



Department of Transportation

ENGINEERING
INSTRUCTION

EI
22-024

Title: **HIGH-TENSION CABLE GUIDE RAIL SYSTEMS – DESIGN GUIDANCE**

SUPERSEDED BY EB 26-015
EFFECTIVE 12/31/26

Approved:

Richard D. Wilder, P.E.
Deputy Chief Engineer, Design

9/16/2022

Date

ADMINISTRATIVE INFORMATION:

- Effective Date: This Engineering Instruction (EI) is effective immediately upon signature.
- Modified Issuances: EI 20-007, “*MASH-Compliant Cable Barrier Systems - Design Guidance*”
- This EI is being issued concurrently with EI 22-025 “*High-Tension Cable Guide Rail Systems-Specifications*”.
- Disposition of Issued Materials: The design guidance will be incorporated into Chapter 10 of the Highway Design Manual. The attached illustrations of foundation options will be linked from the Approved List for 710-22B, “High-Tension Cable Barrier Systems”.

PURPOSE: To announce restrictions on and customized details for the Brifen and Gibraltar cable guide rail systems that are acceptable for new installations in New York State.

TECHNICAL INFORMATION:

- Two proprietary, MASH-compliant, high-tension cable guide rail systems, the Brifen and the Gibraltar, are now available for use on NYSDOT projects. However, some specific adaptations are required.
 - Direct driven posts are to be used. Socketed line posts are not permitted. The details of these proprietary posts are accessible from links in the [Approved List](#).
 - The normal post spacing for installations are to be 10 feet to limit typical TL-3 deflections to 11 feet or less.
 - End anchorage capacities need to be approximately proportional to the tension in the cables and the number of cables. Beyond the design tension, the tension in the cables will vary with the air temperature. The manufacturers’ tension criteria at 50°F are 4203 pounds for Brifen and 6200 pounds for Gibraltar.
 - At the contractor’s option, end anchorage may be provided by either anchor blocks or caissons. Concrete block anchors are to be a minimum of 4’ wide and 5’ deep. Normally, the choice to use anchor blocks or caissons will be at the contractor’s option. If the Designer encounters a situation where either only a block or only a caisson will be acceptable, that limitation should be included in the special conditions of the contract documents.
 - For the Brifen system, the anchor blocks are to be a minimum of 12 feet long.
 - For the more highly tensioned Gibraltar system, the anchor blocks are to be a minimum of 16 feet long. Caissons are to be 10’ deep and 3’ in diameter.
- Because of the high installed cost of the end anchors, designers should avoid specifying runs of high-tension cable less than 500 feet in length.
- As with NYSDOT’s generic cable guide rail, the distance between anchors should not exceed 2,000 feet.
- High-tension cable guide rail should not be installed where the radius of curvature of the run will be less than 500 feet as the tension may cause the posts to lean towards the inside of the curve.
- Because of the high tensions involved, contractors must wait a minimum of seven days after

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cast-in-place end anchors have been cast before tensioning the cables. Additional curing time may be required by the manufacturers.

- Shoulder breaks to slopes steeper than 1:3 should be a minimum of 4 feet behind the posts.
- The post spacing should be reduced to 5 feet. Where shoulder breaks to slopes steeper than 1:3 are closer than 8 feet behind posts.
- New Approved Lists, 710-22A and 710-22B, have been added for medium-tension and high-tension cable guide rail systems, respectively.
 - The Department's generic three-cable barrier with the top cable at a height of 29" is the only medium-tension system on List 710-22A. New installations should only be made on medium- and low-speed highways, specifically those with posted speed limits of 45 mph or less.
 - The Brifen and Gibraltar systems appear on the 710-22B Approved List for High-Tension Cable Barrier Systems and may be used on highways without regard to posted speed.
- The net cost effects are expected to be low, as the rate of use for high-tension cable has been quite low. The elimination of the sockets should reduce costs.
 - The Brifen system had requirements for geotechnical exploration and evaluation. To eliminate the uncertainties and delays caused by those requirements, the Department has chosen to adopt anchor designs that are intended to accommodate reasonable worst-case conditions. The elimination of exploration and testing should result in lower bid prices for installations of the Brifen high-tension cable guide rail.
 - The increased anchor requirements for the Gibraltar should slightly increase its bid prices.
- EI 20-007 is modified with regard to in-kind repair/replacement of damaged runs. Specifically, on any NYSDOT runs, damaged posts are to be replaced with S3x5.7 posts of the required height.

IMPLEMENTATION:

- DQAB will link the relevant proprietary documents from the Materials Details section of the product listings on the [710-22B Approved List](#).
- When considering the use of a proprietary high-tension cable barrier system on NYSDOT projects, Bidders should obtain quotes from the suppliers for a system which meets the NYSDOT-approved details.

TRANSMITTED MATERIALS: Four documents are attached to this EI. The three proprietary drawings will be linked from the Materials Details section for the Department's Approved List 710-22B, *High-Tension Cable Guide Rail*. That location should be used for reference as there may be revisions made to the drawings in the future which will not be reflected in those attached to this EI. The documents are

- *Justification for Judging the NYSDOT Adaptation of the Direct-Driven Brifen O-Post System to be MASH-Compliant.*
- BrifenUSA drawing MASH-BFD-4512 "MGT END ANCHOR BLOCK (4' W X 5' D X 12' L)".
- BrifenUSA drawing OP-D-012A (NY) " 72" DRIVEN O-POST WITH 24" X 12" SOIL PLATE DETAIL".
- Gibraltar Cable Barrier System, "MASH 2016 – TL-4", (2 sheets) with NYSDOT deletions.

BACKGROUND: Engineering Instruction 20-007 announced the availability of the MASH-compliant Brifen Cable Guide Rail System. To fully conform with the way the system was tested, design required each post be installed in a concrete socket. The sockets significantly increased the installed cost of the system. Additionally, the Department had previously banned the use of socketed posts due to instances of severe corrosion. In response, the Department worked with Brifen USA to develop an acceptable direct-driven post option. Later, the MASH-compliant Gibraltar system and use of its driven post option was approved.

CONTACT: Questions on this issuance may be addressed to Terry.Hale@dot.ny.gov or by telephone at (518) 485-7009.

Justification for Judging the NYSDOT Adaptation of the Direct-Driven Brifen O-Post System to be MASH-Compliant

The Brifen O-post system was crash tested to MASH criteria and evaluated to have passed by Southwest Research Institute. The owners of the system, Hill and Smith, Ltd., were sent an Eligibility Letter by FHWA. The letter, B-245, was sent on December 17, 2013.

The New York adaptations differ from the configuration tested in only three ways: the post spacings, the support of the posts below grade, and the end anchor blocks. The following discussions cover why the adapted system is still judged to be MASH-compliant.

Post Spacing Adaptations

The MASH tests were run with two different post spacings, 21 feet and 7 feet. As stated in Hill and Smith's application to FHWA, the request was for "O-Post spacing of 7 ft. through 21 ft.". NYSDOT's generic medium-tension cable guide rail for TL-2 uses post spacings of 16 feet and 8 feet which are spacings within the tested range. NYSDOT's new 38" tall cable guide rail uses 10-foot and 5-foot spacings.

Support of the Posts Below Grade

Prior to MASH testing, Brifen had post support concepts which included a direct-driven post, a concrete socketed post, and a driven steel socket. In the MASH tests, the O-Posts were placed in sockets in concrete footings. The arrangement ensured that the posts would bend at essentially the ground surface with very little movement of the post below ground surface.

Because of the cost and time required to cast concrete sockets, the NYSDOT adaptation uses the basic concept of Brifen's direct-driven post design. The post itself changes only in length, having it increase to a total length of 6 feet, of which 34 inches is driven below grade. Additionally, a soil plate is welded to the post. The plate provides a lateral bearing surface against the soil starting 2 inches below grade. The net area of the plate is 12 inches wide and 2 feet deep. The bottom corners of the plate may be clipped at a 45-degree angle to facilitate driving.

For the direct-driven post to provide the same support as a concrete socket would provide, it was necessary to demonstrate that, when loaded to failure, the bending and displacement of the post would be essentially the same. To this end, at NYSDOT's request, BRIFENUSA fabricated a 6' post and drove it into the ground in their yard in Oklahoma City. To ensure a conservative test, the soil plate was not included. They then videotaped as the post was impacted at 30 mph by an I-beam mounted to the front of a pickup truck.



As seen in the next picture, the post experienced very little lateral movement, around 2", and bent just below ground surface.



This result confirmed that, for the soil conditions of the test, the post behaved very similarly to the way it behaved in the concrete socket used in the MASH tests. By extension, vehicle deflections and crash performance would have been almost indistinguishable, regardless of whether concrete-socketed posts or direct-driven posts had been used. Additionally, New York soils are typically frozen for several months of each year. The frozen soils will further force posts to bend as if they were in sockets.

Terminal Anchor Blocks

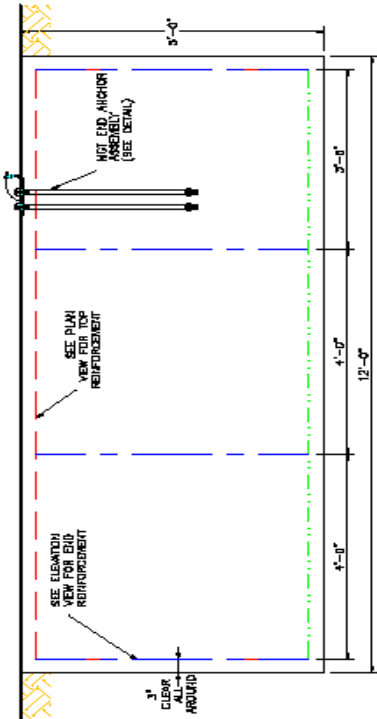
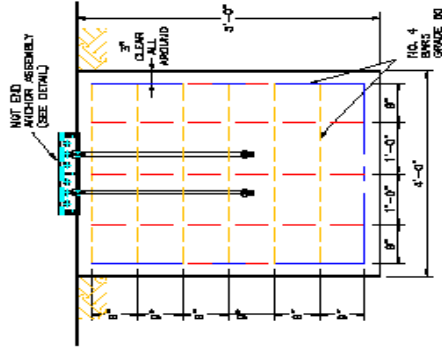
Because of the high tensions used in the cables, large concrete anchor blocks are needed at each end. For the MASH testing, the end anchors were concrete blocks, 5' W x 5' D x 12' L. The size of the block was intended to ensure that the sustained tension from the cables would not result in long-term movement of the blocks.

Because the 5' width would be difficult to fit within some shoulder break widths, New York decided to use an anchor block that was 4' W x 5' D x 12' L. It was judged that, while the 20% reduction in mass might increase the possibility of long-term movement of the blocks, the weight of the blocks (over 16 tons) would provide sufficient inertia and soil resistance to adequately anchor the system during the very brief duration of an errant vehicle's impact into the run.

8/12/2022

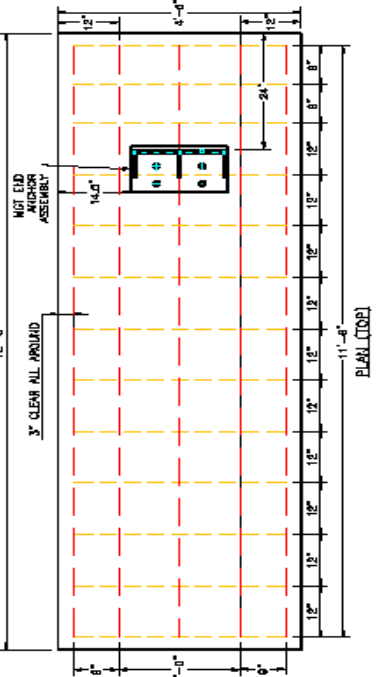
MGT END ANCHOR BLOCK FOUNDATION

| BAR LIST | |
|----------|------------------|
| A | 6 NO. 4 @ 30'-6" |
| B | 23 NO. 4 @ 8'-6" |
| C | 2 NO. 4 @ 13'-0" |
| D | 4 NO. 4 @ 12'-6" |

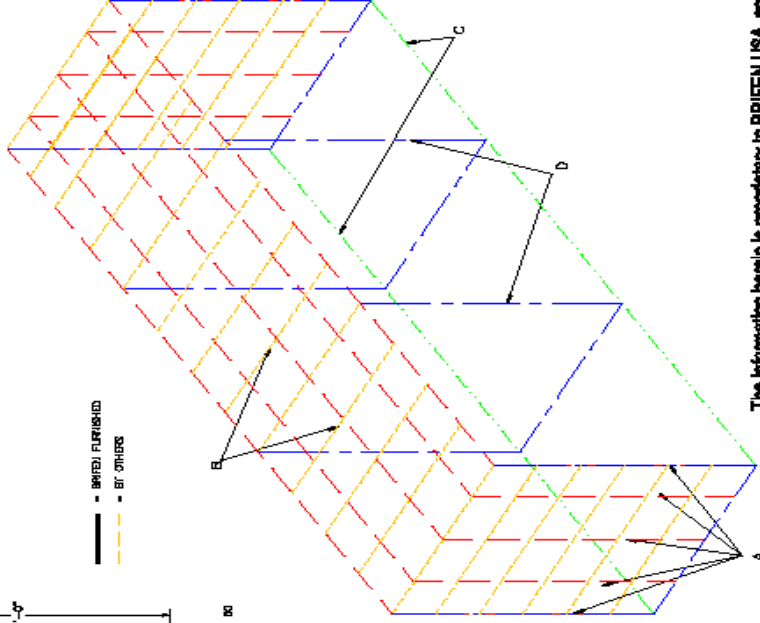


ELEVATION (END)

ELEVATION (SIDE)

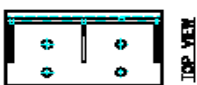
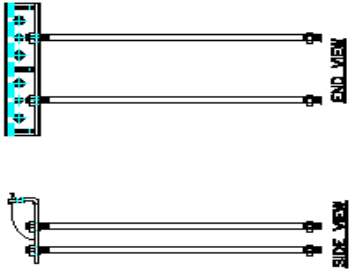


PLAN (TOP)



- NOTE:
1. NOT ANCHOR PLATE SETS PUSH WITH TOP OF CONCRETE. SEE GENERAL DRAWING FOR OTHER DETAILS.
 2. NOT END ANCHOR ASSEMBLY FINISHED; COMPLETE (PER CONTRACT REQUIREMENT) AND ALL REINFORCING STEEL BY OTHERS.
 3. NOT END ANCHOR BLOCK DESIGN IS BASED ON ASSUMED SOIL CONDITIONS DESCRIBED IN THE GEOTECHNICAL EVALUATION REPORT.

MGT END ANCHOR ASSEMBLY



The information herein is proprietary to BRIFEN USA, and shall not be disclosed, duplicated or used otherwise without the express written consent of BRIFEN USA, Inc.

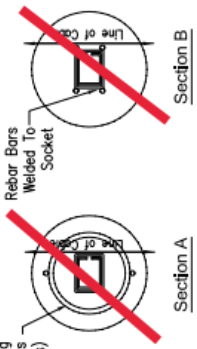
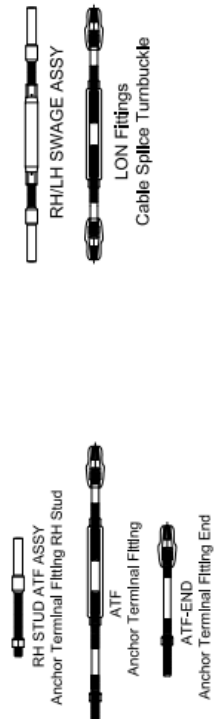
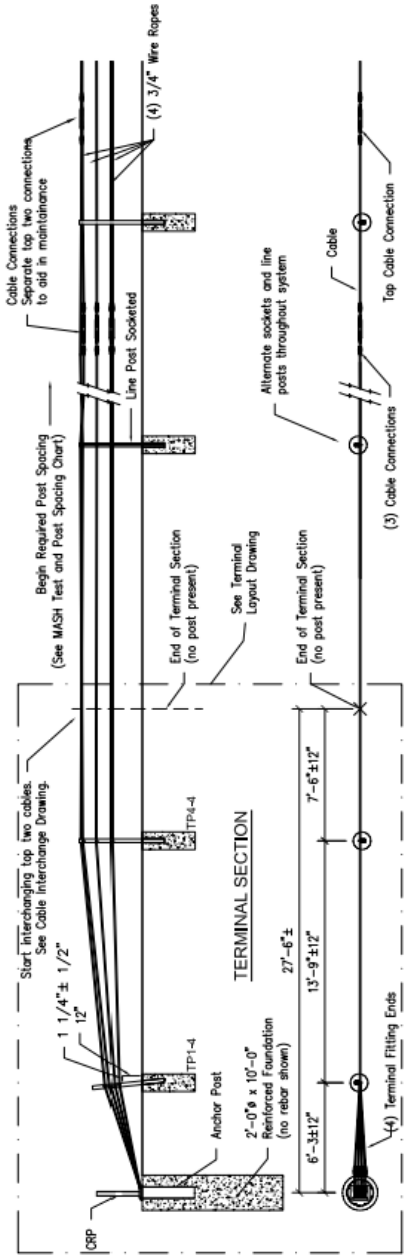


| Revision | | MGT END ANCHOR BLOCK (4' W X 6' D X 12' L) | | Scale | |
|----------|----------|---|--|--------------|-------|
| No. | Date | By | | Drawn By | Notes |
| 1. | | | | Jaffrey Rose | |
| 2. | 4/8/2020 | | | | |
| 3. | | | | | |
| 4. | | | | | |
| 5. | | | | | |

| ANCHOR FOUNDATION DETAIL | | Sheet No | |
|--------------------------|-------|----------|--|
| Drwg. No. | Issue | | |
| 100-400-4012 | | | |

GENERAL NOTES:

- For additional information contact Gibbaltar, Inc. at 1-833-715-0810 or see the manufacturer's product manual.
- All concrete shall be per specification; minimum 2500 PSI.
- The Cable Barrier System shall be installed on shoulders or on medians with slopes of 6:1 or flatter. If installed on slopes steeper than 6:1 up to 4:1 the TL-4 system performs as a TL-3 and Gibbaltar must be contacted for various guidelines related to placement and post spacing.
- The Cable Barrier System is accepted by the FHWA Test Level -4.
- See the specification for delineation.
- Rock Clause: Where solid rock is encountered:
6.A. For socketed post, continue digging 12" diameter, 15" deep into rock or the required plan depth, whichever comes first.
6.B. For driven post, continue digging 12" diameter, 15" deep into rock or the required plan depth, whichever comes first.
6.C. For Anchor post, continue digging 24" diameter, 30" deep into rock or the required plan depth, whichever comes first.
7. The Cable Barrier System shall be installed in standard compacted soil. Soil must be well drained.
- All non-welded rebar by others.
- Line and Terminal Post Foundation Reinforcement Options
9.A. Without moatstrip, 36" Deep x 12" diameter foundations with #3 rebar ring x 6" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
9.B. With 4" minimum depth hot mix asphalt, 30" deep x 12" diameter foundations with #3 rebar ring x 6" diameter with two #4 rebar vertical bars 30" long or 30" welded rebar socket.
9.C. With 3" minimum depth concrete moatstrip, 24" deep x 12" diameter foundations. (No rebar required).



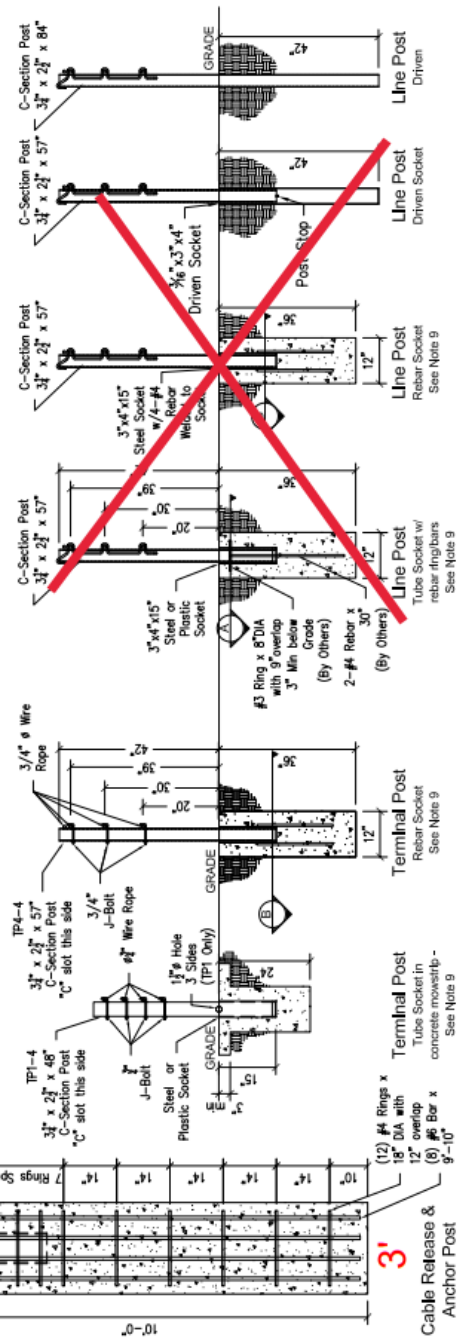
Cable Tension Chart*

| | |
|-------|------|
| -10°F | 8600 |
| 0°F | 8200 |
| 10°F | 7800 |
| 20°F | 7400 |
| 30°F | 7000 |
| 40°F | 6600 |
| 50°F | 6200 |
| 60°F | 5800 |
| 70°F | 5400 |
| 80°F | 5000 |
| 90°F | 4600 |
| 100°F | 4200 |
| 110°F | 3800 |

*Allowable Deviation from Chart +/- 10%.

MASH 2016 TL4 Post Spacing Chart

| MASH TEST | Line Post Spacing |
|-----------|-------------------|
| 3-10 | 7'-0" |
| 3-11 | 7'-0" |
| 3-11 | 21'-0" |
| 4-12 | 21'-0" |



PROPRIETARY TO GIBBALTAR

MASH 2016 TL4 Cable System Layout

Gibbaltar Cable Barrier Systems

DATE: 1-7-2019

Drawn: NTS

Layout: ANS1 B

Scale: 1/8" = 1'-0"

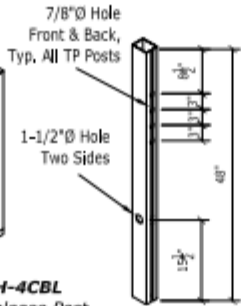
Sheet: BH



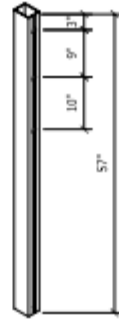
AP-MASH-4CBL
MASH Anchor Post



CRP-MASH-4CBL
MASH Cable Release Post



TP1-4
Terminal Post
No. 1/Weak



TP4-4
Terminal Post



J-BLT
J-Bolt



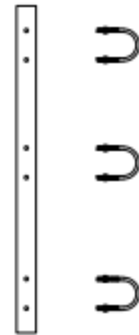
RH STUD ATF ASSY
Anchor Terminal Fitting RH Stud



ATF
Anchor Terminal Fitting



ATF-END
Anchor Terminal Fitting End



U-Bolt Lock-Plate Assembly



~~Tube Socket
(Steel or Plastic)~~



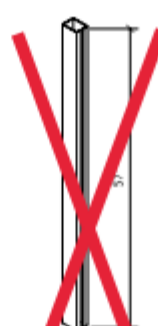
~~**LOCK-S**
Shock Rebar Socket~~



~~Post Stop~~



~~**TUBE-D**
Driven Socket~~



~~**4-LNP-S**
Line Post/Socketed~~



4-LNP-D
Line Post/Driven



4-HPIN Alum.
3 Cable Alum. HPIN



RH/LH SWAGE ASSY



CSTB
Cable Splice Turnbuckle



4-LOCK
TL4 Lockplate



WEDGE



ACORN
Acorn w/ Wedge



TORP
Longitudinal Section ONLY
Torpedo Cable Splice

PROPRIETARY TO GIBRALTAR

| | | |
|--|-----------------------------------|-----------------------|
| | MASH 2016 TL4 System Parts | |
| | Gibraltar Cable Barrier Systems | |
| | Scale: NTS | Date: 12/19/18 |
| | Layout: ANST B | Drawn: BH |