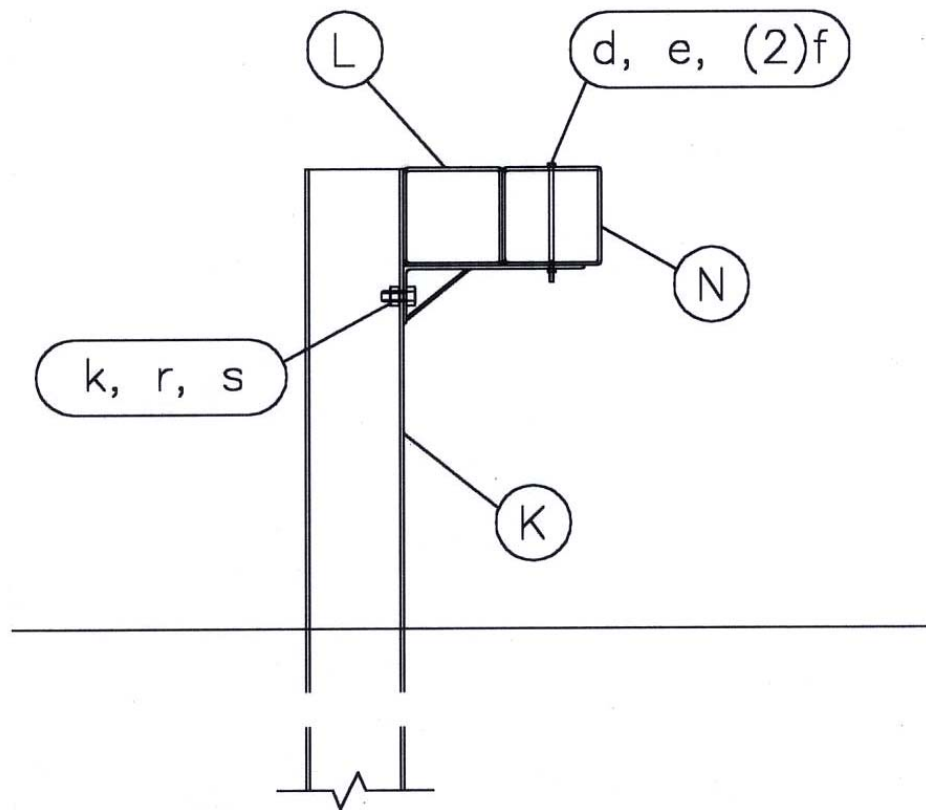


Figure 6. Rail Support Brackets at Interior Posts (Extended Blocks) for the BEAT-BP



Item L
Support Bracket w/
Blockout Tube

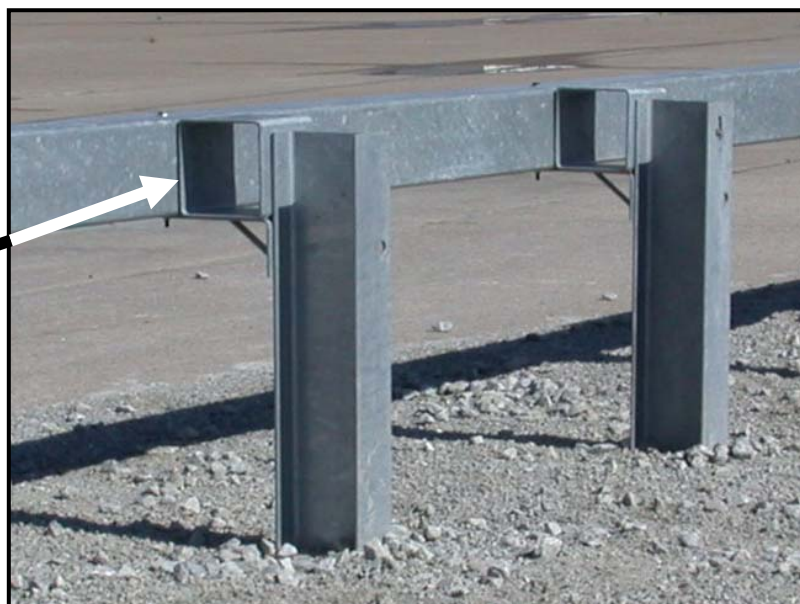


Figure 7. Blocked Rail Support Brackets at Interior Posts for the BEAT-BP

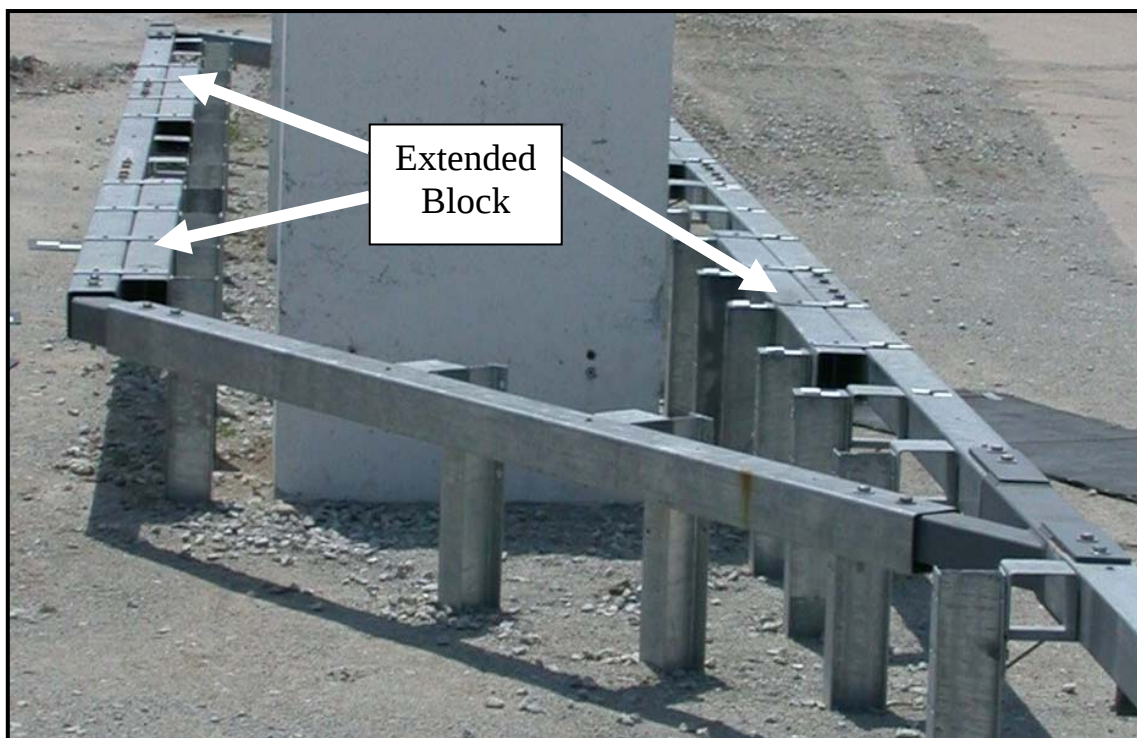
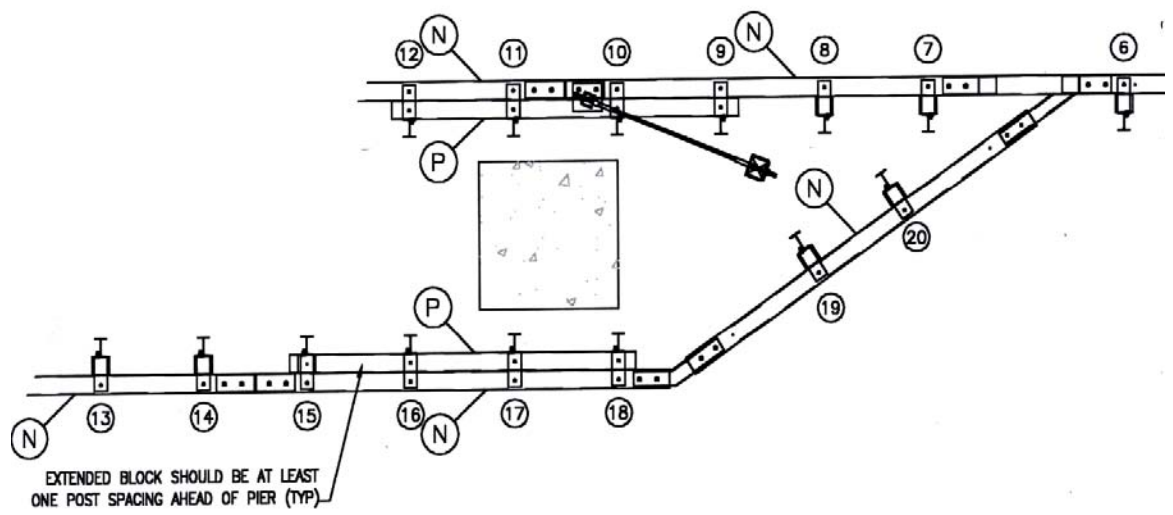


Figure 8. Extended Block for BEAT-BP

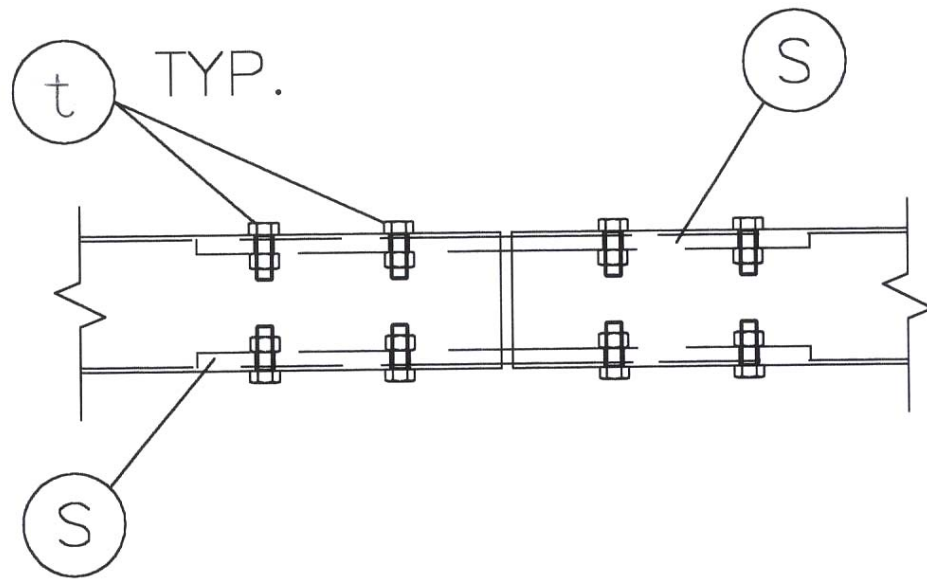


Figure 9. Internal Splice Detail for the BEAT-BP

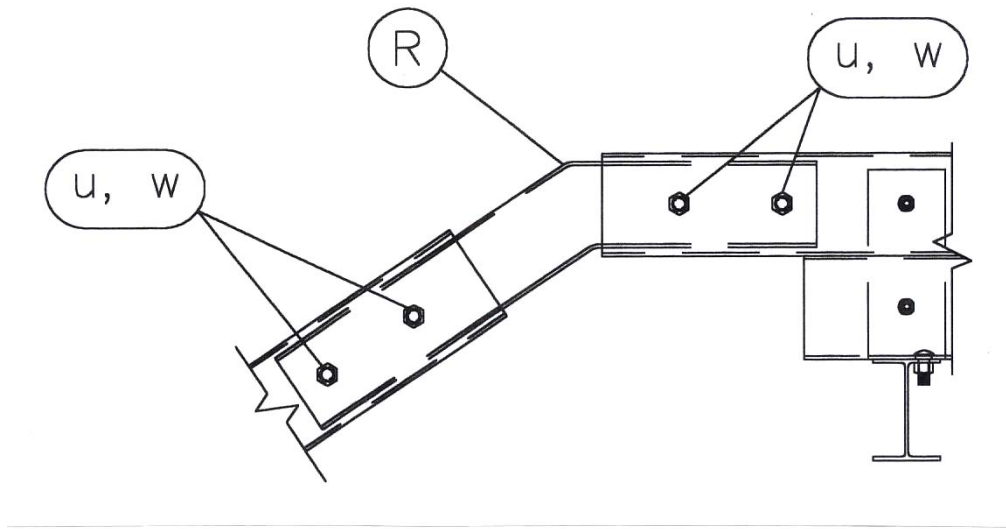


Figure 10. Bent Splice Connection for BEAT-BP

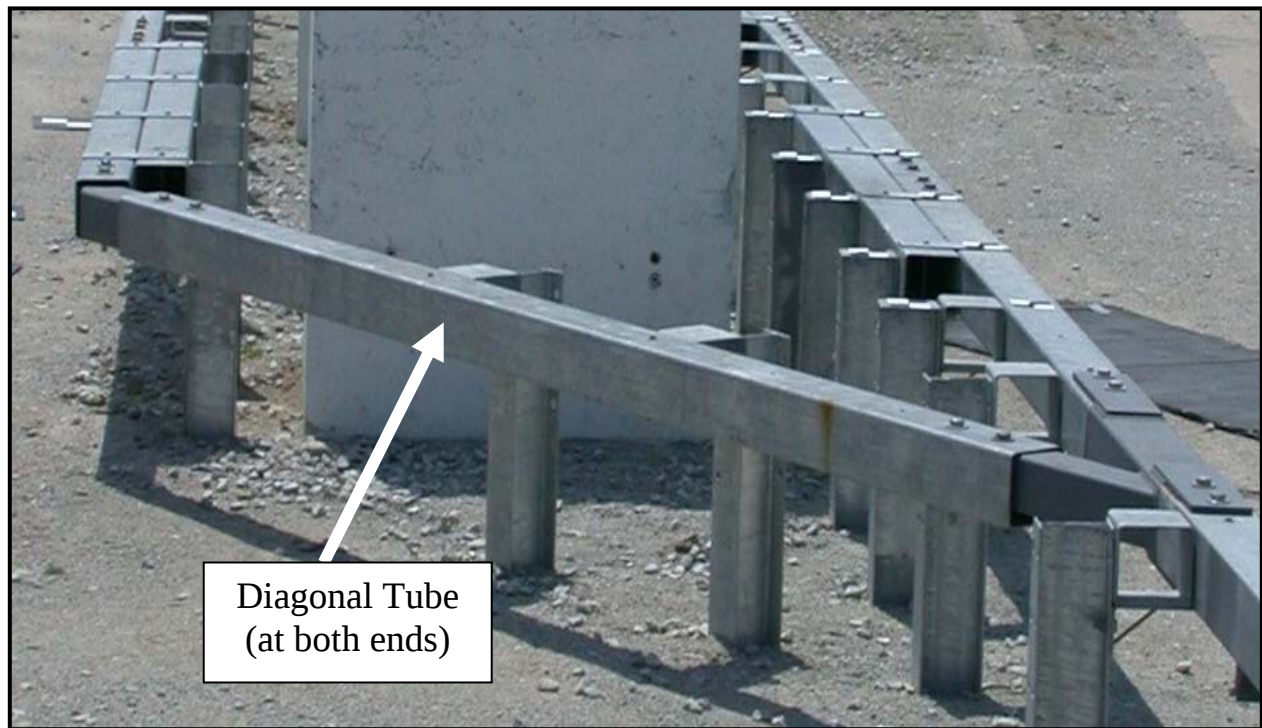
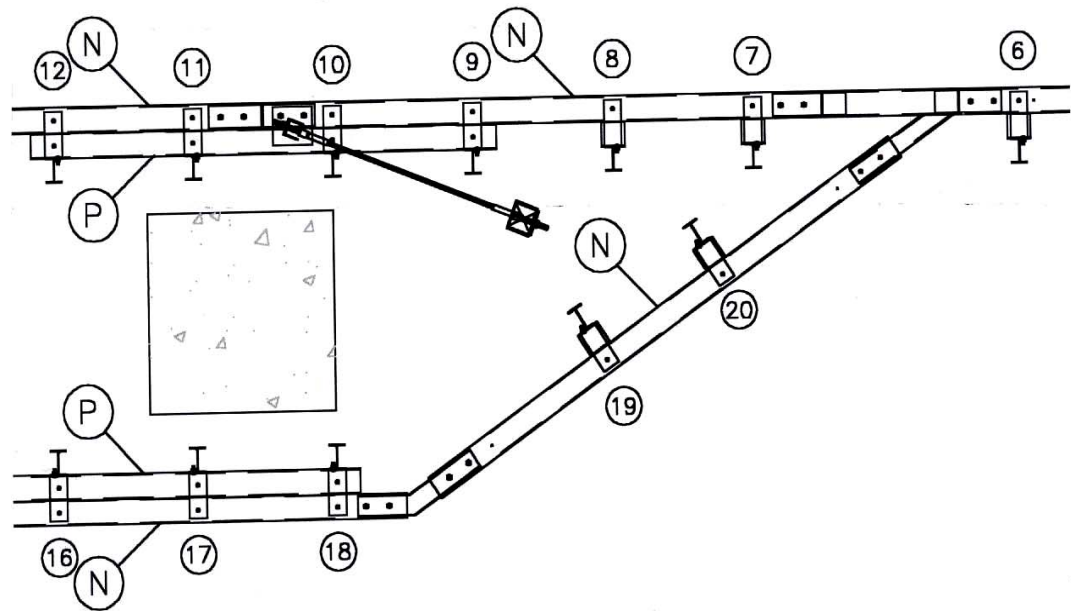


Figure 11. Diagonal Tubes for BEAT-BP

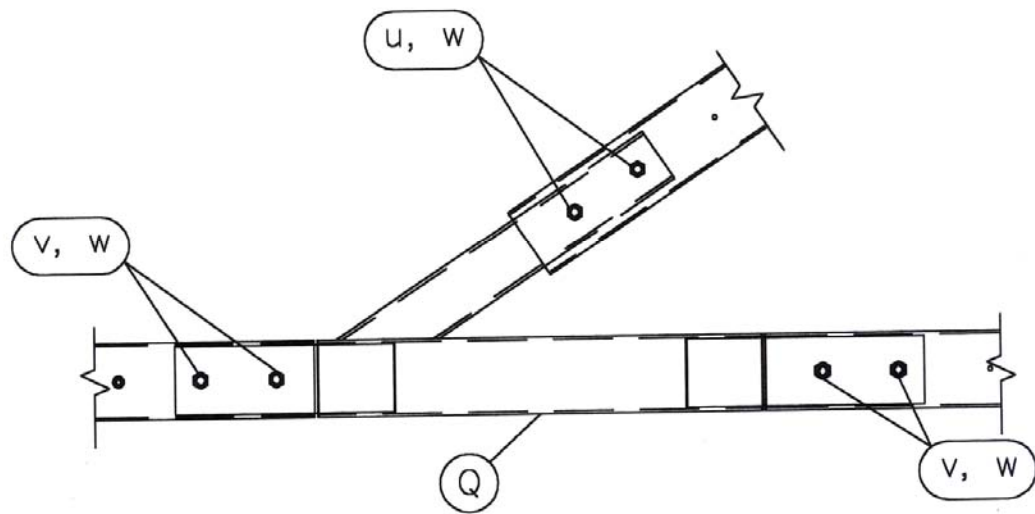


Figure 12. Y Splice Connection for BEAT-BP

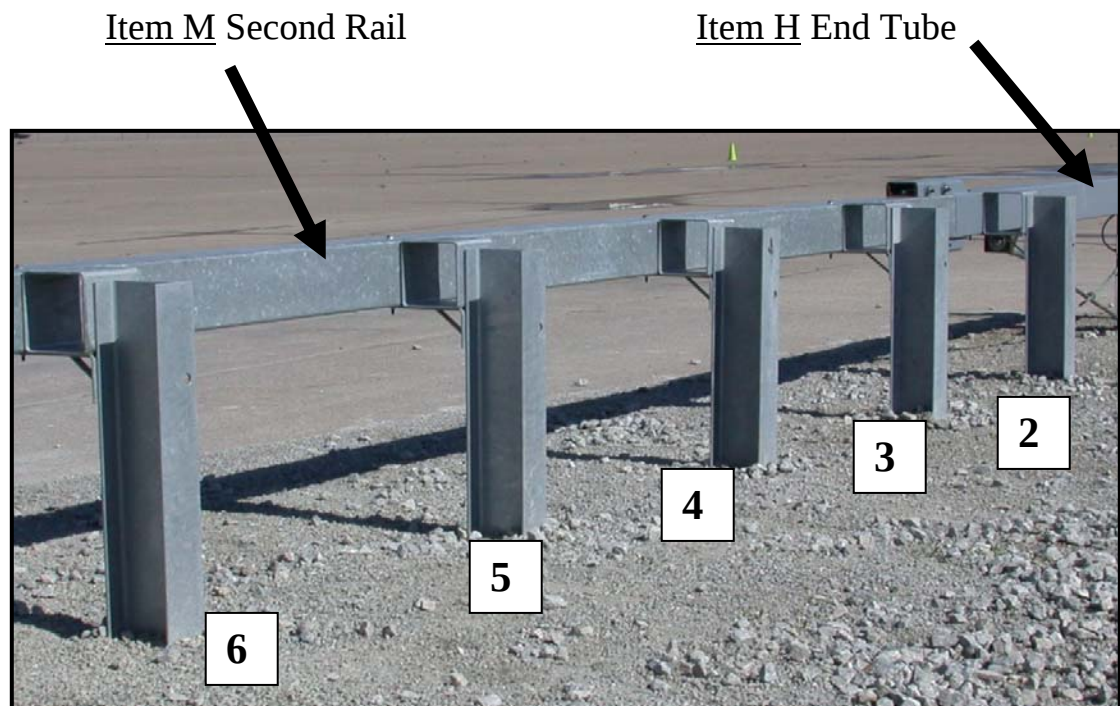
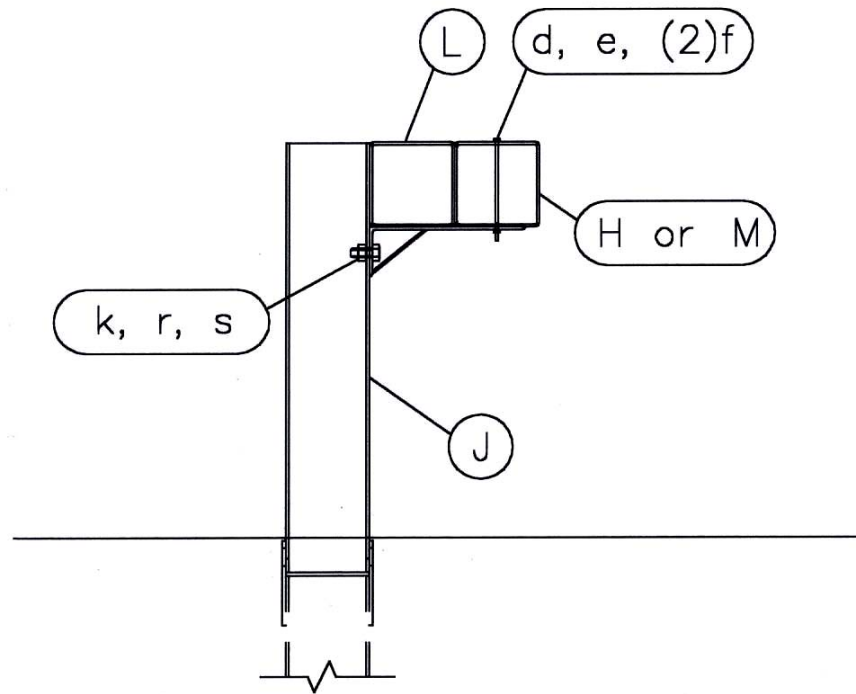
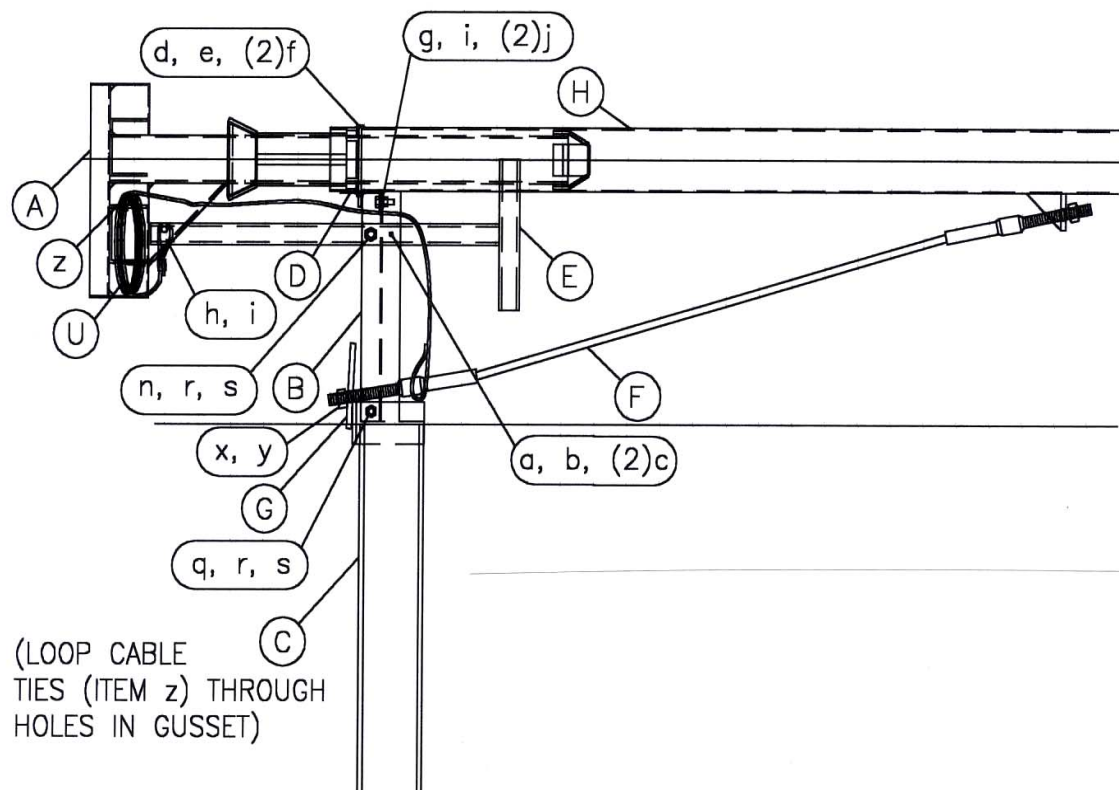


Figure 13. Breakaway Plug Welded Posts for BEAT-BP



Note: Post Breaker (Item E) is to be Placed on the Back (Non-Traffic) Side of Post

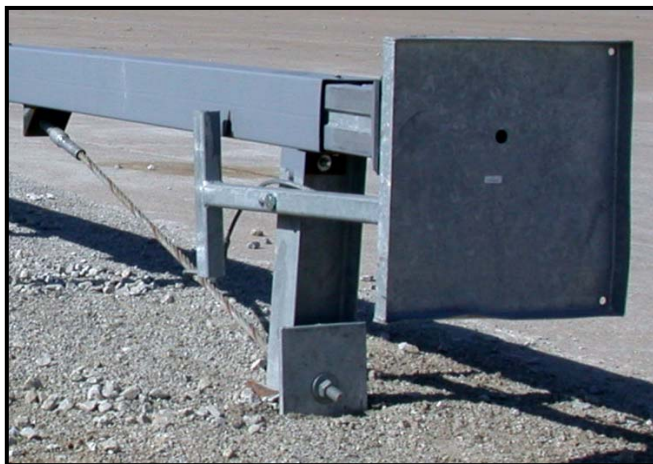


Figure 14. Impact Head, Post #1, Post Breaker, Tether Cable for BEAT-BP

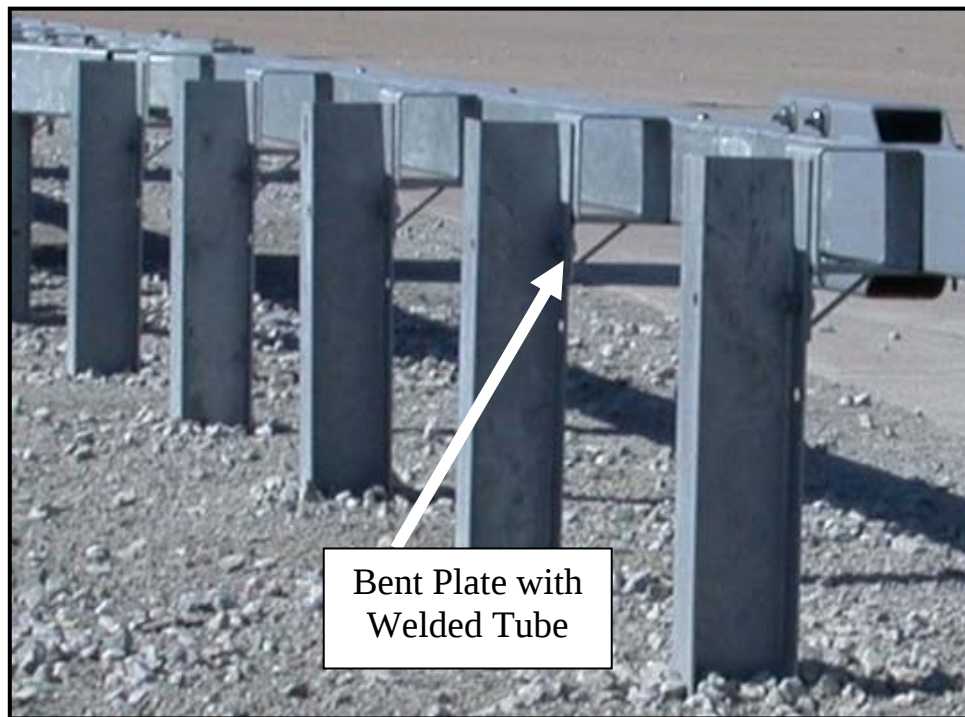
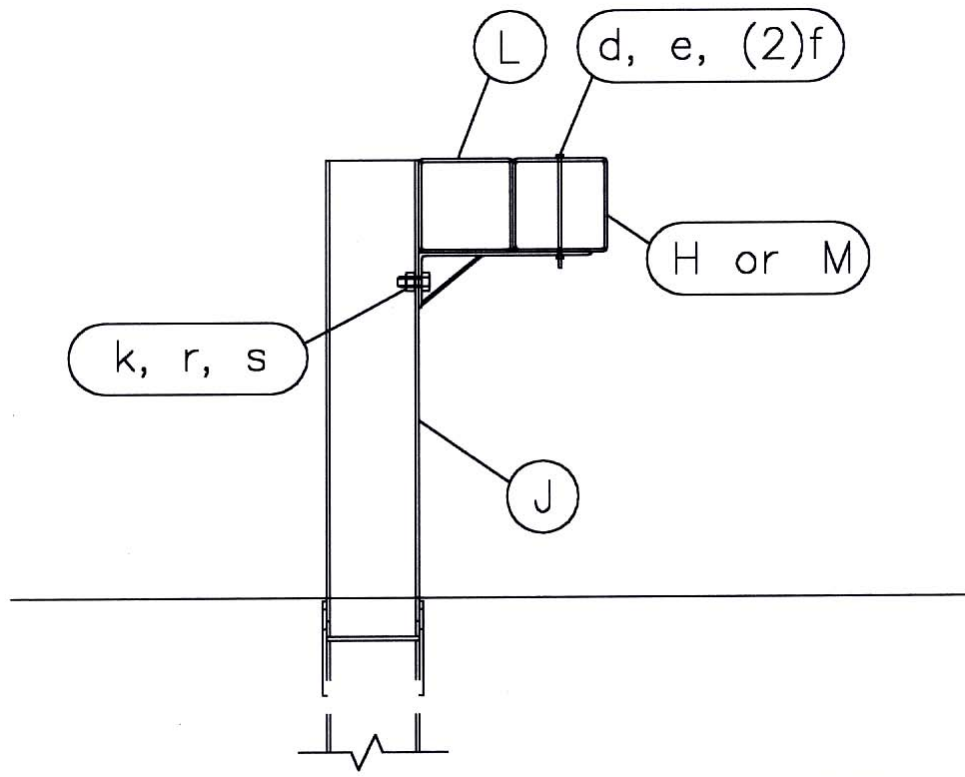


Figure 15. Rail Support Brackets at Posts #2-6 for BEAT-BP

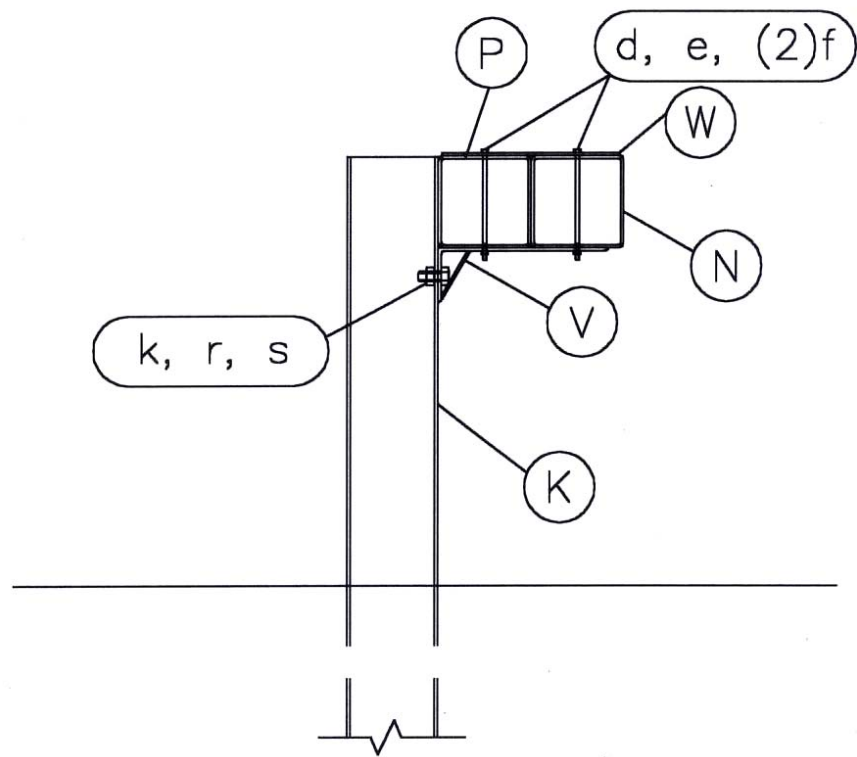
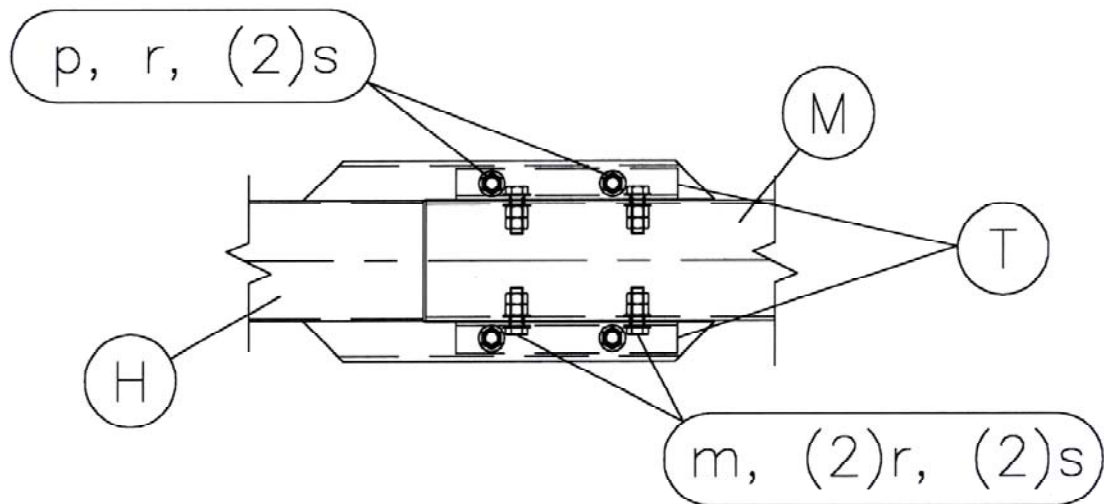


Figure 16. Tie Plate Connection for BEAT-BP



Item H End Tube section has bent plates welded to the end of the tube. These bent plates will set on top of Item T Splice Channels as shown.

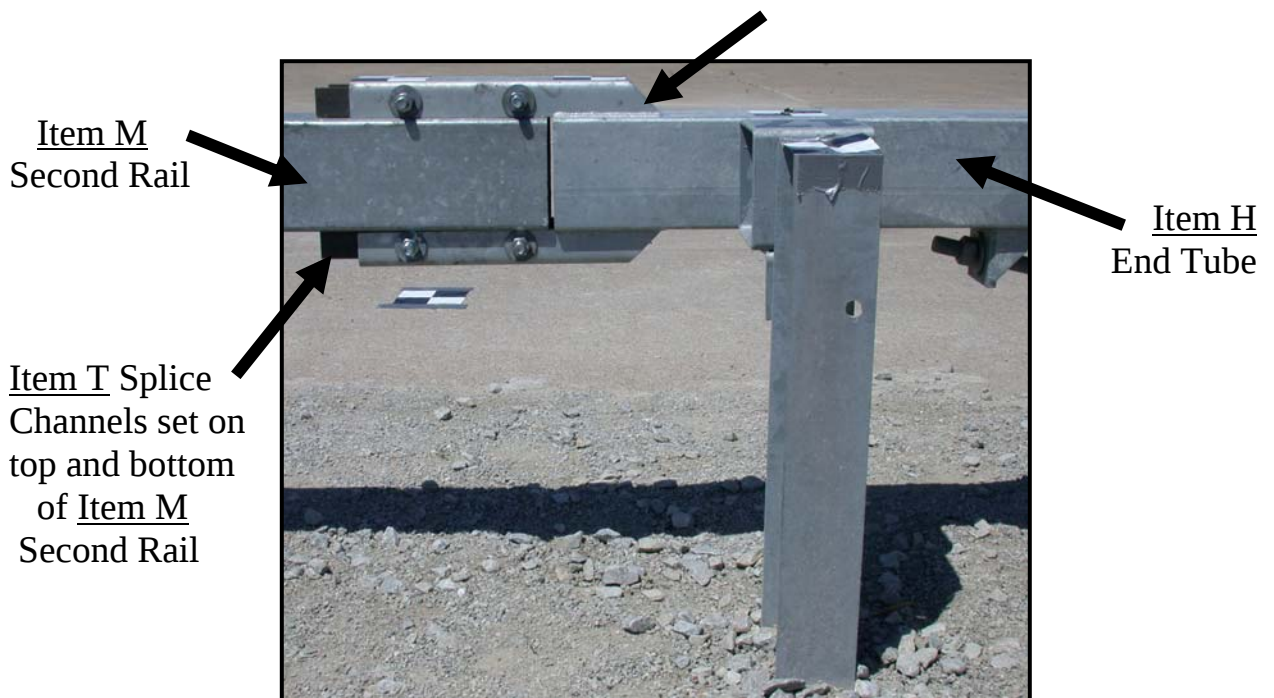


Figure 17. End Splice Channel Connection for BEAT-BP

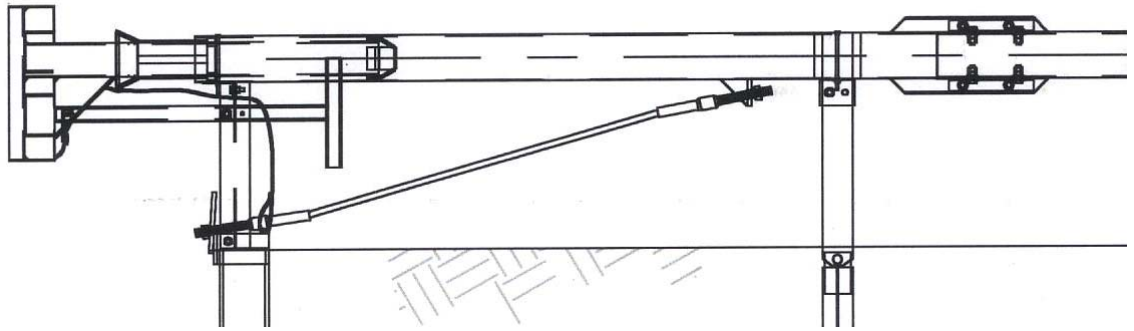


Figure 18. Cable Anchor Assembly at Post #1 for BEAT-BP

BEAT-BP Installation Inspection Checklist

State: _____

Date: _____

Project #: _____

Inspection performed by: _____

Location: _____

- ☐ The approach area in front of the **BEAT-BP** system is free of fixed objects and has a fill slope or cut slope of 10:1 or flatter.
- ☐ The **BEAT-BP** 6"x 6" x 3/16" extended block tube sections effectively shielding the leading edge of each pier.
- ☐ The minimum distance between the backside of the standard steel posts and the object being shielded is 8 inches.
- ☐ The top rail height of the 6"x 6" box beam tubing is 2'-4".
- ☐ The 6"x 6" end tube section is the special 1/8" thickness tube as supplied by the manufacturer with notched corners at the approach end where the impact head is placed.
- ☐ The end tube section is bolted to the second rail tube with the special end splice channel.
- ☐ The "Bent", the "Y" and the "Internal" splices are secured with the proper hardware.
- ☐ The first 6 posts at both ends are breakaway. All posts have proper support bracket:
 - Post #1 is centered under the rail and has a support bracket only with no blockout.
 - Posts #2-6 & posts without extended block have support bracket/blockout weldment.
 - Posts with extended block in front of piers have bent plate support brackets.
- ☐ The box beam tubing is attached to all rail support brackets with a 5/16" x 7 1/2" hex bolt.
- ☐ The rail support brackets are attached to posts with proper hardware:
 - Post #1 only support bracket bolt is 1/2"x 2" hex bolt
 - All other posts support bracket bolts are 5/8" x 1 1/2" hex bolt
- ☐ The upper and lower sections of post #1 are properly connected with a 5/8"x 8" hex bolt.
- ☐ The tie plates are properly attached at the extended blocks in front of the piers.
- ☐ The impact head is properly inserted into the end tube section with the large triangular gusset plates facing down. The bottom of the impact head is approx 12" above ground.
- ☐ The post breaker is on the approach back side of post #1 and stabilized with two bolts.
- ☐ 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.
- ☐ The interior anchor cable is properly attached to interior anchor posts and anchor plate.
- ☐ The tether cable is properly attached to restrain the impact head.
- ☐ If the posts were augered, be sure the backfill material around the posts is compacted.

Additional notes: _____

Installation Recommendations

When Rock is Encountered on the BEAT-BP System

The following recommended installation procedures are intended for installations where bedrock is encountered at a depth shallower than the eight-foot length post embedment for BEAT-BP post #1 and the interior anchor posts. When cobbles or loose rock is encountered that prevents driving the first post to full depth, it is necessary to auger to full depth or follow the "Alternative Foundation Using Concrete" option shown below. Concrete shall not be used at any other BEAT-BP posts.

In installations where bedrock is encountered at the depths indicated below, it will be necessary to core into the rock for the following depths. This cored hole should be 10" in diameter. The installer should assure that the rock removed out of the cored hole is reasonably solid rock.

<u>Surface of Rock</u>	<u>Required Core Depth Below Rock Surface</u>
0 to 2'	36"
2' to 4'	24"
4' to 7'	12"
7' to 8'	Core to 8'

The post may then be shortened by cutting the bottom of the post. Place granular material in the bottom of the hole so that the base rests 2.5" from the bottom of the cored hole. Cold galvanize paint the cut surfaces.

The post shall be placed in the hole and backfilled with adequately compacted material. If preferred, this post #1 may be backfilled with concrete.

These depths will provide sufficient anchorage to provide system redirection capacity and prevent the post from being pulled vertically from the ground during impact.

Alternative Foundation Using Concrete

If the BEAT-BP post #1 or the interior anchor posts have reached a minimum depth of 48" and cannot be driven further, the following options may be followed for installation in an augered hole:

<u>Depth of Augered Hole</u>	<u>Diameter of Augered Hole</u>	<u>Concrete Depth</u>
48" to 67"	24" Diameter	Bottom 36" of hole
68" to 95"	12" Diameter	Bottom 24" of hole

NOTES

[illegible]