Standards Committee
Meeting Agenda
Wednesday, July 5, 2023, at 9:00am
Meeting Location: 1334 Smith Street, Charleston, WV in Lower-Level Conference
Also meeting virtually via Google Meet. E-mail distribution includes instruction.

Call to Order

Roll Call of Attendees

Approval of Minutes of 5-3-2023 Meeting

Unfinished Business – Standards discussed at last Committee meeting.

TITLE	Champion
3rd time to Committee. Discussed in March and May. Update of various Structure Directives (SD). The following SDs are included with brief summary of updates: 1) *SD110-Project Design Criteria*. Update to line and grade criteria. 2) *SD1040-Structrural System Selection*. Removed sections which are duplicated in SD 1041 through 1044. 3) *SD1041-Steel Superstructure Type*. Changed Fracture Critical Member (FCM) to Nonredundant Steel Tension Member (NSTM) to reflect changes in National Bridge Inspection Standards terminology. Also, revised text for more generality in superstructure type by span length. 4) *SD1042-Concrete Superstructure Type*. Revised text for more generality in superstructure type by span length. 5) *SD1043-Abutment Types*. Minor terminology updates. 6) *SD1044-Pier Type*. Terminology updates, such as FCM to NSTM 7) *SD1073-Rehabilitation Techniques*. Terminology updates, such as FCM to NSTM. Revised Dye Penetrate to NDT for greater flexibility in repair. Revision to 1073.6 to reflect what I think was the original goal of the section. 8) *SD2034-Fatigue Critical*. Terminology update, such as FCM to NSTM 9) *SD2045-Croncrete Superstructures*. Remove strand diameter requirement to provide greater flexibility to the Designer. SDs have been updated per comments at the last meeting. Approval is expected in July	B. Neeley

<table>
<tr><th>TITLE</th><th>Champion</th></tr>
<tr><td>2nd time to Committee. Discussed in May.
Twenty (20) proposed drawings and revisions to WVDOH Standard details Book – Volume 2. The sheets are listed below. A summary of each sheet's revisions are included in the meeting packet; and proposed sheets have revised areas highlighted yellow.
a) TE1-3A Roadside Sign Supports Steel Beam Type
b) TE1-3B Roadside Sign Supports Steel Beam Type
c) TE1-3C Roadside Sign Supports Steel Beam Type
d) TE2-1A Bridge or Retaining Wall Sign Mounting, Type K 1 & 2 Supports
e) TE2-1B Bridge or Retaining Wall Sign Mounting, Type K 1 & 2 Supports
f) TE2-2 Bridge or Retaining Wall Sign Mounting, Type L Pipe Post Mount
g) TE2-3 Barrier Wall Sign Support Bracket Type D
h) TE3-1 Overhead Sign Support – Steel Two Tube Span (TTS)
i) TE3-2 Overhead Sign Support – Steel One Tube Span (OTS)
j) TE4-3A Overhead Sign Support – Steel Double Arm Cantilever
k) TE4-3B Overhead Sign Support – Butterfly Cantilever
l) TE4-4A Overhead Sign Support – Single Arm Cantilever (Heavy)
m) TE4-4B Overhead Sign Support – Single Arm Cantilever (Light)
n) TE4-5 Overhead Sign Support – Steel Common Details
o) TE5-1A Overhead Sign Support Box Truss Span
p) TE5-1B Overhead Sign Support Box Truss Span
q) TE9-1 Sign Clamps for Tubular Supports
r) TEL41 Junction Box Details Type A
s) TES-31 Pedestrian Push Buttons (PPB)
t) TEM-2 Typical Pavement Markings (Sheet 2 of 2)

No update to the Standard Details.

Note - We are currently evaluating comments from fabricators and hope to have to updates at the next meeting.</td><td>Susan Hathaway, CDM Smith</td></tr>
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New Business

TITLE	Champion
None	

Next Meeting Date: Wednesday, September 6, 2023.
Deadline for submissions: August 11, 2023.

Adjournment

Standards Committee
Meeting Minutes
May 3, 2023

Call to Order: The meeting was called to order by Acting Chair Steve Boggs shortly after 9:00 AM.

Attendees: See Attendee List for a list of attendees.

Minutes: Minutes of the 3-1-2023 Meeting were approved with note to add Consultant Service Manual as new business item in Manuals Committee.

Unfinished Business: Items which were discussed and approved at prior meeting are listed below:

I. Update of various Structure Directives (SD).

1. *SD110-Project Design Criteria*.
2. *SD1040-Structrural System Selection*.
3. *SD1041-Steel Superstructure Type*.
4. *SD1042-Concrete Superstructure Type*.
5. *SD1043-Abutment Types*.
6. *SD1044-Pier Type*.
7. *SD1073-Rehabilitation Techniques*.
8. *SD2034-Fatigue Critical*.
9. *SD2045-Croncrete Superstructures*.

The Structure Directives were reviewed and discussed at the meeting. There were a couple comments and suggestions. Hope to approve at the next meeting.

New Business: Items discussed for the first time at committee meeting are listed below:

II. *Standard Details*. Twenty (20) proposed drawings and revisions to WVDOH Standard details Book – Volume 2. The following Standard Details were introduced and discussed at the meeting:

a) *SD110-Project Design Criteria*. *TE1-3A Roadside Sign Supports Steel Beam Type*
b) *TE1-3B Roadside Sign Supports Steel Beam Type*
c) *TE1-3C Roadside Sign Supports Steel Beam Type*
d) *TE2-1A Bridge or Retaining Wall Sign Mounting, Type K 1 & 2 Supports*
e) *TE2-1B Bridge or Retaining Wall Sign Mounting, Type K 1 & 2 Supports*
f) *TE2-2 Bridge or Retaining Wall Sign Mounting, Type L Pipe Post Mount*
g) *TE2-3 Barrier Wall Sign Support Bracket Type D*
h) *TE3-1 Overhead Sign Support – Steel Two Tube Span (TTS)*
i) *TE3-2 Overhead Sign Support – Steel One Tube Span (OTS)*
j) *TE4-3A Overhead Sign Support – Steel Double Arm Cantilever*

k) *TE4-3B Overhead Sign Support – Butterfly Cantilever*
l) *TE4-4A Overhead Sign Support – Single Arm Cantilever (Heavy)*
m) *TE4-4B Overhead Sign Support – Single Arm Cantilever (Light)*
n) *TE4-5 Overhead Sign Support – Steel Common Details*
o) *TE5-1A Overhead Sign Support Box Truss Span*
p) *TE5-1B Overhead Sign Support Box Truss Span*
q) *TE9-1 Sign Clamps for Tubular Supports*
r) *TEL41 Junction Box Details Type A*
s) *TES-31 Pedestrian Push Buttons (PPB)*
t) *TEM-2 Typical Pavement Markings (Sheet 2 of 2)*

The sheet revisions were introduced by Susan Hathaway, CDM Smith at the meeting. There was minimal discussion of them. Hope to approve at the next meeting.

III. *Design Directive (DD) 202 – Field and Office Reviews for Initial Engineer, Preliminary Engineering, and Final Design.* The DD updates Appendix A, which lists the resource agencies. The following Standard Details were introduced and discussed at the meeting:

Next Meeting: The next meeting is on Wednesday, July 5, 2023. Deadline for submissions June 9, 2023.

Adjournment: The meeting was adjourned.

Manuals Committee
Meeting Minutes
March 1, 2023

Call to Order: The meeting was called to called to order by Acting Chair Steve Boggs shortly after conclusion of Standards Committee meeting.

Attendees: See Attendee List for a list of attendees.

Unfinished Business: Items which were discussed and approved from the prior meeting are listed below:

I. *Consultant Services Manual.* This is an update of the 2011 manual; it includes four new chapters and revisions to the other chapters for consistency with current WVDOH policies and procedures.

The updates to the manual were reviewed and discussed. There were no comments. The Consultant Service Manual was approved at the meeting. Vote 5-0.

New Business: Items discussed for the first time at committee meeting are listed below:

II. None.

Next Meeting: The next meeting is on Wednesday, July 5, 2023. Deadline for submissions June 9, 2023.

Adjournment: The meeting was adjourned.

March Standards and Manuals Committee Meeting
Wednesday, May 3, 2023
Attendee List

Virtual Meeting Attendees

1. Brown Phillip	WVDOH – MCS&T Division
2. Brown Tracy	WVDOH – State Bridge Engineer
3. Crane John	Contractors Association of West Virginia
4. Cummings John	WVDOH – MCS&T Division
5. Elkins Jerry	HNTB
6. Farley Paul	WVDOH – MCS&T Division
7. Gillispie Adam	WVDOH – MCS&T Division
8. Jack Shawn	WVDOH – MCS&T Division
9. Johnson Derrick	FHWA
10. Mance Mike	WVDOH – MCS&T Division
11. Ahmed Mongi	HDR
12. Moran Timothy	WVDOH – Operations Division
13. Smith Yuvonne	FHWA
14. Stanevich Ron	WVDOH – MCS&T Division
15. Thaxton Andrew	WVDOH – MCS&T Division
16. Williamson Steve	Michael Baker

In Person Meeting Attendees

1. Adkins, Janie	WVDOH – Technical Support Division
2. Boggs, Steve	WVDOH – Technical Support Division
3. Crum, Matt	WVDOH – Contract Administration Division
4. Hathaway, Susan	CDM Smith
5. Long, Travis E	WVDOH – Technical Support Division
6. Staud, Amy	HDR
7. Whitmore, Ted	WVDOH – Traffic Engineering
8. Williams, Chris	WVDOH – Traffic Engineering

TOTAL ATTENDEES: 24

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1010
PROJECT DESIGN CRITERIA
January 25, 2023
Supersedes May 4, 2022
~~First Edition~~

All designs shall be in accordance with the latest edition of the *AASHTO LRFD Bridge Design Specifications* (Governing Specifications), including all interim specifications and the *West Virginia Division of Highways Standard Specifications, Roads and Bridges* (Standard Specifications) including the latest supplemental specifications.

See Design Directive (DD) 600 ~~information that is~~ for applicable ~~to the~~ roadway design criteria associated with bridge planning. Reference is also made to DD 202, which contains the Bridge Submission Checklists for each phase of the project.

1010.1-TYPICAL DECK TRANSVERSE SECTION

The typical deck transverse section shall be determined by the Project Manager. Generally, the bridge width shall not be less than that of the approach roadway section and barriers shall be provided in accordance with the Governing Specifications.

1010.2-LINE AND GRADE GEOMETRICS

The ~~WVDOH will determine the~~ line and grade ~~on a project~~ shall be ~~determined~~approved by the Project Manager ~~or Consultant as appliable~~. ~~If a Consultant is designing the project, then the line and grade will be determined by the Consultant.~~ The Bridge Designer shall coordinate with the Project Manager to establish line and grade that can accommodate the proposed structural system. See SD 1040 for more information.

1010.3-EXISTING PROJECT RELATED INFORMATION

Early in the project, the Bridge Designer should gather as much existing information about the project as possible. This information could prove to be extremely useful during the planning phase of the project. Available information could consist of inspection reports, bridge replacement studies, as-built plans on the existing bridge and roadway, and photographs, among other items.

1010.4-HIGHWAY DRAINAGE, ~~HYDROLOGY AND HYDRAULICS,~~ HYDROLOGY, HYDRAULICS AND SCOUR ANALYSIS

The WVDOH has developed a comprehensive Drainage Manual that shall be utilized in establishing design frequencies for Highway Drainage~~,~~ and Hydrology and Hydraulics on new and replacement structures. See also DD 501 and Governing Specifications Section 2.6. A scour analysis shall be performed on all waterway or stream/river crossings.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1040
STRUCTURAL SYSTEM SELECTION
January 17, 2023
Supersedes May 4, 2022
~~*First Edition*~~

1040-STRUCTURAL SYSTEM SELECTION

The WVDOH encourages diversity in studying a wide range of bridge systems for each project. However, the number and complexity of the systems studied will vary for each specific site. A bridge structural system consists of a superstructure and substructure.

All feasible superstructure types must be considered in the preliminary phases of the project. Haul lengths and weight limits should be verified by the Designer by contacting suppliers in the area. Prior to the submission of the Span Arrangement, the Designer shall meet with the Bridge Project Manager to discuss the span arrangement alternatives that will be included in the submission. In the case of a bridge design by a consultant, this meeting is referred to as the Pre-Span Arrangement meeting. At this meeting, the Designer and the Bridge Project Manager will make decisions on what superstructure, abutment, pier types and span arrangements should be studied in the span arrangement phase of the project. ~~The following sections discuss some of the steel and concrete superstructure types that are used by the WVDOH.~~ All structures studied shall accommodate their anticipated movements. In this regard, jointless bridges are to be used whenever possible. However, for very long structures, the Bridge Designer shall minimize the number of intermediate expansion joints.

The substructure consists of abutments, ~~and~~ piers and bents founded on various types of foundations. ~~Common abutment and pier types along with foundation types are also described later in this section.~~

~~1040.1 STEEL SUPERSTRUCTURE TYPES~~

~~Steel superstructures should be considered for any span length ranging from 20 FT to 900 FT or more. Generally, the following table, Table 1040.A, can be used as a guideline for selecting steel superstructure types.~~

~~SPAN LENGTH (FT)~~	~~SUPERSTRUCTURE TYPE~~
~~20 to 100~~	~~Rolled Beams~~
~~60 to 130~~	~~Rolled Beams with Cover Plates~~
~~80 to 400~~	~~Welded Plate Girders~~
~~200 to 400~~	~~Box Girders~~
~~400 to 900~~	~~Truss~~
~~500+~~	~~Cable Stayed~~
~~650+~~	~~Tied Arch~~

~~Table 1040.A~~

~~The superstructure should be designed such that the structure has redundant load paths and is not considered fracture critical. Some designs, especially truss and tied arch designs, are generally, by their very nature, fracture critical. As defined in the Governing Specifications, a Fracture Critical Member (FCM) is a "*Component in tension whose failure is expected to result in the collapse of the bridge or the inability of the bridge to perform its function*". The Designer is to declare at Span Arrangement or TS&L if the structure is fracture critical. Design calculations, welding procedures, and material specifications can be incorporated into the project to make the use of these superstructure types acceptable.~~

~~Unpainted weathering steel in bridge construction has been shown to be a cost-effective choice when the site conditions are appropriate for its use. The cost savings associated with the use of weathering steel is realized both in initial construction and in long-term maintenance of the structure. Unpainted weathering steel will be used for construction whenever appropriate. For a more detailed discussion. See SD 2039.~~

~~High performance steel should also be considered when determining viable superstructure alternatives. It has been found to not only provide cost savings but also increase the serviceability of a structure. For a more detailed discussion, see the WVDOH's policy on high performance steel, SD 2031.~~

~~Painted steel may be used where the use of weathering steel is not permitted. These locations include:~~

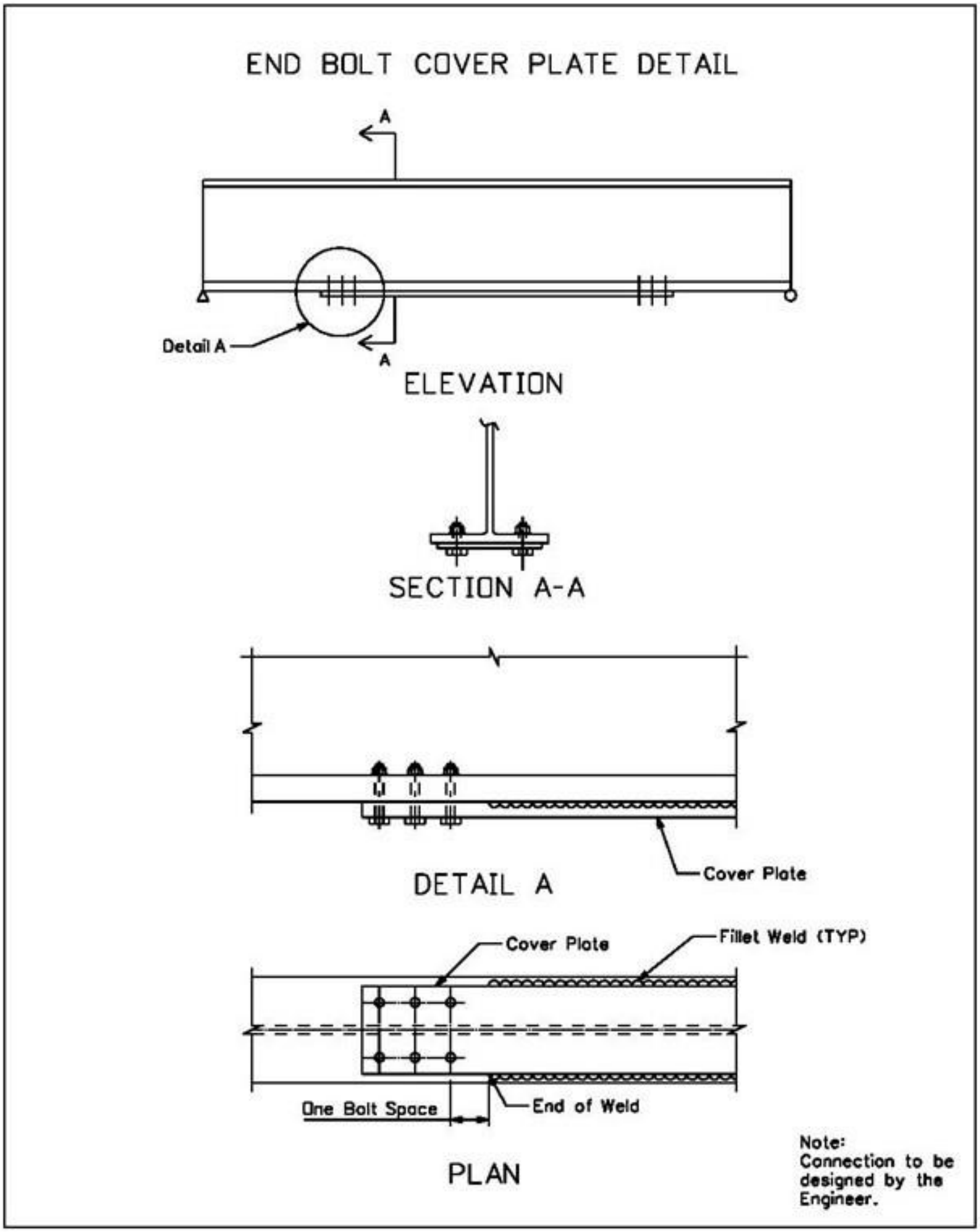
A. ~~Wet environments.~~
B. ~~Industrial areas where concentrated chemical fumes may drift directly onto the structure.~~
C. ~~Grade separations resulting in "tunnel-like" conditions.~~
D. ~~Low level water crossings.~~
E. ~~Other locations as determined by the Bridge Project Manager.~~

~~The following section discusses the various types of steel superstructure types and guidelines for when to consider them.~~

~~**1040.1.1 Rolled Beams:** Rolled beams should be considered for any span length ranging from 20 FT to 100 FT. With cover plates, the span range of rolled beams can be extended to 130 FT. However, only end bolted cover plates shall be used. See Figure 1040.B. The Designer shall determine the availability of any rolled section considered, including lengths and grade of steel.~~

~~The Designer should minimize the number of beam lines. Rolled beam bridges should have a minimum of three stringer lines, however four is desired.~~

~~Continuous spans shall be used for multi-span bridges. The ratio of the length of the end spans to the intermediate spans should preferably be 0.75.~~



~~**Figure 1040.B**~~

~~**1040.1.2 Plate Girders:** Plate girders should be considered for any span length ranging from 80 FT to 400 FT. The Designer shall carefully evaluate the bridge cross section to ensure appropriate girder spacing. Substantial cost savings may be realized early in the design process. The following shall be considered during the span arrangement study:~~

A. ~~Use of wider girder spacing to eliminate girder lines, in some cases, may increase the total weight of the steel. However, the savings realized through fabrication of fewer girders, fewer cross frames and bearings, as well as savings realized through shorter erection time will often offset an increase in raw steel cost. Three girder lines is the minimum unless the system is structurally redundant and not fracture critical, however four is desired.~~

B. ~~Consultation with fabricators and erectors is recommended to assess the fabrication and erection costs of the girders.~~

~~Generally, continuous spans shall be used for multi-span bridges. The ratio of the length of the end spans to the intermediate spans should preferably be 0.75. If the end span to intermediate span ratio is small, anchored end spans shall be used to eliminate any uplift problems at the abutments. Configurations experiencing uplift shall be approved by the State Bridge Engineer. The Bridge Designer should also consider the economics of a system designed span by span (i.e., simply supported for dead load and continuous for live load).~~

~~Detailing interior and exterior girders the same is often desirable. Therefore, when designing tangent bridges, consider "balancing" the total factored design stress for interior and exterior girders to yield similar performance. Balancing factored design moments is accomplished by adjustment of girder spacing and overhang dimensions. This type of study may be efficiently performed using simple line girder analyses. Consult with fabricators to ascertain the least cost approach.~~

~~Limit girder spacing to 15 FT for typical girder structures. For girder/sub-stringer framing arrangements, the main girders may be efficiently spaced at 20 FT to 22 FT. Large girder spacings may cause an increase in the structural thickness of the deck slab. Therefore, evaluation of larger girder spacings must be accompanied by an evaluation and cost analysis of the deck slab. Steel fabrication and erection savings may be partially offset by an increase in deck cost.~~

~~Optimize the girder weight by investigating various web depths.~~

~~The minimum web thickness for plate girders is~~ $\cancel{{}^{7}/_{16}}$ ~~IN. Increment the web thickness by a minimum of~~ $\cancel{{}^{1}/_{16}}$ ~~IN. It is generally more economical to maintain a constant web thickness throughout a project. However, the web thickness may be varied at field splices, or less desirable, at shop splices. The Designer shall consult with a steel fabricator to determine the most economical location of a splice, and whether or not the added cost of additional web thickness will be offset by changing the web thickness.~~

~~**1040.1.3 Box Girders:** Steel box girders can be considered as an alternate for steel plate girders for span length ranging from 200 FT to 400 FT.~~

~~A box girder has two or more vertical or inclined webs, a continuous bottom flange plate connecting the webs, and narrow top flange plates on each web. The box girder cross section having a hollow rectangular or trapezoidal section is a suitable candidate in an urban setting where aesthetics play an important role in bridge type selection. The closed section of a box girder has high torsional resistance, which makes them economical for curved bridges.~~

DRAFT

~~**1040.1.4 Trusses:** Trusses can be used for bridges over navigable river crossings with spans from 400 FT to 900 FT or where aesthetics play an important part in the bridge type. The main structural elements of a typical bridge truss consist of stringers, floor beams, top chord, bottom chord, vertical and diagonal members of the main longitudinal trusses, lateral bracings and sway bracings. Chord members carry the bending moment while the diagonals carry the shear. Axial loads are the predominant forces in all truss members.~~

~~Based on aesthetics and the object of reducing the total truss weight, it is preferable to use a curved chord truss rather than a truss with parallel chords. Truss bridges can be designed as simple or continuous spans. Simple span trusses for multi-span bridges are recommended only when problems due to excessive foundation settlement is anticipated. For a continuous truss bridge with three or more spans, a common method of construction utilizing cantilevered end spans that support the central suspended span can be used.~~

~~The stringers can be designed similar to steel rolled beam bridge members. The floor beams are generally plate girders with variable plate sizes. Generally, the truss members are composite box sections made of welded plates and the bracing members are rolled W, T or channel shapes. The use of high-performance steel shall be investigated in the span arrangement study for main truss members, stringers, and floor beams.~~

~~**1040.1.5 Cable Stayed:** Cable-stayed bridges are competitive for medium and long spans, 500 FT to 1500 FT. The superstructure, consisting of a concrete deck on steel girders, is supported at several intermediate points by cables radiating from one or more towers. Generally, a cable stayed bridge system consists of a three-span structure with a long main span and two smaller end spans.~~

~~**1040.1.6 Tied Arch:** Tied arch bridges can also be used for medium and long spans, 650 FT to 1700 FT. A tied arch may also be used as a center span in conjunction with plate girder approach spans. The high horizontal reactions induced in large span arches are carried by the tie girder, which is essentially a tension member connecting both ends of the arch itself. The rib of an arch bridge can be either a girder member or a truss.~~

~~**1040.2 CONCRETE SUPERSTRUCTURE TYPES**~~

~~Concrete superstructure types should be considered for any span length ranging from 20 FT to 700 FT or more. Generally, the following, Table 1040.C, can be used as a guide for selecting concrete superstructure types.~~

~~**SPAN LENGTH (FT)**~~	~~**SUPERSTRUCTURE TYPE**~~
~~up to 30~~	~~Slab Bridges~~
~~20 to 100~~	~~Box Beams~~
~~35 to 165~~	~~I - Girders~~
~~165 to 300~~	~~Post Tensioned I - Girders (Drop-In)~~
~~100 to 180~~	~~Segmental Concrete Boxes (Span-By-Span)~~
~~150 to 450~~	~~Segmental Concrete Boxes (Precast)~~
~~450 to 700~~	~~Segmental Concrete Boxes (Cast-In-Place)~~
~~500+~~	~~Cable Stayed~~

~~**Table 1040.C**~~

~~The possible exceptions to the use of precast concrete beams are structures with severe horizontal curvature, vertical curvature, limitations on structure depth, skew greater than acceptable limits, and restrictions on transportation.~~

~~Concrete compressive strengths for commonly used precast beams shall be no less than 6000 PSI (5500 PSI for WVDOH Standard Box Beams) at release (~~f'_{ci}~~) with a minimum final compressive strength of 8000 PSI (~~f'_c~~).~~

~~High strength concrete (HSC) should also be considered when determining possible concrete superstructure alternatives. Precast beams may be designed using high strength concrete with a final compressive strength of up to 10000 PSI and a release strength of up to 9000 PSI. HSC allows engineers to design structures with smaller beams when clearance criteria needs to be met, reduce dead loads for more cost efficient substructures, and increase span lengths over conventional concrete.~~

~~The following discusses the various types of concrete superstructure types and guidelines for when to consider them.~~

~~**1040.2.1 Slab Bridges:** This superstructure type consists of a reinforced concrete slab with the main reinforcing parallel to the direction of traffic. This type of structure may be economical for very short span bridges, generally less than 30 FT in length.~~

~~**1040.2.2 Box Beams:** For short span bridges of 100 FT or less, prestressed concrete box beams may be considered an economical solution.~~

~~Three basic cross-sectional configurations are commonly used. They are:~~

A. ~~Adjacent box beams with or without a hot-laid bituminous concrete (HLBC) wearing surface.~~
B. ~~Adjacent box beams with a composite reinforced concrete deck.~~
C. ~~Spread box beams with a composite reinforced concrete deck.~~

> ~~Note: All bridges, including adjacent box beam bridges, on routes designated as coal haul roads and/or subject to heavily loaded trucks shall have composite reinforced concrete decks.~~

~~Factors involved in the choice of box beam configuration design should include but are not limited to economics, traffic type and volume, time constraints, and method of construction (whether by contract or state construction crews which generally have limited construction capabilities). The Bridge Designer should verify capabilities with the District prior to designing a structure that will be built with state forces.~~

~~**1040.2.3 Prestressed Concrete Beams**: AASHTO Type I, II, III, IV or Type IV Modified prestressed concrete beams should be considered for bridges with spans from 25 FT to 145 FT. The maximum span length is based on the haul capacity for a particular project site and shall be verified with a prestressed concrete beam supplier familiar with the project location. For continuous spans, the bridge system shall be designed simply supported for dead load and continuous for live load and superimposed dead load only. The Designer should minimize the number of beam lines. Prestressed concrete beam bridges should have a minimum of three beam lines.~~

~~The Engineer or Design of Record should verify availability of shapes from multiple fabricators.~~

~~Approximate Maximum Span Lengths (FT)~~

		~~Beam Spacing (FT)~~				
		~~14~~	**~~12~~**	**~~10~~**	**~~8~~**	**~~6~~**
~~AASHTO Type~~	**~~I~~**	~~25~~	~~30~~	~~35~~	~~40~~	~~45~~
	~~II~~	~~40~~	~~45~~	~~50~~	~~55~~	~~60~~
	~~III~~	~~60~~	~~65~~	~~70~~	~~75~~	~~85~~
	~~IV~~	~~75~~	~~85~~	~~90~~	~~95~~	~~105~~
	~~V~~	~~95~~	~~100~~	~~110~~	~~120~~	~~125~~
	~~VI~~	~~105~~	~~115~~	~~120~~	~~130~~	~~135~~
~~Type IV Modified~~	**~~60 IN~~**	~~85~~	~~95~~	~~100~~	~~110~~	~~120~~
	~~66 IN~~	~~95~~	~~100~~	~~110~~	~~120~~	~~125~~
	~~72 IN~~	~~100~~	~~110~~	~~120~~	~~125~~	~~135~~
	~~78 IN~~	~~110~~	~~115~~	~~125~~	~~130~~	~~140~~
	~~84 IN~~	~~115~~	~~125~~	~~130~~	~~135~~	~~145~~

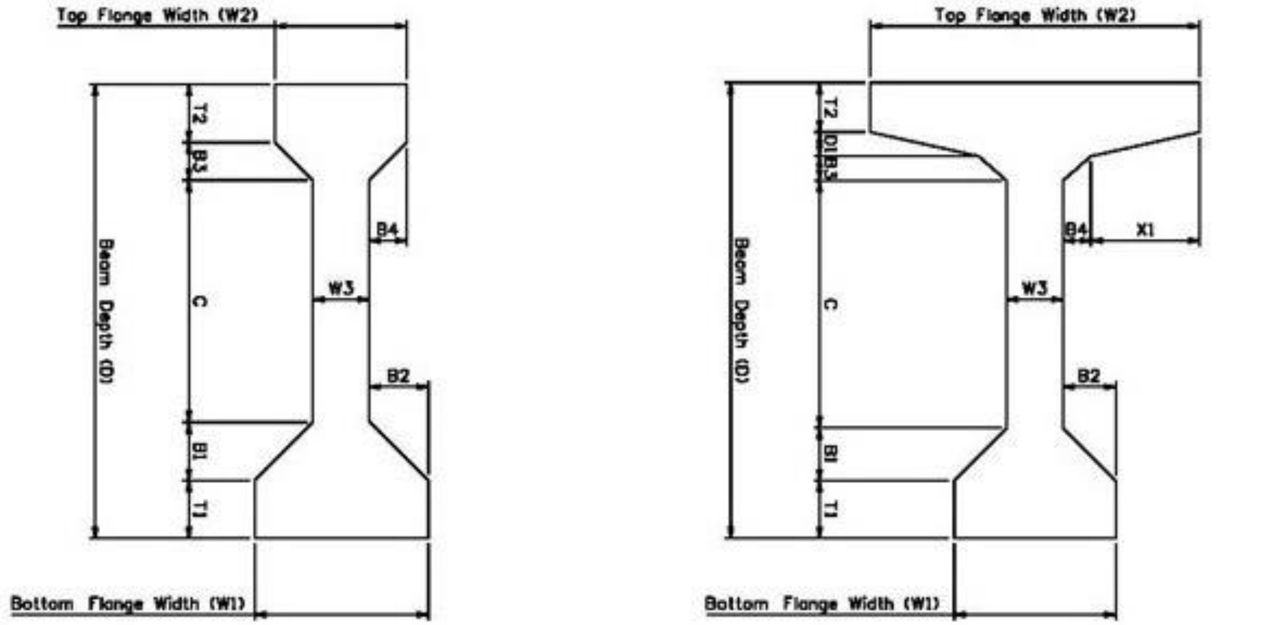
~~NOTE: These values are approximate and should be used for preliminary design purposes only. These values shall not be used for final design. The designs were based on single span (simply supported) bridges with 32 IN Type F barriers, no sidewalks and utilizing concrete with a release strength (f'_{ci}) of 6000 PSI and a final strength (f'_c) of 8000 PSI.~~

~~Table 1040.D~~

~~1040.2.4 Post-Tensioned I-Beams (Drop-In):~~ ~~Using post-tensioned drop-in spans can increase span lengths for prestressed concrete beams. The drop-in segments will be field spliced and beam post-tensioned as specified within the contract plans. At the field splice locations, temporary shoring towers or strongbacks may be required.~~

~~1040.2.5 Segmental Concrete Boxes:~~ ~~Segmental concrete boxes are an economical solution for bridges with span lengths over 100 FT and where repetition of the box fabrication can be achieved. There are three methods of construction for segmental concrete: span-by-span, balanced cantilever, and cast-in-place. Each offers advantages in different situations.~~

WVDOT-DOH STANDARD PRESTRESSED CONCRETE I-BEAM SECTIONS



AASHTO I-BEAM
Typical-Type II, III & IV

AASHTO I-BEAM
Typical-Type IV MOD, V* & VI*

Beam Designation	Top Flange Width (IN) W2	Bottom Flange Width (IN) W1	Depth (IN) D	Depth (IN)						Flange (IN)			Web Thickness (IN) W3	Basic Beam Properties		
				T2	D1	B3	C	B1	T1	X1	B4	B2		Area (IN^2)	Y_b (IN)	I_{xx} (IN^4)
II	12	18	36	6	-	3	15	6	6	-	3	6	6	369	15.8	50,980
III	16	22	45	7	-	4½	19	7½	7	-	4½	7½	7	560	20.3	125,390
IV	20	26	54	8	-	6	23	9	8	-	6	9	8	789	24.7	260,730
IV MOD	36	26	60	4	2	3	34	9	8	11	3	9	8	860	28.8	384,248
IV MOD	36	26	66	4	2	3	40	9	8	11	3	9	8	908	31.6	491,660
IV MOD	36	26	72	4	2	3	46	9	8	11	3	9	8	956	34.4	615,361
IV MOD	36	26	78	4	2	3	52	9	8	11	3	9	8	1,004	37.3	756,222
IV MOD	36	26	84	4	2	3	58	9	8	11	3	9	8	1,052	40.2	915,113
V	42	28	63	5	3	4	33	10	8	13	4	10	8	1,013	31.9	521,180
VI	42	28	72	5	3	4	42	10	8	13	4	10	8	1,085	36.4	733,320

~~Figure 1040 E~~

~~**1040.2.6 Cable Stayed:** Cable-stayed bridges are competitive for medium and long spans, 500 FT to 1500 FT. The superstructure, consisting of a concrete deck on prestressed concrete beams, is supported at several intermediate points by cables radiating from one or more towers.~~

~~**1040.3 ABUTMENT TYPES:** Abutments are structures positioned at the beginning and end of a bridge, which support the superstructure and approach roadway and retains the earth embankment. Abutments can be classified into the following five types:~~

- ~~A. Wall Type Abutment.~~
- ~~B. Pedestals.~~
- ~~C. Stub Abutment.~~
- ~~D. Integral Abutment.~~
- ~~E. Semi-Integral Abutment.~~
- ~~F. Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS).~~

~~**1040.3.1 Wall Abutment:** This type of abutment, also known as a full height abutment, may be used when right-of-way is critical or the site does not permit a longer bridge with sloping embankments. Span lengths can be reduced using a wall type abutment. The footing may transfer loads by direct bearing (spread footing) or it may be supported on piles or rock socketed drilled shafts.~~

~~The maximum exposed face should generally be 30 FT, measured from gutter line to ground line in the profile view. Taller heights may be permitted, with permission of the Bridge Project Manager, when the negative effects of a tall structure on the traveling public or aesthetics are not a governing factor. Otherwise, where walls greater than 30 FT are required, a stepped (terraced) wall configuration shall be used.~~

~~**1040.3.2 Pedestals:** The beam seat is supported on columns/drilled shaft or pedestals resting on individual footings. This configuration is useful for meeting unique construction problems, e.g., widely varying elevations of competent rock.~~

~~**1040.3.3 Stub Abutment:** Stub abutments are relatively short abutments that resemble wall type abutments. These abutments are generally placed on the approach embankment and are supported on rock, piles or rock socketed drilled shafts.~~

~~**1040.3.4 Integral Abutment:** Integral abutments are generally short abutments supported on a single row of piling. These abutments, like stub abutments, are generally placed on approach embankments and are well suited for bridges with limited thermal movements. The ends of the bridge beams are cast directly into the abutments, thereby eliminating the need for bridge deck expansion devices.~~

~~This abutment type can be used in combination with MSE walls to provide the benefits of a wall type abutment while satisfying the preference for using jointless bridges.~~

~~See SD 2090 for limitations on the use of integral abutments.~~

~~**1040.3.5 Semi-Integral Abutment:** Semi-integral abutments can be either wall or stub type abutments. The difference between a semi-integral and an integral abutment is that for semi-integral abutments, the beams are cast in a closure diaphragm that is structurally independent from the stem. This type also eliminates the need for bridge deck expansion devices.~~

~~See SD 2090 for limitations on the use of semi-integral abutments.~~

~~**1040.3.6 Geosynthetic Reinforced Soil - Integrated Bridge System Abutment (GRS-IBS):** GRS-IBS Abutments were initially developed by FHWA and can provide an economic alternative to other abutment types especially where adjacent box beams are used and scour is not considered to affect the foundations. The GRS-IBS abutment type consist of high-performance woven geotextile and open graded stone such as # 8 crushed stone. For low abutment heights, this abutment type can save time since concrete curing time is eliminated. The integrated approaches provide the reinforced backfill required for bridges and can eliminate the need for approach and sleeper slabs on low ADT bridges. Since the bridge is supported on the layers of GRS and no deep foundations are needed, "the bump at the end of the bridge" is eliminated. Standard 8 IN split face masonry block should be used as the facing.~~

~~It is important to place GRS-IBS abutments adjacent to non-scourable streams (hard bedrock is exposed), or where the existing abutments can provide a scour wall, or where the Reinforced Soil Foundation (RSF) can be placed below the scour depth. All GRS-IBS bridge locations shall be approved by the State Bridge Engineer.~~

~~The design of GRS-IBS abutments is empirically based on a service limit bearing resistance of 4,000 PSF provided by the criteria presented in "Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide". Publication No. FHWAHRT-11-026, is followed.~~

~~**1040.3.7 Wingwalls:** Wingwalls are walls on either side of an abutment used to retain the roadway embankment. Wingwalls can be constructed of cast-in-place concrete or MSE walls and shall be designed as retaining walls. They shall be sufficiently sized to prevent the roadway embankment from spilling onto the abutment seats or into the clear area under the bridge.~~

~~U-shaped or turned-back wingwalls are commonly used in embankment situations and straight wings are used in cut sections. Flared wingwalls between these extremes can also be appropriate based on site conditions. The Designer must study the existing and proposed surfaces to determine which type of wingwalls best fits the site. Wingwalls with a tapered bottom surface shall be avoided due to compaction difficulties beneath the wall. The top surface of U-shaped wingwalls may be tapered parallel to the roadway slope to match the finished grade.~~

~~1040.4 PIER TYPES~~

~~Piers are intermediate supports in a multi-span bridge system. All feasible pier types must be considered in the preliminary phases of the project.~~

~~**1040.4.1 Cap-and-Column Type Piers:** Cap-and-column type piers have two or more circular or rectangular columns connected on top with a cap (a reinforced concrete beam that supports the superstructure). Generally, the pier cap ends will be cantilevered. For columns greater than 100 FT to 150 FT, the use of a compression strut at mid-height, similar to the pier cap, shall be investigated. The individual columns will be supported on an appropriate foundation.~~

~~**1040.4.2 T-Type or Hammerhead or Wall Type Piers:** T-type or Hammerhead piers have a deep rectangular tapered beam carrying the superstructure supported on a single wide rectangular or oval column in the middle. For wall type piers, the width of the rectangular column will be very close to the length of the pier cap. The single column will be supported on an appropriate foundation. In some situations, the feasibility of using a single large circular column instead of a wide rectangular or oval column has to be investigated during the preliminary design phase of the project.~~

~~**1040.4.3 Post-Tensioned Concrete/Integral Pier Caps:** To satisfy the vertical clearance requirement beneath a pier cap, a post-tensioned or integral pier cap shall be investigated.~~

~~**1040.4.4 Steel Pier Caps:** Steel pier caps are fracture critical. If used, the design shall allow for reasonable access to the interior for future maintenance, inspection, and repair.~~

~~**1040.5 FOUNDATION TYPES**~~

~~All feasible foundation types must be considered in the preliminary phases of the project. The WVDOH's policy is to found all new bridge foundations on rock. However, bridges may be allowed to be supported on Intermediate Geomaterial (IGM) at the discretion of the Geotechnical Engineer.~~

~~**1040.5.1 Spread Footing:** Spread footings have been found to be economical for depths to 20 FT. Preferably, spread footings should be founded on rock. However, spread footing foundations may be supported on Geosynthetic Reinforced Soil-Integrated Bridge Systems or MSE retaining wall backfill.~~

~~In situations where a cofferdam may be required for the construction of a spread footing, the cost of the cofferdam shall be included when comparing foundation options. Spread footing foundations shall be placed below the scour depth. Other concerns to consider include the stability of approach embankments, differential settlement, etc.~~

~~**1040.5.2 Piling:** Piling must be designed for both axial and lateral loads as appropriate. As a minimum, piling shall be sized using a wave equation program such as GRLWEAP. Loads may include external (non-structure related) as well as structural loads. For example, pile foundations might be used to enhance stability of the approach embankment if the embankment factor of safety is questionable.~~

~~Piling to competent rock will normally be designed as end bearing and driven to refusal. Additional loading from negative skin friction (downdrag forces), resulting from embankment settlement, must be added to that from structural loads and any other external loads. Battered piles may be required to help resist lateral loads but shall be avoided wherever possible. Pile tips shall be used for refusal on rock. The cost for pile tips shall be included in the cost estimate for the pile foundation.~~

~~With permission of the Bridge Project Manager, friction piles and end bearing piles on non-competent rock strata may be considered when site-specific conditions warrant and when all other concerns (such as settlement or scour) are addressed.~~

~~The minimum piling length shall be 10 FT. See SD 2120.~~

~~For integral abutments, single-line piling systems shall be used, predrilled 15.0 FT deep using 1.0 FT diameter for soil or 2.0 FT diameter for rock.~~

~~Foundations supported on piling should be placed below the scour depth. When the bridge scour computations indicate that the steel piling may be exposed due to scour, then the piling cap placement must be designed in accordance with SD 2120.~~

~~**1040.5.3 Rock Socketed Drilled Shafts:** Rock socketed drilled shafts provide superior scour protection versus traditional steel piling, greater resistance against high lateral and uplift loads, and accommodation of site concerns associated with the pile driving process (vibrations,~~

~~interference due to battered piles, etc.), and in some cases exclude the need of cofferdams. In addition, rock socketed drilled shafts may eliminate the need of caisson caps, for certain configurations such as single or multiple column piers.~~

~~Rock socketed drilled shafts shall be designed using soil-structure intersection software such as LPILE. The rock socket length shall be determined as to the second node that crosses the zero-deflection line in the service limit state. For strong rock both end and side resistance can be added directly. For soft rock, such as claystone and soft siltstone, only end resistance shall be used.~~

~~Construction techniques shall be in accordance with the Standard Specifications. These include testing by the Division of: pre-installation core holes, wet or dry hole condition, plumbness, shaft sidewall and bottom cleanliness, and concrete inspection. Results from the testing may require remedial action from the Contractor.~~

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

DRAFT

STRUCTURE DIRECTIVE 1041
STEEL SUPERSTRUCTURE TYPES
May 17, 2023
Supersedes May 4, 2022
~~First Edition~~

Steel superstructures should be considered for any span length ranging from twenty (20) feet to nine hundred (900) feet or more. Generally, Table 1041.A can be used as a guideline for selecting steel superstructure types.

SPAN LENGTH (Feet)	SUPERSTRUCTURE TYPE
20 to 100	Rolled Beams
60 to 130	Rolled Beams with Cover Plates
80 to ~~400~~500	Welded Plate Girders
200 to 400	Box Girders
400 to 900	Truss
500+	Cable Stayed
650+	Tied Arch

Table 1041.A

The superstructure should be designed such that the structure has redundant load paths and ~~is not considered fracture critical~~ does not contain Nonredundant Steel Tension Members (NSTM). Some designs, especially truss and tied arch designs, ~~are generally,~~ by their very nature, ~~fracture critical~~ contain NSTM's. As defined ~~in the Governing Specifications~~ by the National Bridge Inspection Standards (NBIS), a ~~Fracture Critical Member (FCM)~~ Nonredundant Steel Tension Member (NSTM) is ~~a~~ "*~~Component in tension whose failure is expected to result in the collapse of the bridge or the inability of the bridge to perform its function.~~ A primary steel member fully or partially in tension, and without load path redundancy, system redundancy or internal redundancy, whose failure may cause a portion of or the entire bridge to collapse.*" The Designer is to declare at Span Arrangement and/or TS&L if the structure ~~is fracture critical~~ has NSTM's. Design calculations, welding procedures, and material specifications can be incorporated into the project to make the use of these superstructure types acceptable.

Unpainted weathering steel in bridge construction has been shown to be a cost-effective choice when the site conditions are appropriate for its use. The cost savings associated with the use of weathering steel is realized both in initial construction and in long-term maintenance of the structure. Unpainted weathering steel will be used for construction whenever appropriate. For a more detailed discussion, see SD 2039.

High performance steel should also be considered when determining viable superstructure alternatives. It has been found to not only provide cost savings but also increase the serviceability of a structure. For a more detailed discussion, see the WVDOH's policy on high performance steel, SD 2031.5.

Painted steel may be used where the use of weathering steel is not permitted. These locations include:

A. Wet environments
B. Industrial areas where concentrated chemical fumes may drift directly onto the structure
C. Grade separations resulting in "tunnel-like" conditions
D. Low level water crossings
E. Other locations as determined by the Bridge Project Manager

The following section discusses the various types of steel superstructure types and guidelines for when to consider them.

1041.1-ROLLED BEAMS

Rolled beams should be considered for any span lengths~~ ranging from twenty (20) ~~ up to one hundred (100) feet. With cover plates, the span range of rolled beams can be extended to 130 feet. However, only end bolted cover plates shall be used. See Figure 1041.B. The Designer shall determine the availability of any rolled section considered, including lengths and grade of steel.

The Designer should minimize the number of beam lines. Rolled beam bridges should have a minimum of three stringer lines, however four is desired.

Continuous spans shall be used for multi-span bridges. The ratio of the length of the end spans to the intermediate spans should preferably be 0.75. If the end span to intermediate span ratio is small, anchored end spans shall be used to eliminate any uplift problems at the abutments. Configurations subject to uplift shall be approved by the State Bridge Engineer.

1041.2-PLATE GIRDERS

Plate girders should be considered for any span lengths ranging from eighty (80) feet to ~~400~~ 500 feet. The Designer shall carefully evaluate the bridge cross section to ensure appropriate girder spacing. Substantial cost savings may be realized early in the design process. The following shall be considered during the span arrangement study:

A. Use of wider girder spacing to eliminate girder lines, in some cases, may increase the total weight of the steel. However, the savings realized through fabrication of fewer girders, fewer cross frames and bearings, as well as savings realized through shorter erection time will often offset an increase in raw steel cost. Three girder lines is the minimum~~ unless the system is structurally redundant and not fracture critical~~, however four is desired.
B. Consultation with fabricators and erectors is recommended to assess the fabrication and erection costs of the girders.

Generally, continuous spans shall be used for multi-span bridges. The ratio of the length of the end spans to the intermediate spans should preferably be 0.75. If the end span to intermediate span ratio is small, anchored end spans shall be used to eliminate any uplift problems at the abutments. Configurations~~ experiencing~~ subject to uplift shall be approved by the State Bridge Engineer. The Bridge Designer should also consider the economics of a system designed span by span (i.e., simply supported for dead load and continuous for live load).

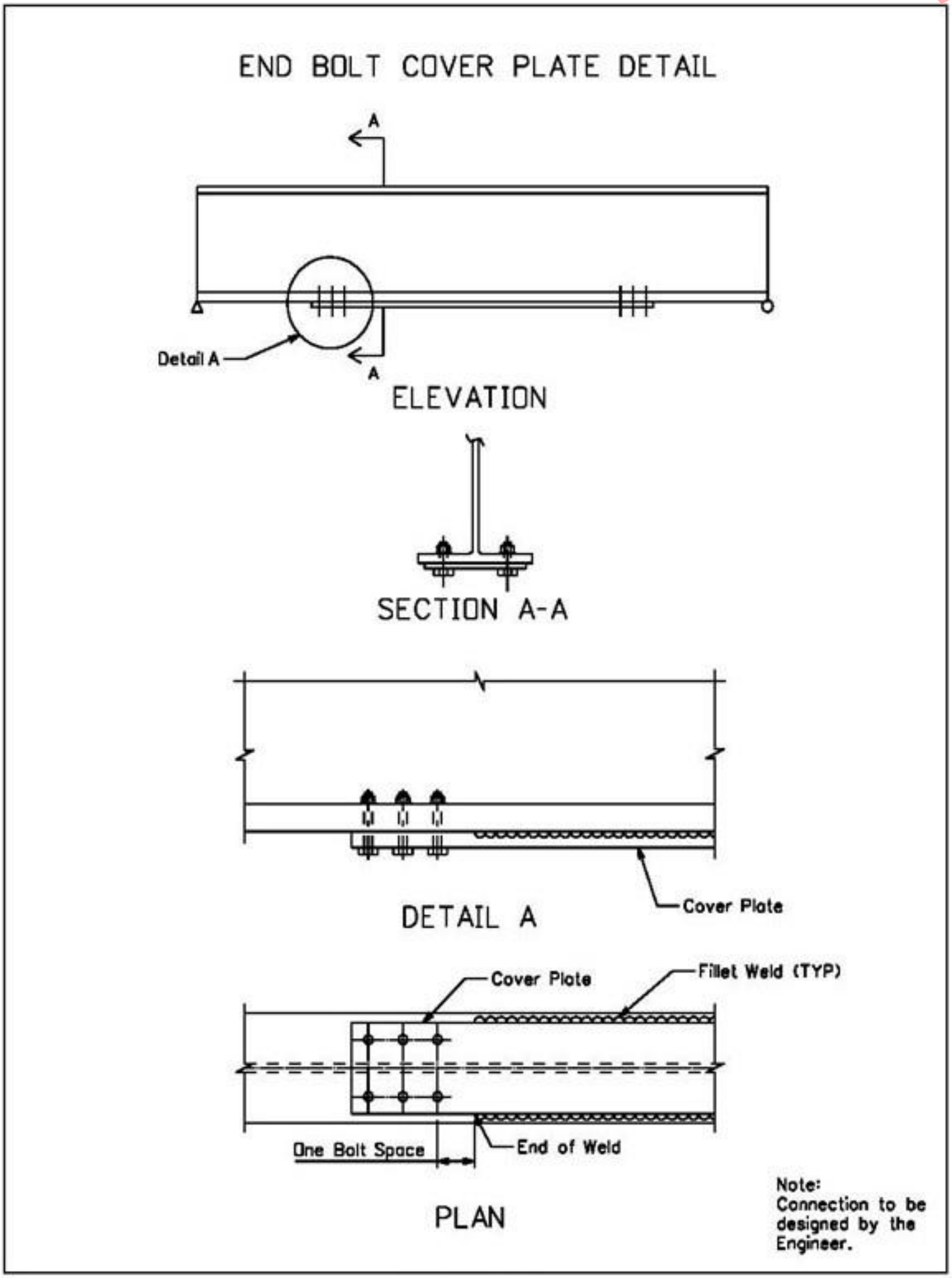


Figure 1041.B

Detailing interior and exterior girders the same are often desirable. Therefore, when designing tangent bridges, consider "balancing" the total factored design stress for interior and exterior girders to yield similar performance. Balancing factored design moments is accomplished by adjustment of girder spacing and overhang dimensions. This type of study may be efficiently performed using simple line girder analyses. Consult with fabricators to ascertain the least cost approach.

Limit girder spacing to fifteen (15) feet for typical girder structures. For girder/sub-stringer framing arrangements, the main girders may be efficiently spaced at twenty (20) feet to 22 feet. Large girder spacings may cause an increase in the structural thickness of the deck slab. Therefore, evaluation of larger girder spacings must be accompanied by an evaluation and cost analysis of the deck slab. Steel fabrication and erection savings may be partially offset by an increase in deck cost.

Optimize the girder weight by investigating various web depths.

The minimum web thickness for plate girders is 7/16 inches. Increment the web thickness by a minimum of 1/16 inch. It is generally more economical to maintain a constant web thickness throughout a project. However, the web thickness may be varied at field splices, or less desirable, at shop splices. The Designer shall consult with a steel fabricator to determine the most economical location of a splice, and whether or not the added cost of additional web thickness will be offset by changing the web thickness.

1041.3-BOX GIRDERS

Steel box girders can be considered as an alternate for steel plate girders for span length ranging from two hundred (200) feet to 400 feet.

A box girder has two or more vertical or inclined webs, a continuous bottom flange plate connecting the webs, and narrow top flange plates on each web. The box girder cross-section having a hollow rectangular or trapezoidal section is a suitable candidate in an urban setting where aesthetics play an important role in bridge type selection. The closed section of a box girder has high torsional resistance, which makes them economical for curved bridges.

1041.4-TRUSSES

Trusses can be used for bridges over navigable river crossings with spans from four hundred (400) feet to 900 feet or where aesthetics play an important part in the bridge type. The main structural elements of a typical bridge truss consist of stringers, floor beams, top chord, bottom chord, vertical and diagonal members of the main longitudinal trusses, lateral bracings, and sway bracings. Chord members carry the bending moment while the diagonals carry the shear. Axial loads are the predominant forces in all truss members.

Based on aesthetics and the object of reducing the total truss weight, it is preferable to use a curved chord truss rather than a truss with parallel chords. Truss bridges can be designed as simple or continuous spans. Simple span trusses for multi span bridges are recommended only when problems due to excessive foundation settlement is anticipated. For a continuous truss bridge with three or more spans, a common method of construction utilizing cantilevered end spans that support the central suspended span can be used.

The stringers can be designed similar to steel rolled beam bridge members. The floor beams are generally plate girders with variable plate sizes. Generally, the truss members are composite box sections made of welded plates and the bracing members are rolled W, T, or channel shapes. The use of high-performance steel shall be investigated in the span arrangement study for main truss members, stringers, and floor beams.

1041.5-CABLE STAYED

Cable-stayed bridges are competitive for medium and long spans (500 FT to 1500 FT). The superstructure, consisting of a concrete deck on steel girders, is supported at several intermediate points by cables radiating from one or more towers. Generally, a cable stayed bridge system consists of a three-span structure with a long main span and two smaller end spans.

1041.6-TIED ARCH

Tied arch bridges can also be used for medium and long spans (650 FT to 1700 FT). A tied arch may also be used as a center span in conjunction with plate girder approach spans. The high horizontal reactions induced in large span arches are carried by the tie-girder, which is essentially a tension member connecting both ends of the arch itself. The rib of an arch bridge can be either a girder member or a truss.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1042
CONCRETE SUPERSTRUCTURE TYPES

May 17, 2023
Supersedes May 4, 2022
~~*First Edition*~~

Concrete superstructure types should be considered for any span length ranging from twenty (20) feet to seven hundred (700) feet or more. Generally, the following table, Table 1042.A can be used as a guide for selecting concrete superstructure types.

SPAN LENGTH (Feet)	SUPERSTRUCTURE TYPE
up to 30	Slab Bridges
20 to 100	Box Beams
35 to 165	I - Girders
165 to 300	Post Tensioned I - Girders (Drop-In)
100 to 180	Segmental Concrete Boxes (Span-By-Span)
150 to 450	Segmental Concrete Boxes (Precast)
450 to 700	Segmental Concrete Boxes (Cast-In-Place)
500+	Cable Stayed

Table 1042.A

The possible exceptions to the use of precast concrete beams are structures with severe horizontal curvature, vertical curvature, limitations on structure depth, skew greater than acceptable limits, and restrictions on transportation.

Concrete compressive strengths for commonly used precast beams shall be no less than 6,000 PSI (5,500 PSI for WVDOH Standard Box Beams) at release (f'_{ci}) with a minimum final compressive strength of 8,000 PSI (f'_c).

High Strength Concrete (HSC) should also be considered when determining possible concrete superstructure alternatives. Precast beams may be designed using high strength concrete with a final compressive strength of up to 10,000 PSI and a release strength of up to 9,000 PSI. HSC allows engineers to design structures with smaller beams when clearance criteria needs to be met, reduce dead loads for more cost efficient substructures, and increase span lengths over conventional concrete. The Designer should consult with the fabricator to determine the most cost-effective solution when HSC is being considered.

1042.1-SLAB BRIDGES

This superstructure type consists of a reinforced concrete slab with the main reinforcing parallel to the direction of traffic. This type of structure may be economical for very short span bridges, generally less than thirty (30) feet in length.

1042.2-BOX BEAMS

For short span bridges of one hundred (100) feet or less, prestressed concrete box beams may be considered an economical solution.

Three basic cross-sectional configurations are commonly used. They are:

A. Adjacent box beams with or without a hot-laid bituminous concrete (HLBC) wearing surface.
B. Adjacent box beams with a composite reinforced concrete deck.
C. Spread box beams with a composite reinforced concrete deck.

NOTE: All bridges, including adjacent box beam bridges, on routes designated as coal haul roads and/or subject to heavily loaded trucks shall have composite reinforced concrete decks unless otherwise approved by the State Bridge Engineer or designee.

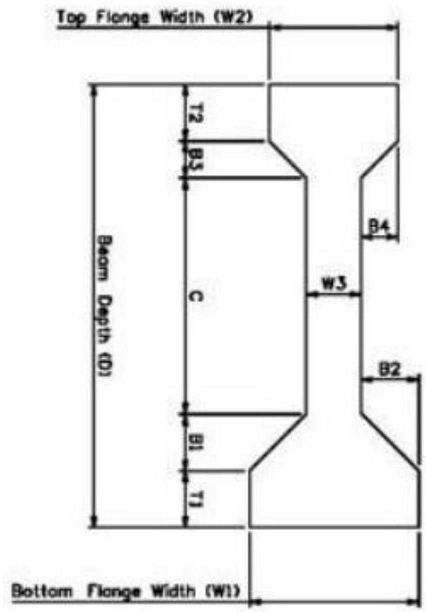
Factors involved in the choice of box beam configuration design should include but are not limited to economics, traffic type and volume, time constraints, and method of construction (whether by contract or state construction crews which generally have limited construction capabilities). The Bridge Designer should verify capabilities with the District prior to designing a structure that will be built with state forces.

1042.3-PRESTRESSED CONCRETE BEAMS

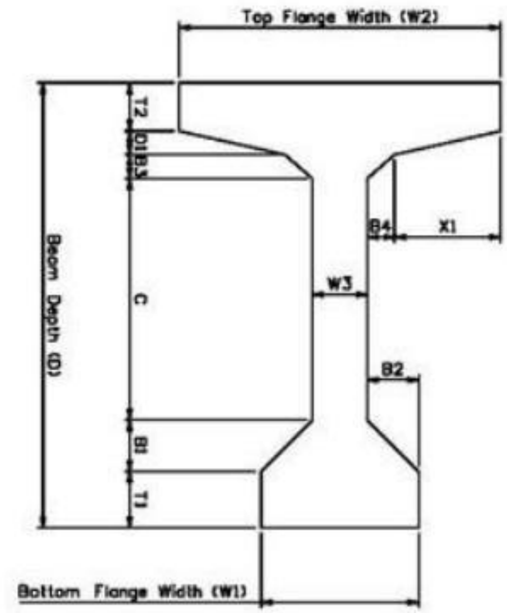
Prestressed concrete beams should be considered for bridges with spans from twenty-five (25) feet to ~~145~~ 160 feet. The maximum span length is based on the haul capacity and availability for a particular project site and shall be verified with a prestressed concrete beam supplier familiar with the project location. For continuous spans, the bridge system shall be designed simply supported for dead load and continuous for live load and superimposed dead load only. The same prestressed concrete beam type is desired for all spans. The Designer should minimize the number of beam lines. Prestressed concrete beam bridges should have a minimum of three stringer lines.

The design of all structures that utilize prestressed concrete I-beam sections will be accomplished using beam sections ~~locally available~~available within WVDOH Standard Details Volume 3 unless otherwise approved by the Project Manager. ~~Beam sections shown in Figure 1042.B represent a historical list of available shapes of prestressed concrete beams.~~

WVDOT-DOH STANDARD PRESTRESSED CONCRETE I-BEAM SECTIONS



AASHTO I-BEAM
Typical-Type II, III & IV



AASHTO I-BEAM
Typical-Type IV MOD, V & VI

Beam Designation	Top Flange Width (IN) W2	Bottom Flange Width (IN) W1	Depth (IN) D	Depth (IN)						Flange (IN)			Web Thickness (IN) W3	Basic Beam Properties		
				T2	D1	B3	C	B1	T1	X1	B4	B2		Area (IN^2)	Y_b (IN)	I_x (IN^4)
II	12	18	36	6	-	3	15	6	6	-	3	6	6	369	15.8	50,980
III	16	22	45	7	-	4½	19	7½	7	-	4½	7½	7	560	20.3	125,390
IV	20	26	54	8	-	6	23	9	8	-	6	9	8	789	24.7	260,730
IV MOD	36	26	60	4	2	3	34	9	8	11	3	9	8	860	28.8	384,248
IV MOD	36	26	66	4	2	3	40	9	8	11	3	9	8	908	31.6	491,660
IV MOD	36	26	72	4	2	3	46	9	8	11	3	9	8	956	34.4	615,361
IV MOD	36	26	78	4	2	3	52	9	8	11	3	9	8	1,004	37.3	756,222
IV MOD	36	26	84	4	2	3	58	9	8	11	3	9	8	1,052	40.2	915,113
V	42	28	63	5	3	4	33	10	8	13	4	10	8	1,013	31.9	521,180
VI	42	28	72	5	3	4	42	10	8	13	4	10	8	1,085	36.4	733,320

~~Figure 1042.B~~

Prestressed concrete beams shall be spaced to optimize girder size and strand usage. Examples of beam types, spacings and span lengths are shown in Table 1042.B.

Approximate Maximum Span Lengths (Feet)

		Beam Spacing (Feet)				
		14	**12**	**10**	**8**	**6**
AASHTO Type	**I**	25	30	35	40	45
	II	40	45	50	55	60
	III	60	65	70	75	85
	IV	75	85	90	95	105
	V	95	100	110	120	125
	VI	105	115	120	130	135
Type IV Modified	**60 IN**	85	95	100	110	120
	66 IN	95	100	110	120	125
	72 IN	100	110	120	125	135
	78 IN	110	115	125	130	140
	84 IN	115	125	130	135	145

NOTE: These values are approximate and should be used for preliminary design purposes only. These values shall not be used for final design. The designs were based on single span (simply supported) bridges with 32 Inch Type F barriers, no sidewalks and utilizing concrete with a release strength (f'_{ci}) of 6,000 PSI and a final strength (f'_c) of 8,000 PSI.

Table 1042.B

1042.4-POST-TENSIONED I-BEAMS (DROP-IN)

Using post-tensioned drop-in spans can increase span lengths for prestressed concrete beams up to 300 feet. The drop-in segments will be field spliced and beam post-tensioned as specified in the contract plans. At the field splice locations, temporary shoring towers or strongbacks may be required. Horizontal and vertical curvature may be better accommodated with post-tensioned drop-in spans.

1042.5-SEGMENTAL CONCRETE BOXES

Segmental concrete boxes are an economical solution for bridges with span lengths over ~~100 FT~~ 300 feet and where repetition of the box fabrication can be achieved. There are three methods of construction for segmental concrete: span-by-span, balanced cantilever, and cast-in-place. Each offers advantages in different situations.

1042.6-CABLE STAYED

Cable-stayed bridges are competitive for medium and long spans (500 feet to 1,500 feet). The superstructure, consisting of a concrete deck on prestressed concrete beams, is supported at several intermediate points by cables radiating from one or more towers.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1043
ABUTMENT TYPES
March 1, 2023
Supersedes May 4, 2022
~~*First Edition*~~

Abutments are structures positioned at the beginning and end of a bridge, which support the superstructure and approach roadway and retains the earth embankment. Abutments can be classified into the following five types:

1. Wall Type Abutment.
2. Pedestals.
3. Stub Abutment.
4. Integral Abutment.
5. Semi-Integral Abutment.
6. Geosynthetic Reinforced Soil – Integrated Bridge System (GRS-IBS).

1043.1-WALL ABUTMENT

This type of abutment, also known as a full height abutment, may be used when right-of-way is critical, or the site does not permit a longer bridge with sloping embankments. Span lengths can be reduced using a wall type abutment. The footing may transfer loads by direct bearing (spread footing) or it may be supported on piles or rock socketed drilled shaft.

The maximum exposed face should generally be thirty (30) feet, measured from gutter line to ground line in the profile view. Taller heights may be permitted, with permission of the Bridge Project Manager, when the negative effects of a tall structure on the traveling public ~~or aesthetics~~ are not a governing factor. Otherwise, where walls greater than thirty (30) feet are required, a stepped (terraced) wall configuration shall be used.

1043.2-PEDESTALS

The beam seat is supported on columns/drilled shafts or pedestals resting on individual footings. This configuration is useful for meeting unique construction problems, e.g., widely varying elevations of competent rock.

1043.3-STUB ABUTMENT

Stub abutments are relatively short abutments that resemble wall type abutments. These abutments are generally placed on the approach embankment and are supported on rock, piles or rock socketed drilled shafts.

1043.4-INTEGRAL ABUTMENT

Integral abutments are generally short abutments supported on a single row of piling. These abutments, like stub abutments, are generally placed on approach embankments and are well suited for bridges with limited thermal movements. The ends of the bridge beams are cast directly into the abutments, thereby eliminating the need for bridge deck expansion devices.

This abutment type can be used in combination with Mechanically Stabilized Earth (MSE) walls to provide the benefits of a wall type abutment while satisfying the preference for using jointless bridges.

See SD 2090 for limitations on the use of integral abutments.

1043.5-SEMI-INTEGRAL ABUTMENT

Semi-integral abutments can be either wall or stub type abutments. The difference between a semi-integral and an integral abutment is that for semi-integral abutments, the beams are cast in a closure diaphragm that is structurally independent from the stem. This type also eliminates the need for bridge deck expansion devices.

See SD 2090 for limitations on the use of semi-integral abutments.

1043.6-GEOSYNTHETIC REINFORCED SOIL-INTEGRATED BRIDGE SYSTEM ABUTMENT (GRS-IBS)

GRS-IBS Abutments were initially developed by FHWA and can provide an economic alternative to other abutment types especially where adjacent box beams are used, and scour is not considered to affect the foundations. The GRS-IBS abutment type consists of high-performance woven geotextile and open graded stone such as #8 crushed stone. For low abutment heights, this abutment type can save time since concrete curing time is eliminated. The integrated approaches provide the reinforced backfill required for bridges and can eliminate the need for approach and sleeper slabs on low ADT bridges. Since the bridge is supported on the layers of GRS and no deep foundations are needed, “the bump at the end of the bridge” is eliminated. Standard eight (8) inch split face masonry block should be used as the facing.

It is important to place GRS-IBS abutments adjacent to non-scourable streams (hard bedrock is exposed), or where the existing abutments can provide a scour wall, or where the Reinforced Soil Foundation (RSF) can be placed below the scour depth. All GRS-IBS bridges locations shall be approved by the State Bridge Engineer.

The design of GRS-IBS abutments is empirically based on a service limit bearing resistance of 4,000 PSF provided by the criteria presented in “Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide” (Publication No. FHWAHRT-11-026) is followed.

1043.7-WINGWALLS

Wingwalls are walls on either side of an abutment used to retain the roadway embankment. Wingwalls can be constructed of cast-in-place concrete or MSE walls and shall be designed as retaining walls. They shall be sufficiently sized to prevent the roadway embankment from spilling onto the abutment seats or into the clear area under the bridge.

U-shaped or turned-back wingwalls are commonly used in embankment situations and straight wings are used in cut sections. Flared wingwalls between these extremes can also be appropriate based on-site conditions. The Designer must study the existing and proposed surfaces to determine which type of wingwalls best fits the site. Wingwalls with a tapered bottom surface shall be avoided due to compaction difficulties beneath the wall. The top surface of ~~U-shaped~~ wingwalls may be tapered ~~parallel to the roadway slope~~ to match the finished grade.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1044
PIER TYPES
March 1, 2023
May 4, 2022
~~First Edition~~

Piers are intermediate supports in a multi-span bridge system. All feasible pier types must be considered in the preliminary phases of the project.

1044.1-CAP-AND-COLUMN TYPE PIERS

Cap-and-column type piers have two or more circular or rectangular columns connected on top with a cap (a reinforced concrete beam that supports the superstructure). Generally, the pier cap ends will be cantilevered. For columns greater than one hundred (100) to 150 feet, the use of a compression strut at mid-height, similar to the pier cap, shall be investigated. Partial height walls may be necessary where vehicle or train collision are required in accordance with AASHTO~~or debris buildup is possible.~~ The individual columns will be supported on an appropriate foundation.

1044.2-T-TYPE OR HAMMERHEAD OR WALL TYPE PIERS

T-Type or Hammerhead piers have a deep rectangular tapered beam carrying the superstructure supported on a single wide rectangular or oval column in the middle. For wall type piers, the width of the rectangular column will be very close to the length of the pier cap. The single column will be supported on an appropriate foundation. In some situations, the feasibility of using a single large circular column instead of a wide rectangular or oval column ~~has to~~ should be investigated during the preliminary design phase of the project.

1044.3-POST-TENSIONED CONCRETE/INTEGRAL PIER CAPS

To satisfy the vertical clearance requirement beneath a pier cap, a post-tensioned or integral pier cap shall be investigated.

1044.4-STEEL PIER CAPS AND BENTS

Most steel pier caps and bents are ~~fracture critical~~ Nonredundant Steel Tension Members (NSTM) and should be avoided. If used, the design shall allow for reasonable access to the interior for future maintenance, inspection, and repair. Steel pier caps and bents shall be designed for redundancy unless otherwise approved by the State Bridge Engineer.

DRAFT

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 1073
REHABILITATION TECHNIQUES
May 17, 2023
Supersedes May 4, 2022
~~First Edition~~

This Directive describes various methods for repairing and rehabilitating bridges. These are in no way meant to limit the Designer to these methods but to give guidance in accepted procedures. All plans developed for rehabilitation shall include appropriate details to comply with AASHTO Standard Specifications for Seismic Design of Highway Bridges. The following shall be considered on all rehabilitation projects:

A. Structural integrity and general acceptability of design.
B. Future maintenance considerations.
C. Hydraulic considerations (waterway opening, backwater effect, etc.).
D. Geometric safety (roadway width, guardrail, etc.).
E. Right of way clearance.
F. DNR and Corps permit clearance.
G. Erosion Control.
H. Suitability of the sequence of construction required by the design.

All material used in any rehabilitation or repair project shall be in accordance with the Standard Specifications and supplemented by project specific special provisions, as necessary.

1073.1-STEEL

Repair of steel members may be necessary to correct deficiencies associated with cracking, corrosion, and fatigue. This includes cracking of joints and welded connections, partial length cover plates, and brackets. ~~Fracture-critical~~ Nonredundant Steel Tension Members require special assessment because their failure would be expected to result in bridge collapse. All repairs shall consider the dead load that exists in original members and the original members shall not be stressed beyond their original allowable inventory stress level. All steel repairs shall be in accordance with the Steel Structures section of the Governing Specifications. All repairs to welds on steel members shall be in accordance with the AASHTO/AWS D1.5M/D1.5: current version, *Bridge Welding Code*.

1073.1.1-Cracks: One method for preventing crack propagation is by drilling holes at the ends of the crack. Consideration shall also be given to filling the hole with a tightened high strength bolt or crack compression bushing to aid in arresting further propagation. ~~Dye penetrant~~ Non-Destructive Testing (NDT) is used to locate and determine the extent of surface cracks. The center of the drilled hole should be positioned so that the end of the crack is located within the hole. If the crack is visible on both sides of the plate, the position of the outside diameter of the hole is at the end of crack that has propagated farthest. ~~Dye penetrant~~ NDT is again used to ensure that the crack did not propagate through the drilled hole. The FHWA has published guidelines on this procedure that are available at the WVDOH.

Welding can be used to repair typical cracks in flanges and webs of beams or girders. Welding in connection with crack repair shall be done in accordance with AWS and the Governing Specifications. The weldability of the bridge material must be assessed prior to the repair procedure to insure a successful weld repair. The risks associated with field weld repairs should be thoroughly evaluated before specifying said repairs.

Superficial nicks and gouges should be repaired by grinding rather than by welding repairs.

1073.1.2-Painting: Repair work for corrosion may include painting of the structure. This consists of surface preparation, prime coating, and finish coating and shall be in accordance with the Painting Steel Structures section of the Standard Specifications and SD 1074.

The Designer is responsible for determining the presence or absence of lead-based coatings by requesting that the Division of Highway's Materials Control, Soils and Testing Division conduct a field survey. If a lead-based coating is present, then the project plans shall contain a note as follows: "The contractor's attention is directed to the fact that the existing structure contains lead-based paint coatings".

1073.1.3-Fatigue: In zones of tension stress, when fatigue critical details exist, action ~~must~~ should be taken to improve the expected fatigue life of the detail unless a cumulative damage fatigue analysis yields adequate life or the structure does not exhibit fatigue damage. The Designer should not use Category D, E or E' weld details for a repair or a new design. The fatigue life analysis shall be performed in accordance with the current version of the *AASHTO Guide Specifications for Fatigue Evaluation of Existing Steel Bridges.*

In designing a fatigue repair, an examination of the existing connections should be performed. The repair should be one that attempts to reduce the fatigue category of the existing connections. The Designer shall consult the Governing Specifications for common connection details and their fatigue category. Figures 1073.A and 1073.B illustrate two accepted fatigue repairs.

1073.1.4-Section Loss: Cover plates are an effective means for restoring section loss in a member. The member must be analyzed to ensure its original or target capacity can be attained with the addition of cover plates. Details of repairs are largely up to the Designer's creativity. The Designer must consider the fatigue characteristics of the repairs they design. If excessive deterioration exists, then replacement of the member may be required. The Designer must consider "locked-in" forces and differences in supplementary cover plate material properties.

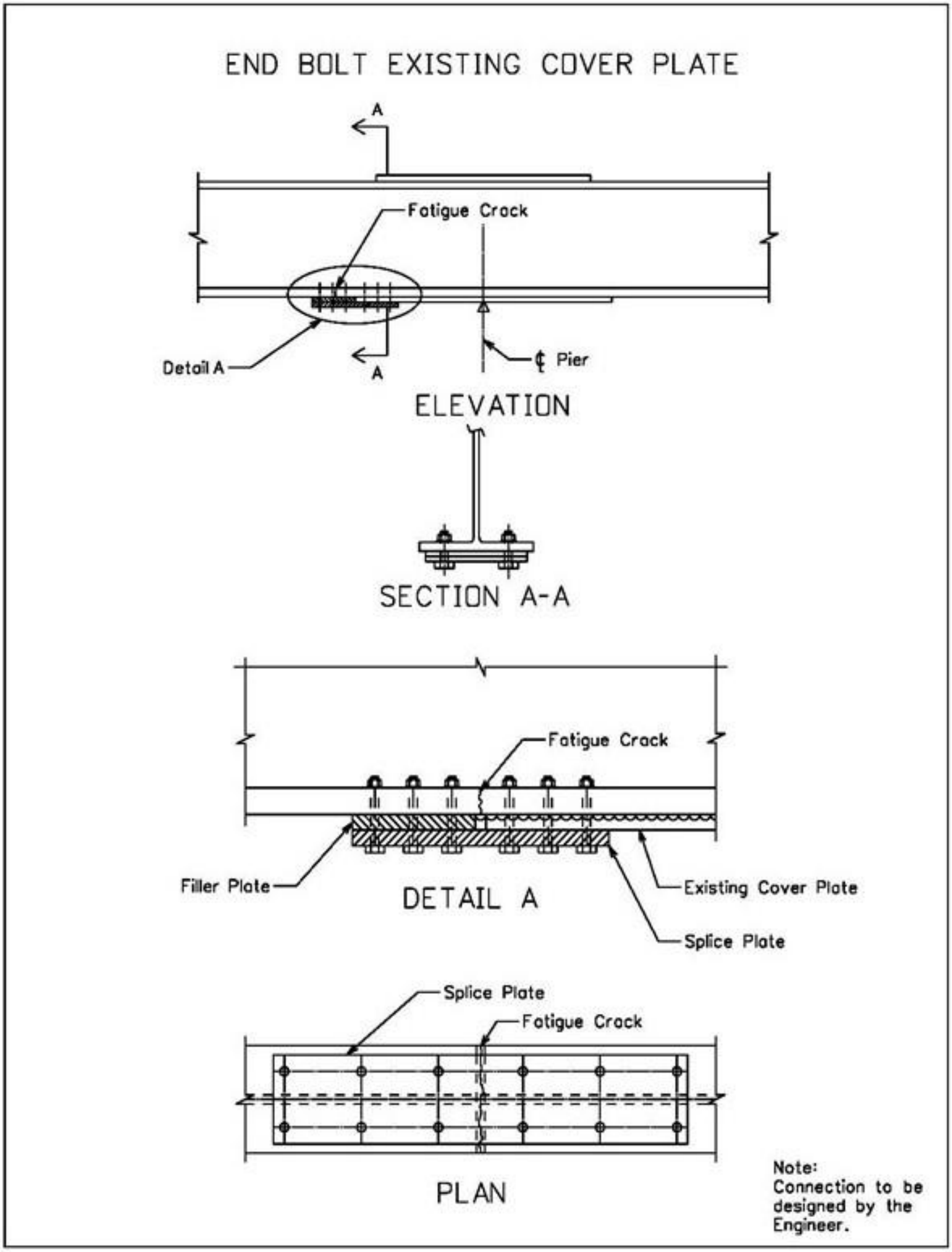


Figure 1073.A

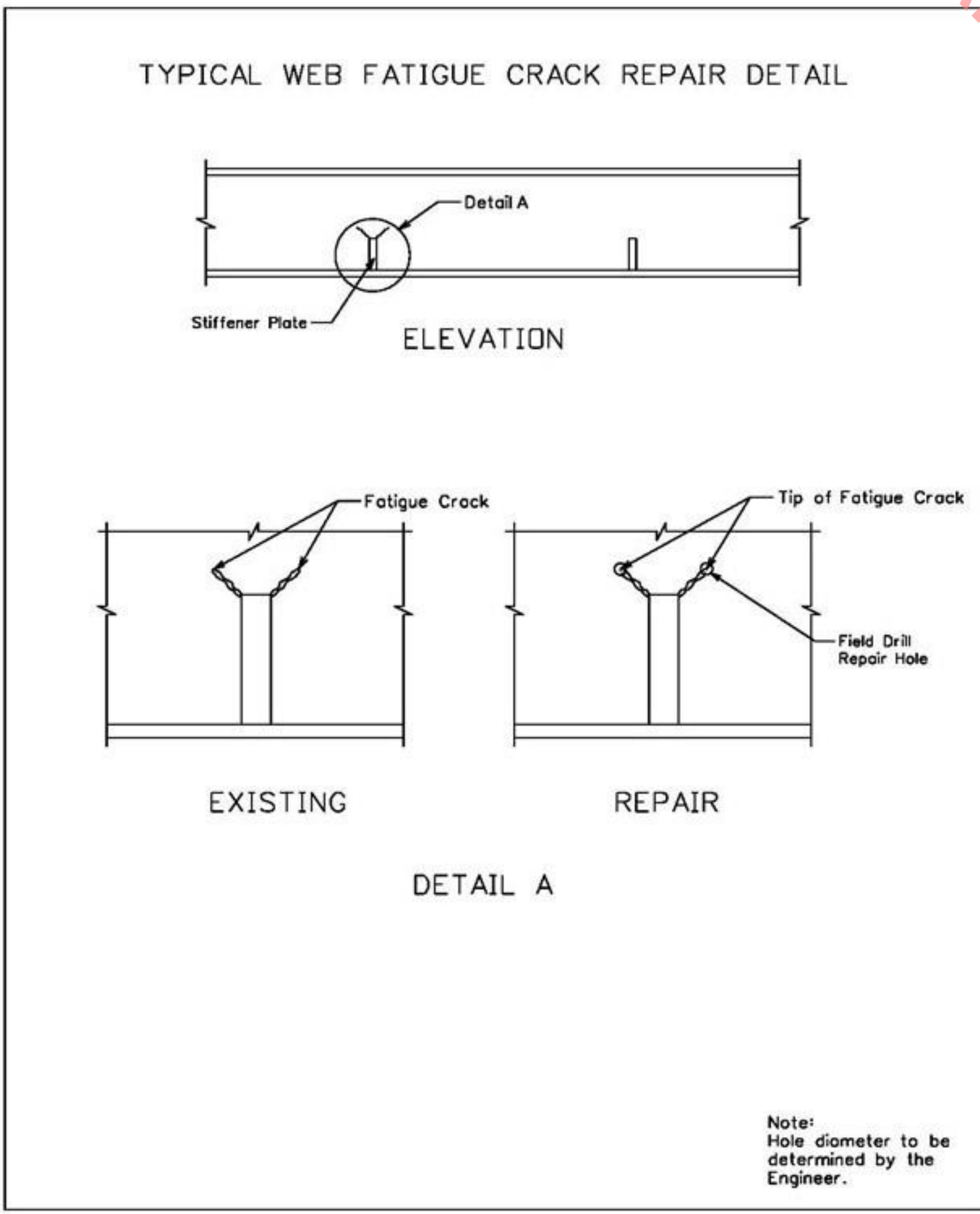


Figure 1073.B

1073.2-CONCRETE

The intent of repairing concrete is to restore the structural integrity and function of the concrete. Typically, concrete repairs consist of removing deteriorated concrete and replacing it with cement mortar or another suitable material. Restoring proper cover, where existing cover is inadequate, is important in selecting repair materials. The following factors should be considered:

A. Structural compatibility of the material and its expected performance with the original construction.
B. Availability, cost, and anticipated life.
C. Ease of construction and availability of qualified contractors in the area.

Initially, all exterior concrete surfaces should be thoroughly examined by means of soundings with hammers to determine loose or defective areas that may exist beyond the visual assessment of deficiencies and deterioration. Defective areas should be removed to a depth necessary to eliminate any loose and disintegrated materials. All exposed reinforcement should be cleaned, care being taken to not damage the steel. Loose reinforcement should be tied back into place and, where necessary, concrete adjacent to lose bars shall be carefully undercut to a depth that permits a minimum of one inch of new concrete around the reinforcement bars. Sections with deteriorated bars should be re-evaluated and capacities restored, when necessary. The area of concrete removal should be large enough to allow for adequate bar splicing. The exposed area of concrete should be cleaned. Where concrete deterioration requires substantial removal ~~beyond half the depth of the member~~, consideration may be given to the replacement of the entire section in the deteriorated area.

A good bond between the repair material and existing concrete surfaces is essential in concrete repair. An epoxy-bonding coat applied just before the repair material can help to obtain a good bond. Dowel bars may be required in a section that is subjected to forces where the bond between the new concrete and the old section is not considered sufficient to transfer the loads. Dowels may consist of expansion anchors, grouted anchors, power-activated anchors, and epoxy and polymer grouts and resins. External or internal vibrators may be used for compaction. Proper curing is essential to ensure that excessive shrinkage will not occur.

Shotcrete can be used as a means for rebuilding an area where deteriorated concrete has been removed. Shotcrete applications are justified ~~where large areas must be repaired and~~ where conventional methods of forming and placing concrete are less suited to the damaged areas, such as vertical and overhead surfaces. Shotcrete application shall be in accordance with the Pneumatically Applied Mortar, Section 623, of the Specifications.

Cracks in concrete must be repaired to stop intrusion of water or chemicals into the concrete and restore the uniform appearance of the concrete surface. Epoxy grouts are typically used for crack repair. This involves injection of low viscosity material under pressure with the intent to seal the crack and restore structural continuity. Where active cracking conditions exists, it must be dealt with by addressing the cause directly.

Grouting can also be used for the repair of concrete substructures submerged in water. This type of repair may necessitate the use of pile jackets or formwork.

All concrete repairs shall be in accordance with the Governing Specifications.

1073.2.1-Concrete Decks: Most repairs needed in bridge decks are associated with increased traffic, heavier vehicles, deicing chemicals, and geometric deficiencies as a result of the initial construction. Common problems are cracking, spalling, chloride contamination, potholing, and delaminating. Cracking in the deck can be repaired as described in the previous section. Minor spalling, potholes, etc. may be temporarily repaired with patches. Patches cannot be considered a permanent solution. Eventually, a bridge deck becomes a composition of patches with no end to the repair process. As the patching process is repeated to repair more damaged areas, an overlay will be needed to serve as a wearing surface and a moisture barrier.

When repairs on a concrete slab become too costly, partial, or complete replacement of the deck is needed. See SD 2020 for design details for concrete decks.

See SD 3000 for the Deck Removal-Grinding note to be included on the General Notes sheet for all projects requiring partial or complete deck removal on existing bridges.

1073.2.2-Deck Overlays: ~~When a specialized concrete overlay (SCO) is used on a deck greater than 7.0 IN thick, the deteriorated concrete shall be removed by rotomilling to one (1.0) inch above the rebar followed by hydro-demolition.~~ Conventional concrete removal, such as rotomilling and the use of pavement breakers shall not be utilized for slabs less than seven (7.0) inches thick. For slabs, 6.5 inches to 7.0 inches thick, special consideration must be given to methods of removal of the deteriorated concrete, such as hydro-demolition, so that damage of the remaining slab is minimized. A specialized concrete overlay will not be considered an acceptable method for deck retrofit for any bridge deck where the original slab thickness is less than 6.5 inches.

1073.3-ADDITIONAL REHABILITATION ISSUES

In past years, it was general practice in the steel bridge building industry to attach miscellaneous brackets, supports and details to the top flanges of stringers and floor beams by field welding. This work was not detailed on contract plans or steel fabrication drawings and was done to facilitate temporary support of various construction aids. The welding may have been performed under limited or no supervision, without proper preheat of the base material using electrodes of unknown quality and condition. Most of these welds were not removed prior to placing the deck.

The industry has since learned that these unauthorized welds are a potential source of fatigue cracking in the negative moment regions of the member flanges and should be removed during subsequent deck replacement. After removal, nondestructive testing is also appropriate to assure integrity of the member flange.

1073.4-TIMBER

Timber members may experience deterioration from decay, insect attacks, and mechanical damage.

Surface treatments or coatings are applied to existing bridge members to protect the wood. This is most effective when applied before decay begins and is used to treat splits, delaminations, mechanical damage or areas that were field fabricated during construction. Shallow penetration limits its effectiveness against established internal decay. Creosote is the preferred treatment. The wood surface should be thoroughly saturated with the treatment so that all cracks and crevices are coated. However, care must be exercised to prevent excessive amounts from spilling or running off the surface and contaminating water or soil. The effectiveness of surface treatments depends on the thoroughness of application, wood species, size, and moisture content at the time of treatment.

Mechanical repair methods use steel fasteners and additional wood or steel components to strengthen or reinforce members. These methods include splicing and stress laminating. Splicing is used to restore load transfer at a break, split, or other defect. Stress laminating may be used for the repair of nail-laminated decks.

Epoxy resins are used as a bonding agent in timber repairs. Epoxy seals the affected area, preventing water and other debris from entering. This should be limited to cosmetic repairs involving surface damage, not internal insect damage.

All timber repairs shall be in accordance with the Governing Specifications.

1073.5-DECK JOINTS

The following describes rehabilitation techniques associated with commonly used types of expansion joints. It is the WVDOH's policy to eliminate deck joints where practical. When replacing an expansion joint, the installation procedures shall be in accordance with the Governing Specifications and the Manufacturer's instructions.

1073.5.1-Open Joints: Finger joints are considered open joints. The major problems associated with finger joints are poor drainage, closed fingers, and loose attachments.

Improper drainage allows deicing chemicals, roadway grit, and gravel to collect on supporting beams and substructure units, causing accelerated rusting and concrete deterioration. Poor drainage can be corrected by first flushing the area to remove debris, then installing sheet metal deflectors or a neoprene trough to divert drainage and prevent the accumulation of debris. Future drainage problems can be prevented through frequent clearing of the drain troughs.

Finger joints that have become permanently closed can exert considerable forces on adjacent structural elements. Closed finger joints are a result of excessive movements of substructure units or insufficient allowances for roadway expansion. If roadway expansion is the cause of the joint closure, a pressure relief joint should be installed in the concrete approach pavement. When joints close due to excessive substructure movements, the unit that is causing the closure should be shifted to correct the problem. If the substructure unit is an abutment, the preferred solution, if practical, is to remove the joint and construct a semi-integral abutment. If the previously stated repairs are not economical, then the suggested means of relieving the pressure is to trim the expansion fingers or to remove and reinstall the entire joint system.

Structural components that have become loose, as a result of vehicular impact, can cause the joint to move in unanticipated ways and damage adjacent concrete. Excessive vertical movement may result in misalignment that can pose a roadway hazard. Finger bars that have broken loose at the welds should be repositioned and welded. Damaged curb plates, if still properly attached, should be straightened in place. Damaged concrete adjacent to the finger joint should be replaced.

1073.5.2-Closed Joints: Elastomeric expansion devices, compression seals, and strip seals are considered closed joints. Each type of closed joints has specific problems associated with them.

Elastomeric expansion devices are a sealed, waterproof joint consisting of steel plates and angles molded into a neoprene covering. Common joint failure occurs in the form of leaking, delamination, loosened or damaged anchor bolts, and damage caused by snowplows during snow removal. An elastomeric joint that shows signs of leaking can be repaired by resealing the joint. Where severe leakage has occurred, the entire section should be replaced. Elastomeric joints that have become delaminated should be replaced. Proper anchorage can be achieved by replacing loose or damaged anchor bolts with new bolts. A section of an elastomeric device that has been damaged by snowplows shall be replaced with a new elastomeric section.

Compression seals are extruded neoprene shapes that are chemically bonded to the adjacent structures. One common failure of compression seals is the loss of bond between the joint material and the adjoining concrete or steel section. The neoprene can also become twisted if the concrete surrounding the joint armoring is not fully consolidated. An acceptable repair for these problems is a complete replacement of the compression seal with a two-part silicone sealant. However, this should only be performed if the concrete headers are found to be in satisfactory condition. If headers have failed, replace with an elastomeric expansion device. If it is practical, the desired repair for a compression seal is to replace the joint and convert the abutment into an integral or semi-integral abutment.

Strip seals consist of a heavy duty-neoprene gland, snaplocked into an extruded steel anchorage. Failures found in strip seals are similar to the ones associated with those of a compression seal, loss of anchorage and deformation of the neoprene gland. A common repair is to remove the damaged neoprene gland and spalling concrete, patch the concrete with an elastomeric concrete, then reinstall the neoprene gland after the concrete has cured. If it is practical, the desired repair for a strip seal is to replace the joint and convert the abutment into an integral or semi-integral abutment.

1073.6-BEARINGS

The following briefly discusses problems common to all types of bearings. This applies to expansion, fixed, pot, sliding and elastomeric bearings. The accumulation of debris on bridge seats attracts and retains moisture. This, combined with deicing chemicals, will cause corrosion of any steel member; particularly components subjected to movement and large forces. Any repairs shall be in accordance with the Governing Specifications.

The decision to repair or replace should be based on the ability of the device to transfer vertical loads and to accommodate superstructure movement. Deficiencies that in most cases warrant repair include the following:

A. ~~Light~~ Heavy rust or surface scaling of non-contact surfaces.
~~B. Loss of lubrication.~~
~~C. Debris and dirt accumulation on the bearing seat.~~
~~D.~~B. ~~Minor~~ Significant tilting and displacement of bearing components at mild temperatures.
~~E.~~C. Heavily rusted masonry and keeper plates.
~~F.~~D. ~~Missing nuts~~ Heavily ~~or~~ deteriorated anchor ~~bolts~~ rods and nuts.

Bearings requiring replacement are ones that are severely deteriorated, suffered loss of function, and exhibit signs of imminent structural instability. The following can be used as a guideline in the choice of bearing replacement:

A. The ability of the bearing to provide the same functions as the existing in terms of load transfer and movement.
B. Compatibility with the environment.
C. Dimensions of new bearing, particularly the height.
D. Structural compatibility of the bearing with other bridge components.

1073.7-HISTORICAL STRUCTURES

Historic structures that are scheduled for rehabilitation shall adhere to the United States Department of Interior's *Standards for the Treatment of Historic Properties*. These standards can be obtained from the Technical Support Division, Environmental Section, of the WVDOH. The Designer shall work closely with the WVDOH on historic rehabilitation projects.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 2034
~~FATIGUE CRITICAL~~ NONREDUNDANT STEEL TENSION MEMBERS
January 17, 2023
Supersedes May 4, 2022
~~First Edition~~

As recommended by the Governing Specifications, the design of new structures will employ continuity or redundancy to provide one or more alternate load paths. Where the use of ~~fracture critical members (FCM)~~ nonredundant steel tension members (NSTM) is unavoidable and approved by the WVDOH, the ~~FCM~~ NSTM should be clearly designated on the contract drawings with the appropriate tension zones indicated and shall be fabricated according to Section 12 of AASHTO/AWS D1.5M/D1.5: ~~2002~~ current version, *Bridge Welding Code*~~, (Bridge Welding Code)~~.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

STRUCTURE DIRECTIVE 2045
CONCRETE SUPERSTRUCTURES
January 17, 2023
Supersedes May 4, 2022
~~First Edition~~

Concrete compressive strengths for precast beams shall be no more than 8,000 PSI at release (f'_{ci}) with a final compressive strength of 10,000 PSI (f'_{c}). Precast beams may be designed using higher strength concrete with approval of the State Bridge Engineer.

AASHTO ~~girders~~ beams shall be designed utilizing straight or straight and draped prestressing strands. These strands shall be AASHTO M 203, Grade 270, ~~0.5 inch or 0.5 inch special,~~ seven-wire, low-relaxation strands. ~~For high performance concrete, 0.6 inch strands may be used for economy.~~ Strand properties are shown in Table 2045.A.

Diameter	Area	Ultimate Strength	Applied Prestressing
0.5 Inch	0.153 IN^2	41.3 KIPS/strand	31.0 KIPS/strand
0.5 Inch (Special)	0.167 IN^2	45.1 KIPS/strand	33.8 KIPS/strand
0.6 Inch	0.217 IN^2	58.6 KIPS/strand	44.0 KIPS/strand

Table 2045.A

The FHWA currently requires a strand development length of 1.6 times the AASHTO development length requirement. This development length requirement shall be used for all strand sizes and spacing. The Designer should be aware that this might affect the use of beams in the 20 feet to 30 feet range.

All reinforcing bars are to be tied at all intersections except where spacing is less than twelve (12) inches in each direction; in which case, every other intersection shall be tied. Tack welding of steel reinforcing cages is not allowed. Designers shall assure that all submissions, such as shop drawings, fabrication details, erection plans, etc., do not reflect alternate fastening methods.

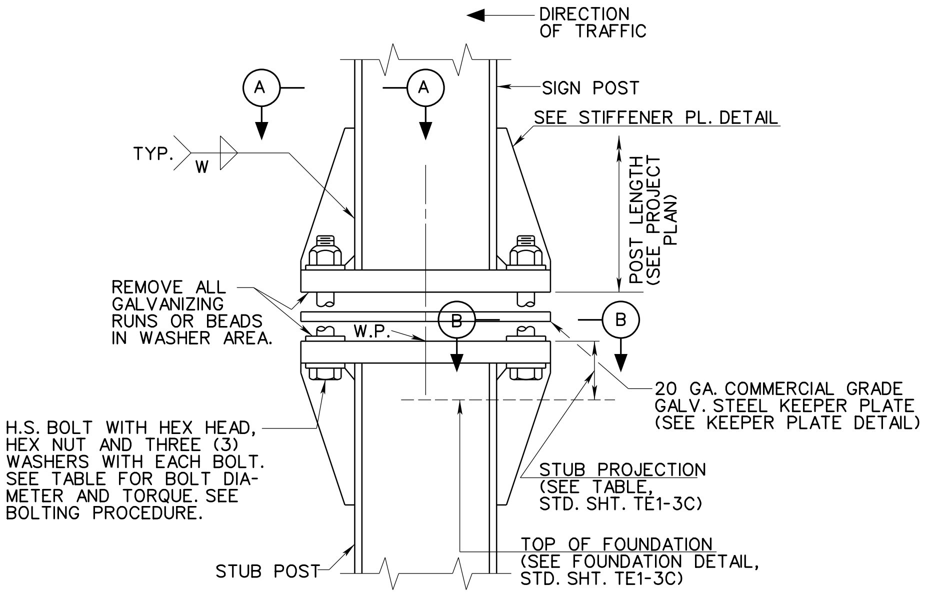
Prestressed ~~girder~~ beam spans shall be designed for the dead and live loads carried by the composite action of the slab and girders. Multi-span ~~girders~~ beams shall be designed as continuous for live load purposes.

In a situation where two or more ~~girders~~ beams of the same size require a slightly different number of strands, resulting from differences in design loadings (i.e., interior and exterior beams), use the greater number of strands if possible. This makes fabrication easier and reduces confusion during construction.

WVDOH Standard Details Vol II - Summary of Revisions

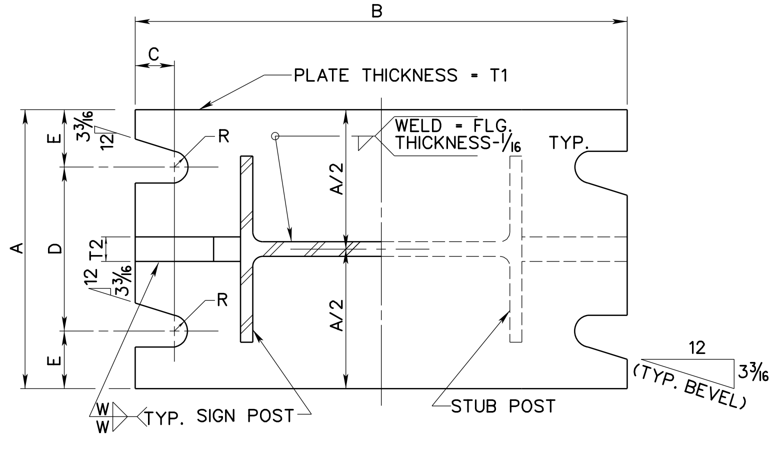
Sheet	Revision #	Date	Summary
TE1-3A	1	4/2022	Returned hinge plate dimensions to the previous standard. Revised T3 & D3 for S4 and W6 supports
TE1-3B	1	4/2022	Removed note allowing use of W10X22 behind guardrail or on a bench.
TE1-3C	1	4/2022	Returned to previous foundation sizes.
TE2-1A	1	11/11/2022	Increased the base plate to allow for more fasteners due to structural loads. Revised Note 1 to remove reference to three post option and to limit sign width to 6'. Revised Note 3 to clarify loads for fabricator to specify anchors. Added note to verify that the concrete structure mounting to will support these loads.
TE2-1B	1	11/11/2022	This option for three posts is not to be used. Loads are too great for typical bridge parapet.
TE2-2	1	11/11/2022	Increased the base plate to allow for more fasteners due to structural loads. Increased the number of required anchor bolts. This bracket is only allowed for Pipe Post Types 6 & 9. Note 4 was added to clarify loads for fabricator to specify anchors for retrofit option.
TE2-3	1	4/2022	Clarified the tubular steel post length to be based on TP3-1A.
TE3-1	1	2/22/2023	Increased the support bracket from W10X77 to W14X90 and revised associated dimensions. Added weld to flange portion of support bracket. Increased thickness of stiffener plate. Increased foundation diameter from 4'-6" to 5'-0" and number of vertical bars (See notes for TE3-2). Shifted Detail 4 and Coping Detail to make room for revision info.
TE3-2	1	6/2022	Added camber information to the sheet.
	2	2/22/2023	Increased the support bracket from W10X77 to W14X90. For TTS option, increased bolt circle (B) to 43" to meet the 1 1/2" clearance requirement between the nut and the post, which required the foundation diameter to increase. Decreased the S and F dimensions which previously were excessive. For the OTS option, increased bolt circle (B) to 26" to meet the 1 1/2" clearance requirement between the nut and the post. Increased the S and F dimensions. Increased the splice plate thickness (C) and added center hole diameter for base plate for both TTS and OTS types.
TE4-3A	1	2/22/2023	Added NPS to column headings and changed post to NPS in Member Size Chart. Revised plate dimensions and added max plate hole diameter to Footing Table. Revised end and box flange plates, revised bolt numbers for DAC-32 & DAC-40, and added Hole Diameter column to Box Connection Table.

TE4-3B	1	2/22/2023	Revised rules for allowable sign area and secondary arm member sizes. Original version allowed max sign area for each arm, but that is incorrect.
TE4-4A	1	11/18/2022	Revised foundation diameter and embedment depth; moved diameter information to new column in Footing Table. Added design soil parameters and 2:1 max slope to Elevations. Added 'W' dimension to the Box Connection Table for SACH-15, 25 & 35 designs. Increased post sizes for SACH-45 & 55 designs in the Member Size Chart and corrected arm sizes in the Box Connection Table. Added base plate hole diameter column to Footing Table. Added camber information.
TE4-4B	1	9/2020	Added Moment Arm Calculation to aid in determining proper design for multiple smaller signs. Revised bolt hole diameter in the Footing Table. Added 'W' dimension and 'X' dimension (TE4-5) to the Box Connection Table. Added camber angle.
	2	5/2022	Revised Arm A and Arm B lengths and added Arm B diameters in Member Size chart.
TE4-5	1	11/18/2022	Revised reinforcing based on footing size changes on TE4-4A.
TE5-1A	1	12/19/2022	Added camber information. Revised max span section length.
	2	2/22/2023	Revised chord member sizes. Deleted inappropriate weld.
TE5-1B	1	2/28/2022	Revised foundation reinforcement. Added Detail 8 to clarify reinforcing. Revised/Added bolt projection information. Clarified footing depth/embedment depth on Foundation Detail.
	2	12/19/2022	Updated Chord Splice Table to match changes made to TE5-1A. Deleted 8" post from Base Plate Table.
TE9-1	1	4/2022	Added saddle to all U-bolt connections on Type 2 and Type 3 details. Added Note 8 about including a saddle between the tube and the zee bar.
TEL-41	1	4/2022	Added note 5 to clarify requirements for size and number of hubs.
TES-31	1	3/2020	Revised sign number for pedestrian push buttons.
TEM-2 (2 of 2)	1	4/2022	Specified in notes 7 & 8 that markings that are to be used for turn movements in the middle of the intersection are to be Type V.



SIGN POST AND STUB POST ELEVATION

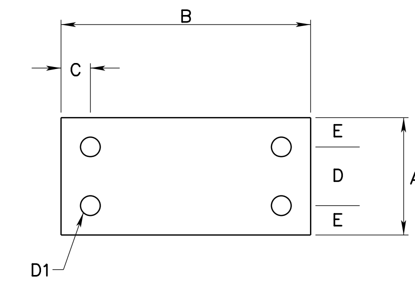
(FOR W SHAPES)



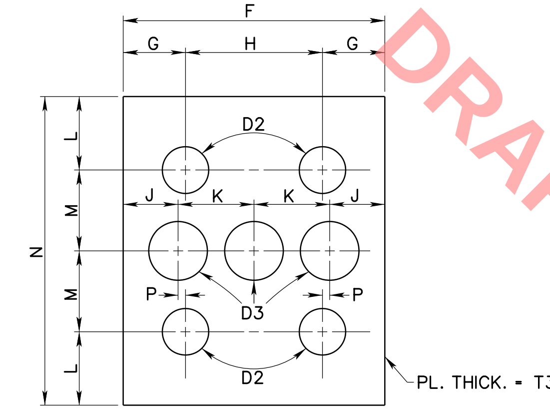
SECTION A-A SECTION B-B

(SEE TABLE FOR DIMENSIONS)

SECTIONS SHOWN ARE FOR INSTALLATIONS ON RIGHT SHOULDER AND IN GORE. PLATE SLOT BEVELS ARE OPPOSITE HAND FROM THAT SHOWN FOR INSTALLATIONS ON LEFT SHOULDER.

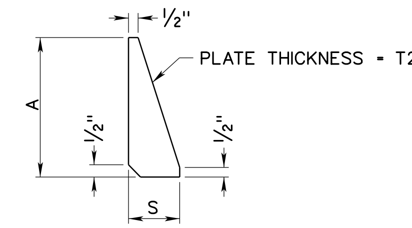


KEEPER PLATE



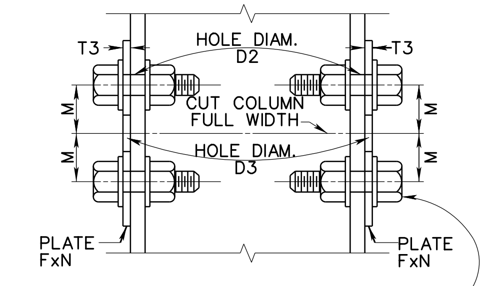
HINGE PLATE DETAIL

SEE TABLE FOR DIMENSIONS AND WEIGHT



STIFFENER PLATE DETAIL

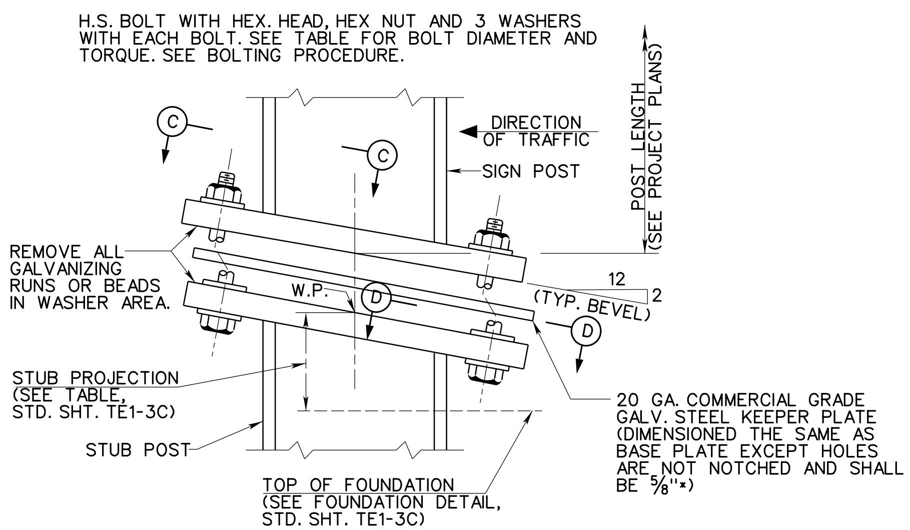
(SEE TABLE FOR DIMENSIONS)



H.S. BOLT, GALV., WITH HEX. HEAD, HEX. NUT AND WASHERS TYP. (USE BEVELED WASHERS WHERE NECESSARY) FOR TIGHTENING PROCEDURE SEE NOTE 1.

DETAIL A

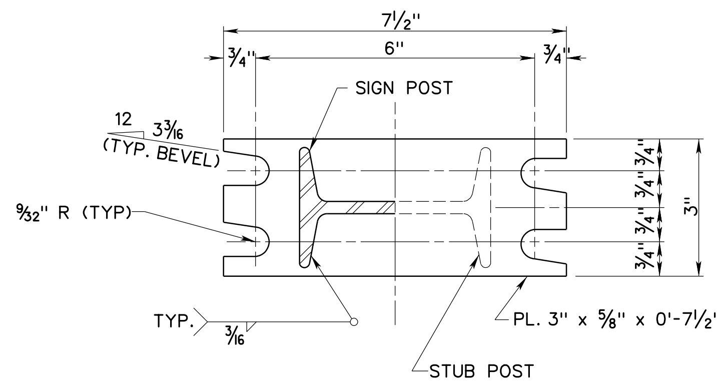
S AND W SHAPES (SIDE VIEW)



SIGN POST AND STUB POST ELEVATION

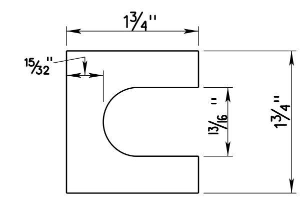
(FOR S SHAPES)

"S" SHAPES IN MEDIAN SHALL HAVE A FLAT CONNECTION (WITH NO BEVEL)



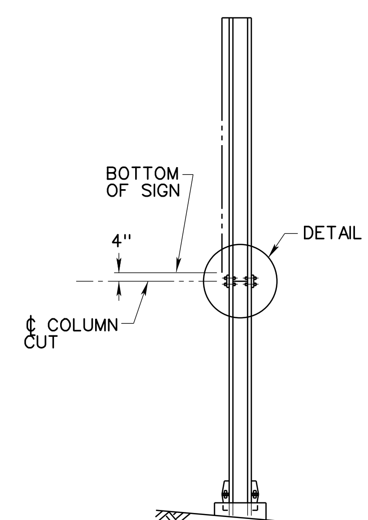
SECTION C-C SECTION D-D

SECTIONS SHOWN ARE FOR INSTALLATIONS ON RIGHT SHOULDER AND IN GORE. PLATE SLOT BEVELS ARE OPPOSITE HAND FROM THAT SHOWN FOR INSTALLATIONS ON LEFT SHOULDER.



FURNISH 2-.012± THICK AND 2-.032± THICK SHIMS PER POST.

SHIM DETAIL



FOR ALL SHAPES

NOTES:

1. PROCEDURE FOR ASSEMBLY OF HINGE PLATE:
   A. ASSEMBLE CONNECTION AND PRE-TIGHTEN THE BOLTS IN A MANNER CONSISTENT WITH THE SNUG TIGHTENING PROCEDURES DESCRIBED IN THE RESEARCH COUNCIL ON STRUCTURAL CONNECTIONS (RCSC) SPECIFICATION FOR STRUCTURAL JOINTS USING HIGH-STRENGTH BOLTS.
   B. FULLY TIGHTEN THE BOLTS BY ROTATING THE NUTS IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
2. PROCEDURE FOR ASSEMBLY OF BASE CONNECTION:
   A. ASSEMBLE POST TO STUB WITH BOLTS AND WITH ONE FLAT WASHER ON EACH BOLT BETWEEN PLATES.
   B. SHIM AS REQUIRED TO PLUMB POST.
   C. BASE PLATE BOLTS ARE TO BE TORQUED USING A "CLICK" TYPE TORQUE WRENCH MEETING THE REQUIREMENTS SPECIFIED IN SECTION 657 OF THE STANDARD SPECIFICATIONS.
3. POST SHALL BE SAW CUT BEFORE GALVANIZING.
4. MATERIALS AND FABRICATION SHALL CONFORM TO THE REQUIREMENTS OF THE WEST VIRGINIA DIVISION OF HIGHWAYS SPECIFICATIONS. ALL HOLES SHALL BE DRILLED. ALL PLATE CUTS SHALL BE SAW CUTS. FLAME CUTTING WILL BE PERMITTED PROVIDED ALL EDGES ARE GROUND. METAL PROJECTING BEYOND THE PLANE OF THE PLATE FACE WILL NOT BE TOLERATED.

W.P. = WORK POINT

BASE CONNECTION DATA TABLE (IN.)												
POST SIZE	BOLT SIZE	A	B	C	D	E	S	T1	T2	W	R	D1
S4 x 7.7	1/2" X 2 1/2"	SEE DETAIL										5/8
W6 x 12	5/8" X 2 3/4"	5	10	3/4	2 3/4	1 1/8	2	3/4	1/2	5/16	11/32	3/4
W8 x 18	3/4" X 3 1/2"	6	12 5/8	7/8	3 1/2	1 1/4	2 1/4	1	3/4	5/16	13/32	7/8
W10 x 22	3/4" X 3 1/2"	6	14 5/8	7/8	3 1/2	1 1/4	2 1/4	1	3/4	5/16	13/32	7/8

HINGE PLATE DATA TABLE (IN.) ⚠1												
F	G	H	J	K	L	M	N	P	T3	D2	D3	BOLT DIA.
2 3/4	5/8	1 1/2	9/16	13/16	7/8	1 1/8	4	1/16	1/4	9/16	5/8	1/2
4	7/8	2 1/4	25/32	17/32	1 1/4	1 1/4	5	3/32	1/4	13/16	7/8	3/4
5 1/4	1 1/4	2 3/4	1	1 5/8	1 1/2	1 1/2	6	1/4	3/8	15/16	1 1/4	7/8
5 3/4	1 1/2	2 3/4	1 1/4	1 5/8	1 1/2	1 1/2	6	1/4	3/8	15/16	1 1/4	7/8

SEE TE1-3B FOR POST SELECTION
SEE TE1-3C FOR FOUNDATION DATA

⚠1 REVISED T3 & D3 FOR S4 & W6 SUPPORTS

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018

REVISION DATE
⚠1 4/2022

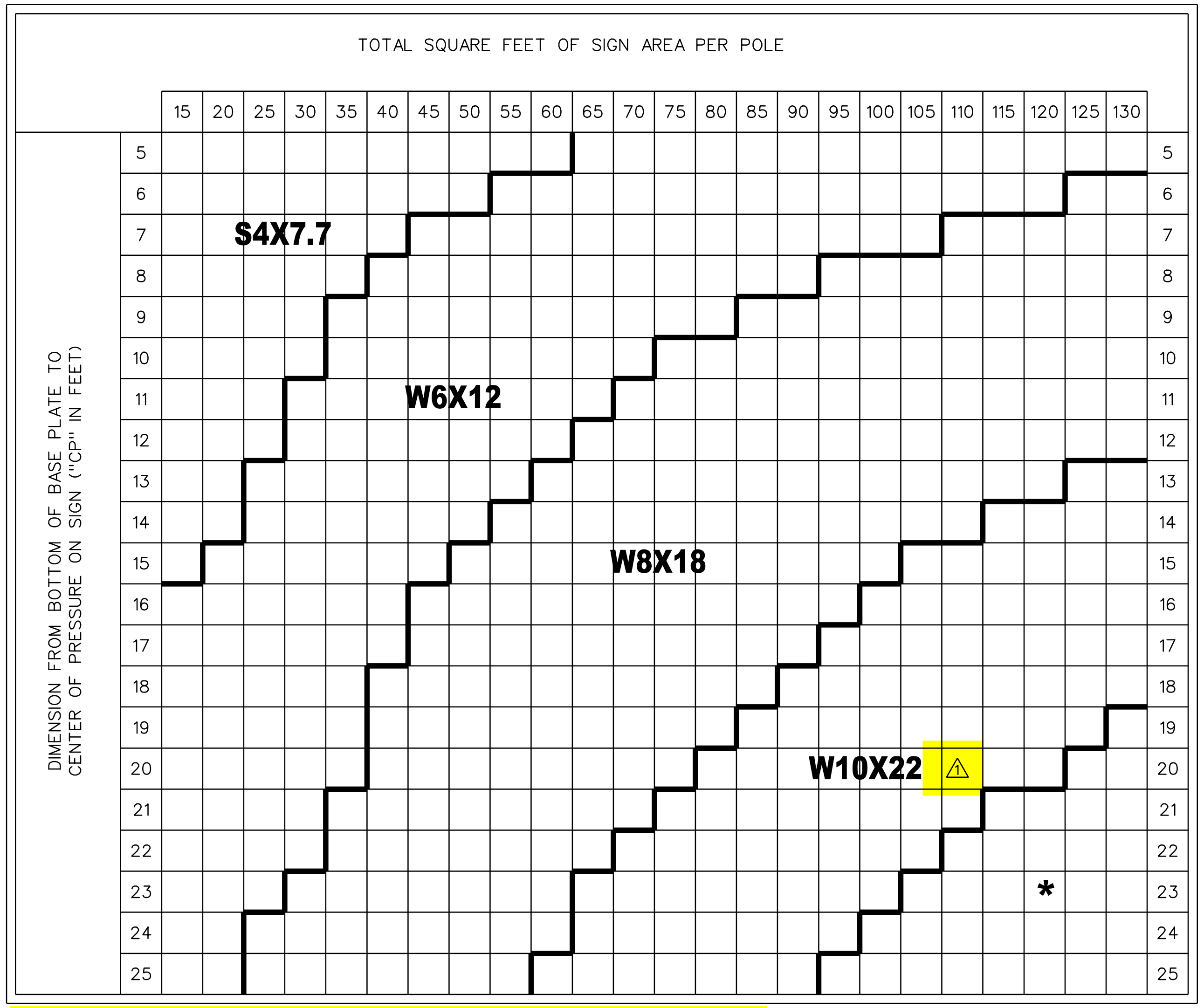
ROADSIDE SIGN SUPPORTS STEEL BEAM TYPE

STANDARD SHEET TE1-3A

J04C02C03-STDBDR.c

Z:\Projects\WVDOT\Standard Details vol II\Final Submittal\Revised 4-2022\Revised DGNs\Revised 4-2022\TE1-3A Rev 4-2022.dgn 4/2023

SUPPORT SIZE SELECTION CHART



* REDESIGN USING ADDITIONAL SUPPORT

NOTES:

1. THE POST SELECTION CHART IS BASED IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 4TH EDITION, 1994.
2. FOR BASE CONNECTIONS TO BE USED IN CONJUNCTION WITH THE POST SELECTION CHART SHOWN, SEE SHEET TE1-3A.
3. FOR FOUNDATION, SEE SHEET TE1-3C.

POST SELECTION PROCEDURES:

BEFORE SELECTING AND SPECIFYING THE USE OF STEEL BEAM TYPE SUPPORTS FOR FLAT SHEET SIGNS, DUE CONSIDERATION SHOULD BE GIVEN TO THE USE OF U-CHANNEL SUPPORTS, INCLUDING BACK-TO-BACK U-CHANNEL. SEE SHEET TE1-7A AND TE1-7B.

1. DETERMINE TOTAL SIGN AREA OF PANEL(S).
2. DETERMINE PRELIMINARY SELECTION OF NUMBER OF POSTS USED.
3. DETERMINE HEIGHT FROM BASE PLATE OF THE LONGEST SUPPORT TO THE CENTER OF PRESSURE * OF THE SIGN(S).
4. CALCULATE THE SQUARE FOOTAGE OF SIGN PER SUPPORT (TOTAL SQUARE FOOTAGE DIVIDED BY NUMBER OF SUPPORTS.
5. USE THE TABLE TO DETERMINE POST SIZE.
6. VERIFY THAT THE SELECTED POST SIZE MAY BE USED BASED ON MINIMUM REQUIRED POST SPACING AND/OR THE AVAILABILITY OF AN APPROVED OMNI-DIRECTIONAL BREAKAWAY DEVICE FOR THE SELECTED SIGN POST, AS APPLICABLE.
7. IF NOT, CHANGE NUMBER OF POSTS USED AND REPEAT STEPS 4, 5, & 6.

SEE THE DESIGN GUIDE FOR SIGNING FOR EXAMPLES.

OMNI-DIRECTIONAL BREAKAWAY DEVICE REQUIREMENTS

IF AN ASSEMBLY IS TO BE INSTALLED NEAR A ROADWAY AND ORIENTED SUCH THAT THE WEBS OF THE SUPPORT BEAMS ARE NOT PARALLEL TO THE ROADWAY, AN APPROVED OMNI-DIRECTIONAL BREAKAWAY DEVICE SHALL BE SPECIFIED FOR USE WITH THE SUPPORTS UNLESS ONE OF THE FOLLOWING REQUIREMENTS ARE MET:

- THE SUPPORTS ARE OUTSIDE OF THE CLEAR ZONE OF THE ROADWAY;
- THE SUPPORTS ARE PROTECTED FROM ERRANT VEHICLES BY GUARDRAIL OR CONCRETE BARRIER. THIS IS PROVIDED PROPER CONSIDERATION IS GIVEN TO THE BARRIER LENGTH OF NEED POINT AND THE ANGLE OF DEPARTURE OF THE ERRANT VEHICLE PER DESIGN DIRECTIVE 662 (USE THE ANGLE SPECIFIED FOR NHS PROJECTS). ALSO, SEE SHEET TP3-1C.

NOTE, AN APPROVED OMNI-DIRECTIONAL BREAKAWAY DEVICE MAY NOT BE AVAILABLE FOR ALL OF THE SUPPORT SIZES LISTED. IN ADDITION, SUPPORT SPACING REQUIREMENTS FOR EACH APPROVED OMNI-DIRECTIONAL DEVICE MAY VARY FROM THOSE SHOWN HEREIN. A DEVICE THAT DOES NOT REQUIRE ADJUSTMENT OF THE SUPPORT SPACING TO MEET THE DEVICE REQUIREMENTS SHALL BE USED. IF NONE ARE AVAILABLE, THE STANDARD SPACING BETWEEN SUPPORTS MAY BE ADJUSTED AT THE DISCRETION OF THE ENGINEER IN ORDER TO MEET THE DEVICE SUPPORT SPACING REQUIREMENTS. OTHERWISE, THE SUPPORT TYPE/SIZE OR ASSEMBLY LOCATION MUST BE ADJUSTED TO MEET THE REQUIREMENTS HEREIN.

OMNI-DIRECTIONAL BREAKAWAY DEVICES SHAL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS. IF SPECIFIC TORQUE VALUES ARE SPECIFIED FOR FASTENERS OF THE DEVICE, THEY SHALL BE TORQUED USING A "CLICK" TYPE TORQUE WRENCH MEETING THE REQUIREMENTS SPECIFIED IN SECTION 657 OF THE STANDARD SPECIFICATIONS.

* CENTER OF PRESSURE IS THE VERTICAL DISTANCE MEASURED FROM THE LOWEST POINT WHERE A SUPPORT MEETS THE GROUND TO THE CENTROID OF THE SIGN ASSEMBLY.

SUPPORT SPACING REQUIREMENTS

NO MORE THAN TWO (2) S4X7.7, W6X12, OR W8X18 SUPPORTS MAY BE PLACED WITIHN A SEVEN (7) FOOT WIDTH, AND NO MORE THAN ONE (1) W10X22 SUPPORT MAY BE PLACED WITHIN A SEVEN (7) FOOT WIDTH UNLESS ONE OF THE FOLLOWING REQUIREMENTS ARE MET:

- THE SUPPORTS ARE OUTSIDE OF THE CLEAR ZONE OF THE ROADWAY;
- THE SUPPORTS ARE PROTECTED FROM ERRANT VEHICLES BY GUARDRAIL OR CONCRETE BARRIER. THIS IS PROVIDED PROPER CONSIDERATION IS GIVEN TO THE BARRIER LENGTH OF NEED POINT AND THE ANGLE OF DEPARTURE OF THE ERRANT VEHICLE PER DESIGN DIRECTIVE 662 (USE THE ANGLE SPECIFIED FOR NHS PROJECTS). ALSO, SEE SHEET TP3-1C.

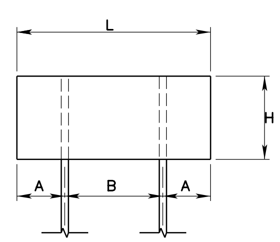
DIFFERENT SPACING REQUIREMENTS MAY APPLY IF AN OMNI-DIRECTIONAL BREAKAWAY DEVICE IS REQUIRED. SEE THE NOTES CONTAINED HEREIN REGARDING SUCH DEVICES.

IN NO CASE SHALL SUPPORTS BE SPACED AT A DISTANCE LESS THAN THE DIAMETER OF THE SUPPORT FOUNDATION (SEE TE1-3C). SUPPORT SPACING SHALL BE INCREASED AS REQUIRED IN SUCH CASES WITH THE APPROVAL OF THE ENGINEER.

THE SUPPORT SPACING SHALL BE DETERMINED BASED ON THE GREATER OF:

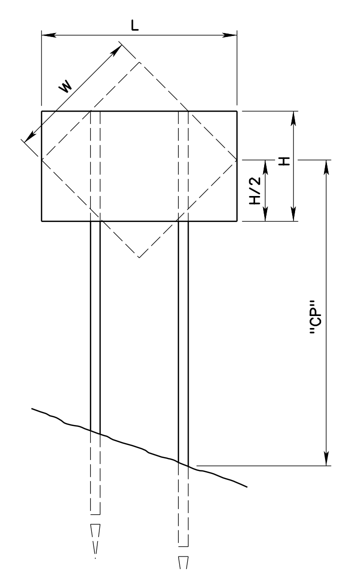
A) THE WIDEST SINGLE SIGN THAT IS ATTACHED TO ALL OF THE ASSEMBLY SUPPORTS OR
B) THE COMBINED OVERALL WIDTH OF SIGNS THAT ARE ATTACHED TO THE SAME PIECES OF RIBBING HAVING THE LARGEST OVERALL WIDTH, AND THAT ARE ATTACHED TO ALL OF THE ASSEMBLY SUPPORTS.

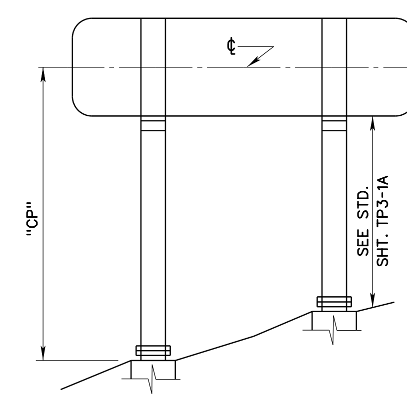
AN EXAMPLE OF B) WOULD BE ROUTE MARKER ASSEMBLIES AS DETAILED ON THE TP4 SHEETS. FOR DIAMOND WARNING SIGN ASSEMBLIES ON TWO SUPPORTS, SEE SHEET TP4-2 FOR SUPPORT SPACING UNIQUE TO THAT APPLICATION.



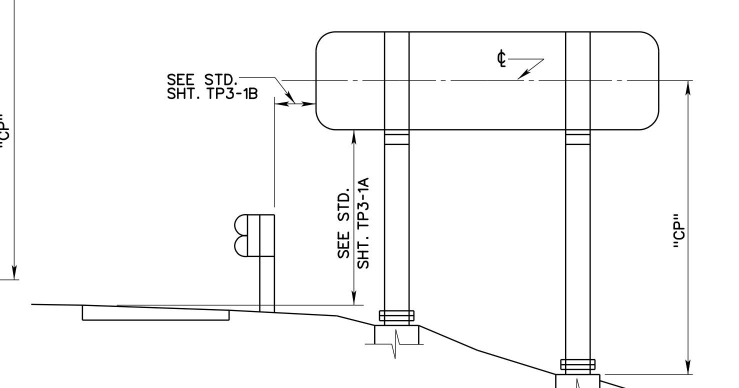
POST SPACING		
NO. OF POSTS	DIM A	DIM B
2	0.2L	0.6L
3	0.14L	0.36L
4	0.11L	0.26L
5	0.08L	0.21L

POST SPACING



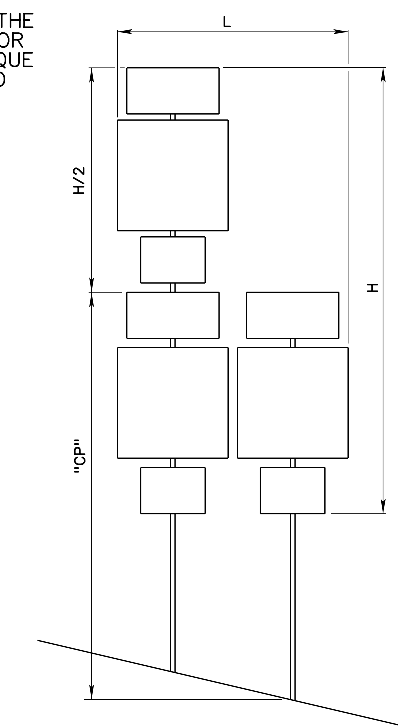


CUT SECTION



FILL SECTION

CENTER OF PRESSURE



ROUTE MARKER

⚠ REMOVED NOTE ALLOWING USE BEHIND GR OR ON BENCH

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

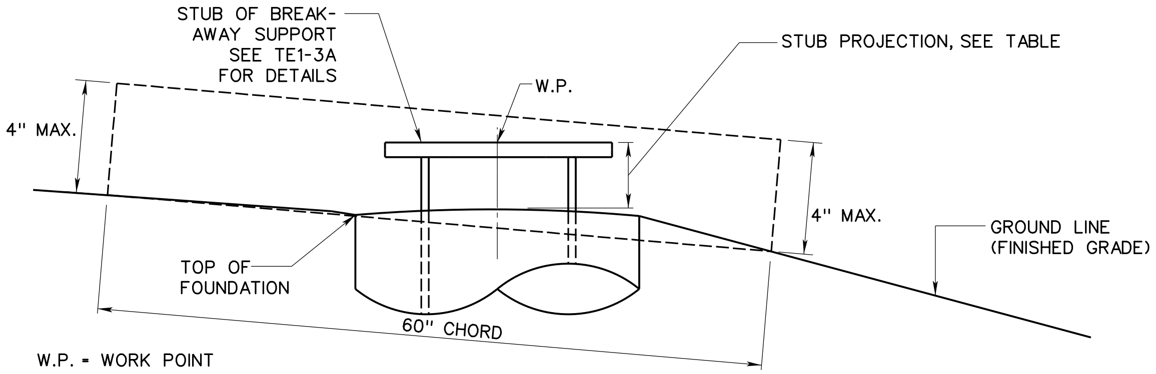
PREPARED: 8/2018

REVISION DATE
⚠ 4/2022

ROADSIDE SIGN SUPPORTS STEEL BEAM TYPE

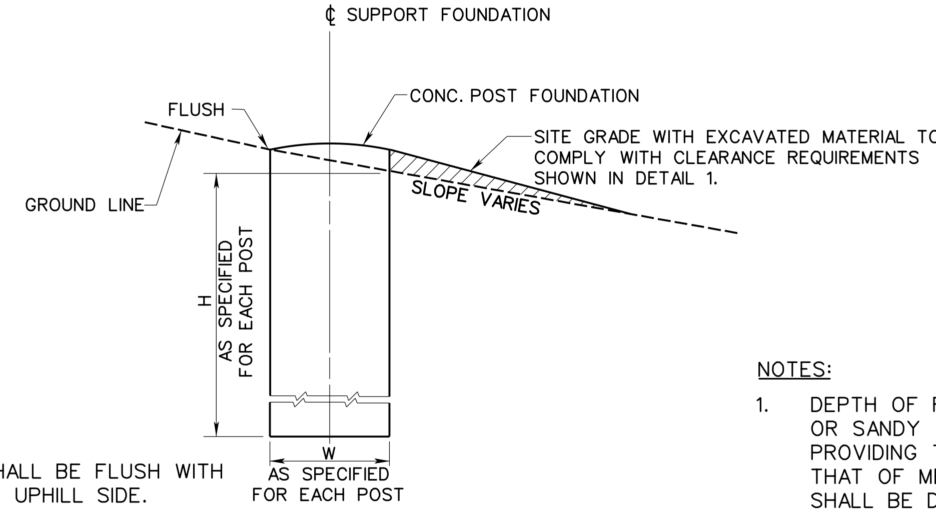
STANDARD SHEET TE1-3B

TRAFFIC ENGINEERING DIVISION



DETAIL 1

THE PROJECTION OF THE STUB ABOVE GROUND LEVEL IS TO NOT EXTEND ABOVE A 60 INCH WIDE CHORD WHICH EXTENDS 4 INCHES ABOVE THE GROUND LEVEL ON EACH END AS SHOWN ON DETAIL 1.

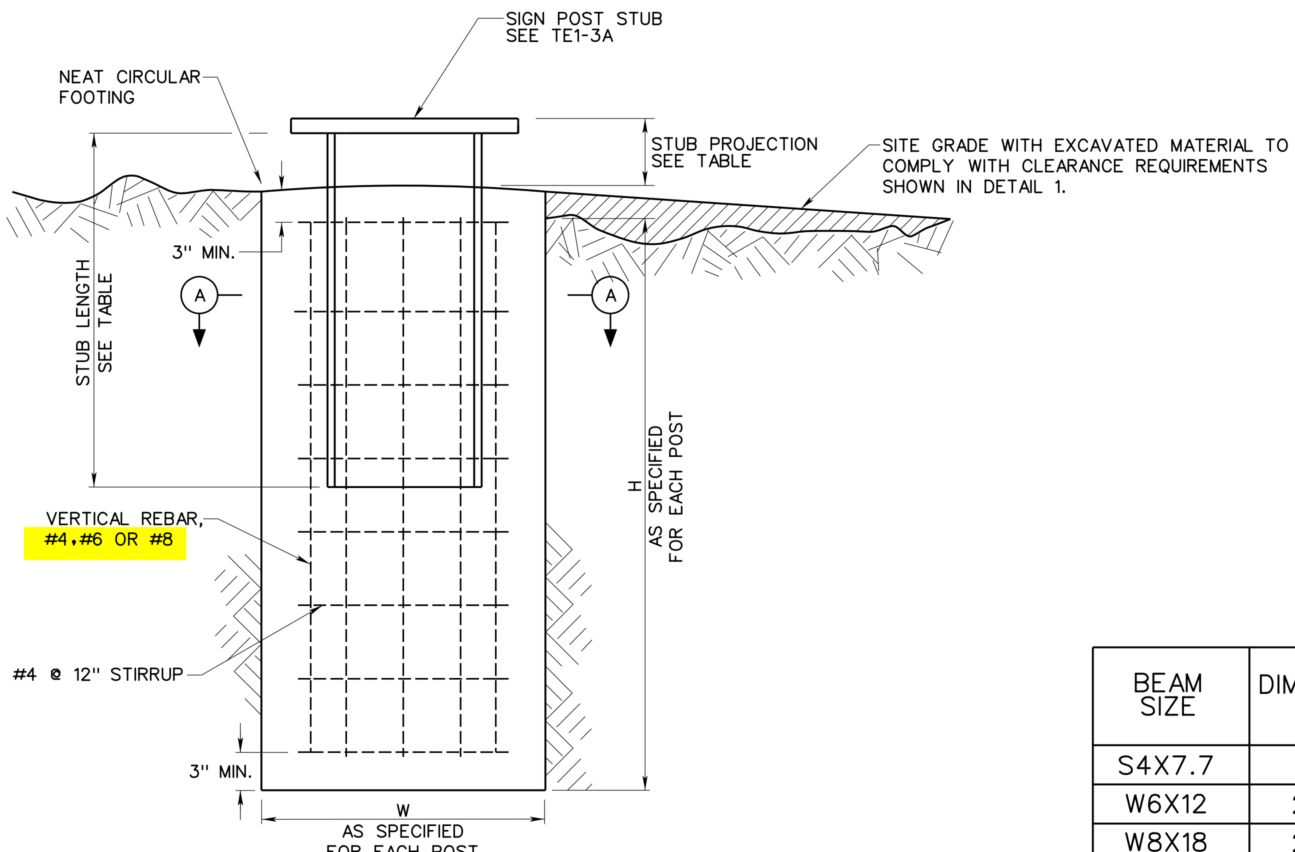


NOTE:
FOOTING SHALL BE FLUSH WITH GROUND ON UPHILL SIDE.

FOUNDATION IN SLOPE

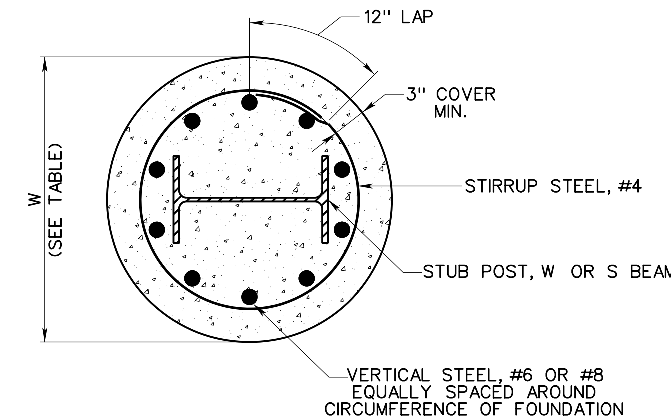
NOTES:

1. DEPTH OF FOUNDATIONS IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SANDY CLAY. THESE FOUNDATIONS MAY BE USED IN OTHER TYPE SOILS PROVIDING THAT THE SOIL'S RESISTANCE TO LATERAL LOADS IS NOT LESS THAN THAT OF MEDIUM CLAY, OR A MAXIMUM BEARING OF 3000 LBS/SQ. FT. FOUNDATIONS SHALL BE DEEPENED AS DIRECTED BY THE ENGINEER TO ADAPT TO LOCAL SOIL CONDITIONS.
2. DEPTH OF FOUNDATIONS SHALL BE MEASURED FROM THE DOWNHILL SIDE OF THE SLOPE FROM THE TOP OF THE UNEXCAVATED MATERIAL AS SHOWN ON THE DRAWING.
3. THE TOPS OF ALL FOUNDATIONS SHALL BE FINISHED SMOOTH WITH THE CONCRETE SLOPING SLIGHTLY DOWNWARD FROM THE STUB TO THE EDGE OF THE FOOTER IN ORDER TO FACILITATE DRAINAGE.
4. IF THE SLOPE IS 4:1 OR GREATER AND IT IS NOT POSSIBLE TO BUILD UP THE DOWNHILL SIDE OF THE GROUND SLOPE IN ORDER TO ALLOW THE TOP OF THE FOUNDATION TO BE LEVEL. THE CONTRACTOR SHALL INCORPORATE A FORM AS DESCRIBED IN SECTION 657 OF THE STANDARD SPECIFICATIONS.



ELEVATION

FOUNDATION DETAIL



SECTION A-A

FOUNDATION REQUIRED PER POST

BEAM SIZE	DIMENSION W	DIMENSION H✳ ⚠	CUBIC YARDS OF CONCRETE ⚠	VERTICAL STEEL ⚠	STIRRUP STEEL	STUB LENGTH	STUB PROJECTION
S4X7.7	1'-6"	4'-0"	0.3	6-#4	#4 @ 12"	1'-6"	3½"
W6X12	2'-6"	4'-0"	0.7	6-#4	#4 @ 12"	2'-0"	3"
W8X18	2'-6"	5'-6"	1.0	6-#6	#4 @ 12"	2'-6"	3"
W10X22	2'-6"	6'-6"	1.2	6-#8	#4 @ 12"	3'-0"	2½"

THE VOLUME OF CONCRETE SHOWN IN TABLE DOES NOT INCLUDE ADDITIONAL CONCRETE THAT MAY BE REQUIRED WHEN THE FOUNDATION IS IN A SLOPE AND MUST BE EXTENDED SO THAT THE TOP OF THE FOUNDATION IS FLUSH WITH THE UPHILL SIDE. SEE DETAIL ABOVE.

✳FOR EXCEPTIONS SEE NOTE 1

⚠ REVISED FOUNDATION FOR ALL SUPPORT SIZES

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 4/2022

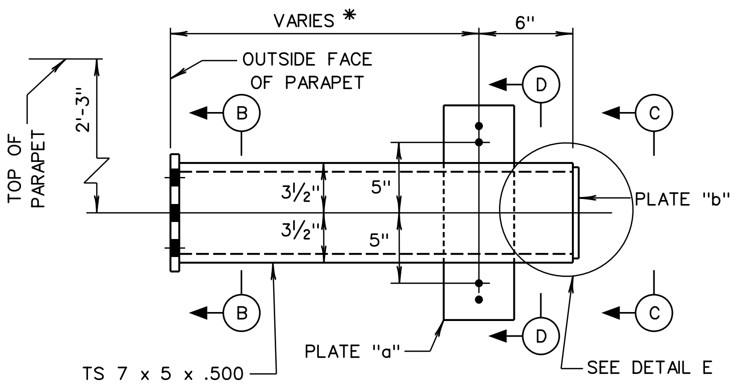
ROADSIDE SIGN SUPPORTS STEEL BEAM TYPE

STANDARD SHEET TE1-3C

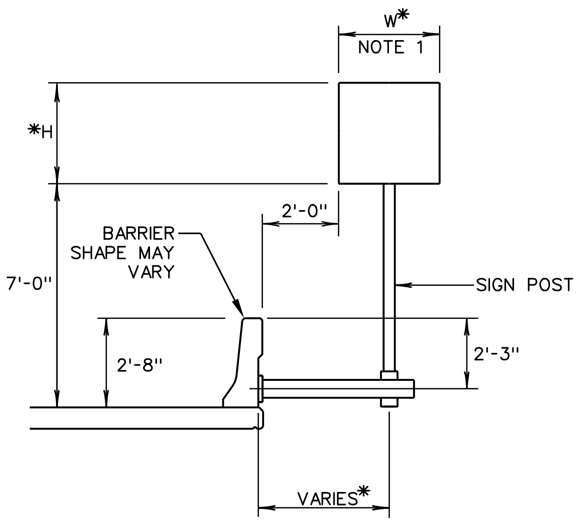
TRAFFIC ENGINEERING DIVISION

* - SIGN SIZE AND SHAPE VARIES
SEE CONTRACT PLANS

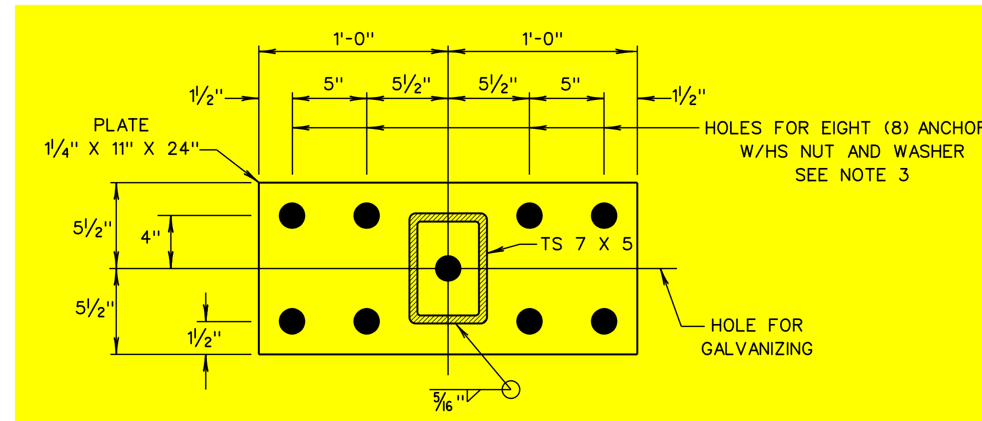
ARM SHALL BE MOUNTED TO WALL SO THAT THE 5" X 15" PLATES WELDED TO THE TUBE ARE ON THE BACK SIDE. THE POST FLANGES SHALL BE MOUNTED AGAINST THESE PLATES.



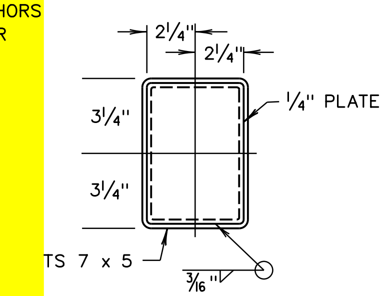
FRONT VIEW



ELEVATION

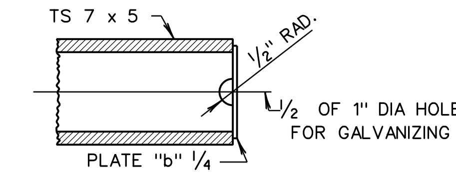


SECTION B-B ⚠

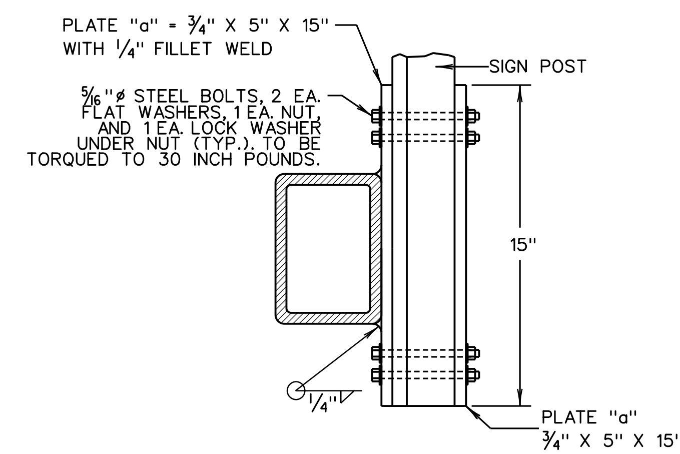


SECTION C-C

TYPE K - ONE SUPPORT



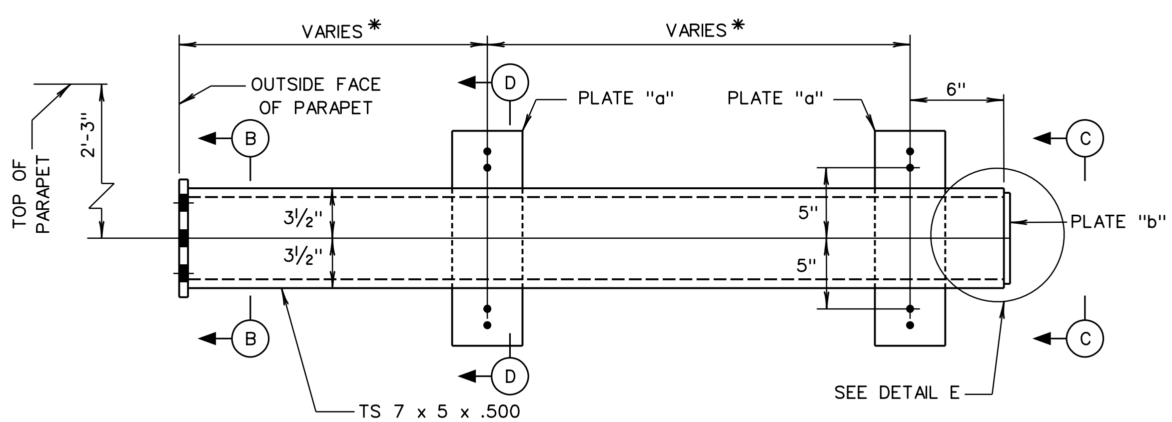
DETAIL E



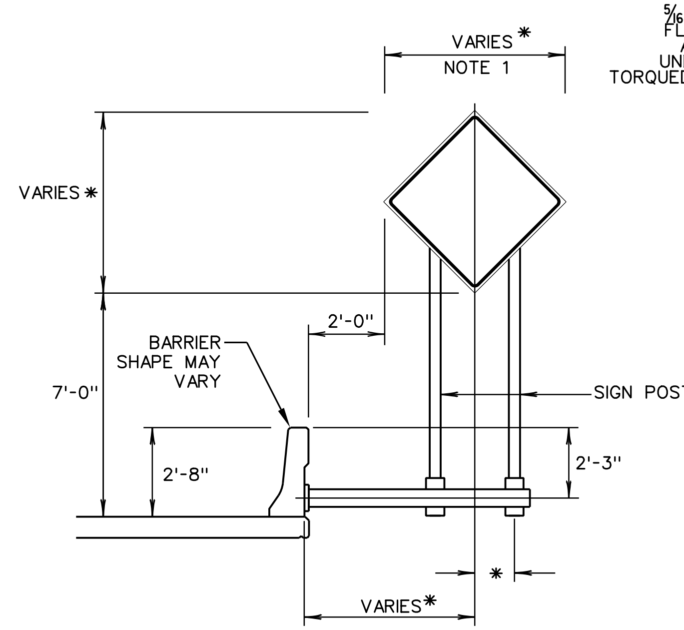
SECTION D-D

* - SIGN SIZE AND SHAPE VARIES
SEE CONTRACT PLANS

ARM SHALL BE MOUNTED TO WALL SO THAT THE 5" X 15" PLATES WELDED TO THE TUBE ARE ON THE BACK SIDE. THE POST FLANGES SHALL BE MOUNTED AGAINST THESE PLATES.



FRONT VIEW



ELEVATION

TYPE K - TWO SUPPORTS

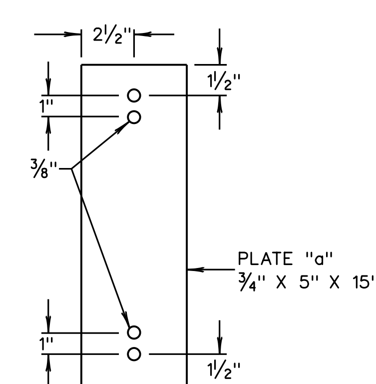


PLATE "a"

NOTES:

1. THE FOLLOWING GUIDELINES SHOULD BE FOLLOWED WHEN SELECTING THE NUMBER OF SUPPORTS TO BE USED WITH THE TYPE K BRACKET:
   - SIGNS GREATER THAN 36 IN. WIDE SHOULD BE INSTALLED ON A MINIMUM OF TWO (2) SUPPORTS, 36" DIAMONDS EXCLUDED.
   - ⚠ TYPE K BRACKET SHALL NOT BE USED FOR ANY SIGN GREATER THAN 6 FT IN WIDTH.
2. ONLY 3# U-CHANNEL SUPPORTS SHALL BE USED WITH TYPE K BRACKETS. REFER TO CHART ON TE1-7A TO CONFIRM 3# U-CHANNEL WILL WORK FOR THE SIGN TO BE INSTALLED.
3. ⚠ ANCHOR SIZE SHALL BE SPECIFIED BY THE MOUNT FABRICATOR ALONG WITH THE ANCHORAGE. EACH ANCHOR SHALL BE DESIGNED FOR A MAXIMUM SERVICE TENSILE LOAD OF 4,000 LBS AND SHEAR SERVICE LOAD OF 2,000 LBS. A FACTOR OF SAFETY OF 4 SHALL BE APPLIED TO THESE LOADS WHEN SELECTING THE ANCHORS. HOLE SIZE SHALL BE 1⁄16 IN LARGER THAN ANCHOR DIAMETER. THE DESIGNER SHALL VERIFY THAT THE STRUCTURE (BARRIER, BRIDGE DECK, WALL, ETC.) HAS THE CAPACITY TO SUPPORT THE SIGN STRUCTURE LOADING.
4. ALL ITEMS SHOWN ON THIS DETAIL SHEET SHALL BE IN ACCORDANCE WITH SECTION 657 OF THE WEST VIRGINIA DIVISION OF HIGHWAYS STANDARD SPECIFICATIONS, ROADS AND BRIDGES, CURRENT EDITION, AND ALL CURRENT SUPPLEMENTAL SPECIFICATIONS.

FOR SIGNS TWELVE (12) INCHES OR LESS IN ACTUAL WIDTH TO BE INSTALLED ON PARAPETS, THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET DESCRIBED IN SECTION 657 OF THE STANDARD SPECIFICATIONS SHALL BE SPECIFIED IN LIEU OF THE TYPE K OR L BRIDGE OR RETAINING WALL SIGN MOUNTING BRACKETS. THIS IS PROVIDED THE ALLOWABLE LOADING ON THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET WILL NOT BE EXCEEDED. THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET IS REQUIRED TO WITHSTAND LOADING WHICH MEETS OR EXCEEDS THAT WHICH WILL BE GENERATED BASED ON THE LIMITS PROVIDED FOR THE THREE (3) LB PER FOOT U-CHANNEL SUPPORT ON THE SUPPORT SIZE SELECTION CHART ON SHEET TE1-7A. IF THE TYPE A BRACKET IS SPECIFIED, THE "SQUARE TUBE SUPPORT," 2.00X14GA" BID ITEM SHALL BE SPECIFIED AND USED FOR PAYMENT OF THE SUPPORT.

⚠ REVISED NOTE 2 TO REMOVE REFERENCE TO 3-POST SUPPORT AND LIMIT SIGN WIDTH TO 6'.
REVISED NOTE 3 TO CLARIFY LOADS.
REVISED BASE PLATE DIMENSIONS TO INCREASE BOLT QUANTITY TO 8.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
PREPARED: 8/2018
⚠ 11/11/2022

BRIDGE OR RETAINING WALL SIGN MOUNTING
TYPE K
1 & 2 SUPPORTS

STANDARD SHEET TE2-1A

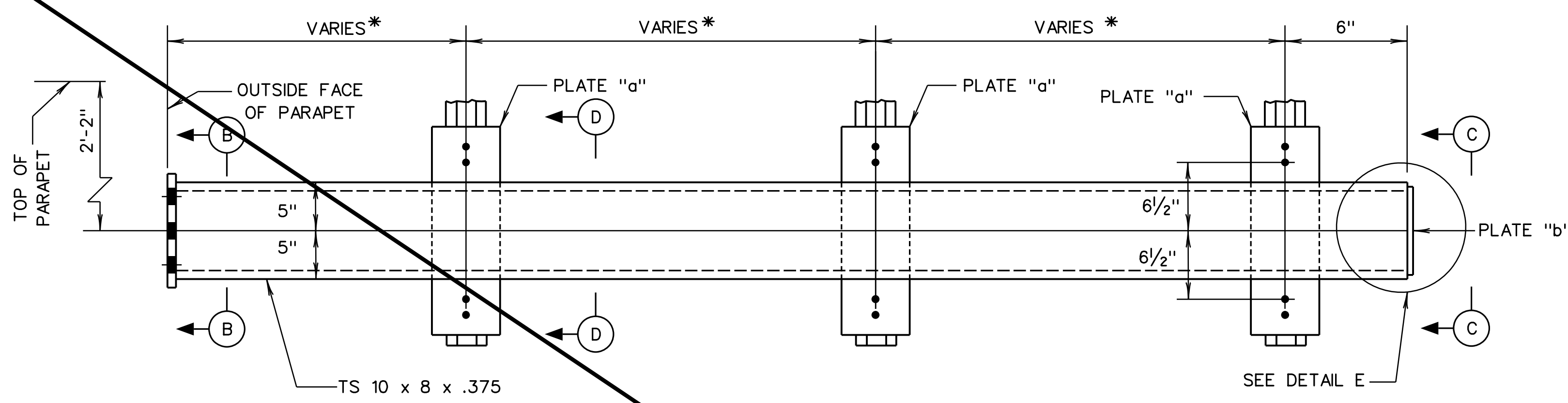
TRAFFIC ENGINEERING DIVISION

J04C02C03-STDBDR.c

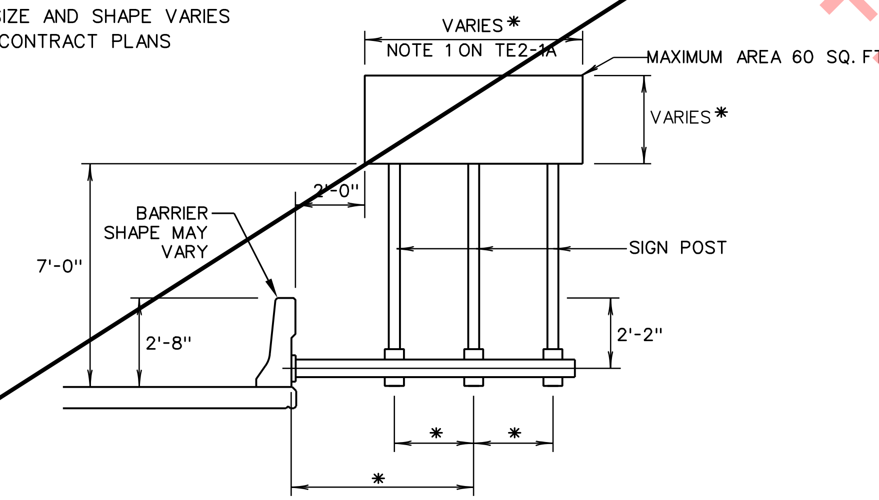
DRAFT

ARM SHALL BE MOUNTED TO WALL SO THAT THE 5" X 18" PLATES WELDED TO THE TUBE ARE ON THE BACK SIDE. THE POST FLANGES SHALL BE MOUNTED AGAINST THESE PLATES.

✱ - SIGN SIZE AND SHAPE VARIES SEE CONTRACT PLANS

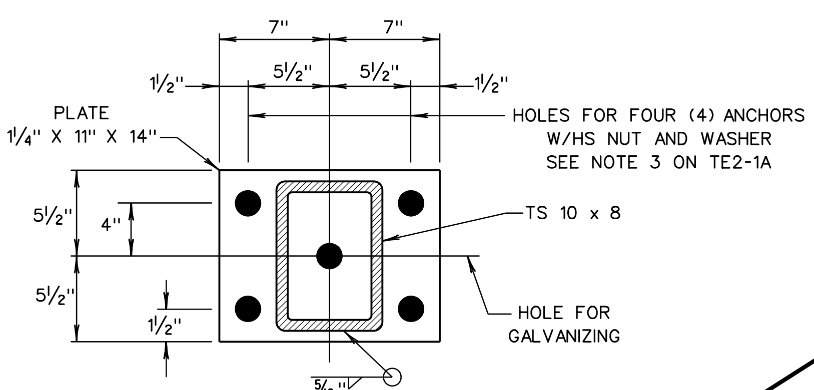


FRONT VIEW

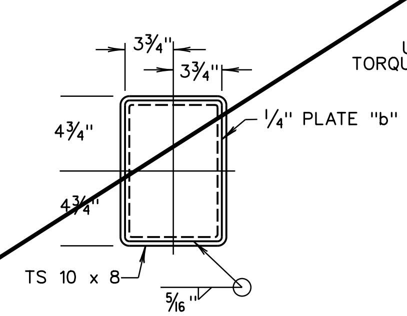


ELEVATION

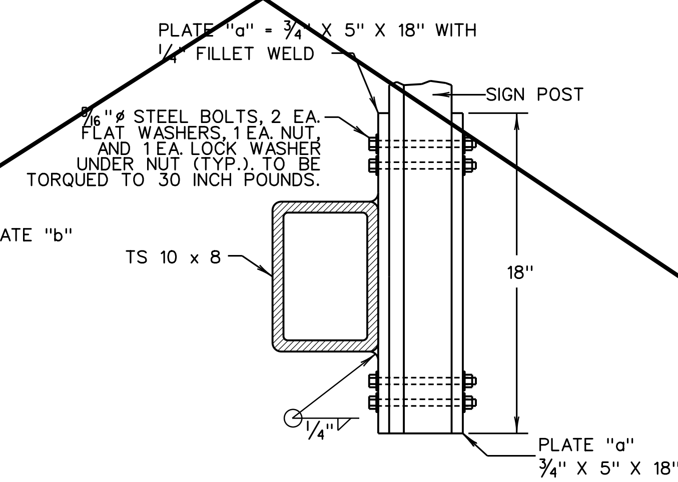
TYPE K - THREE SUPPORTS



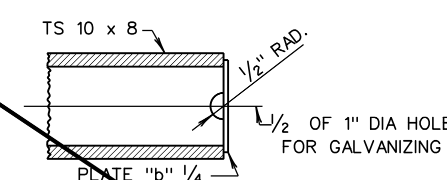
SECTION B-B



SECTION C-C



SECTION D-D



DETAIL E

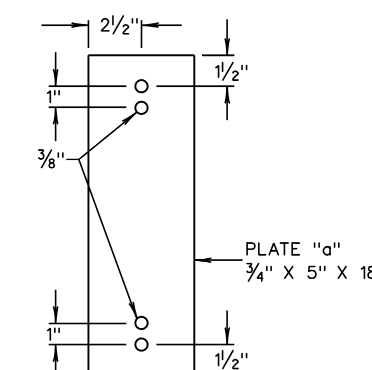


PLATE "a"

NOTE:
SEE NOTES ON TE2-1A.

OBSOLETE

SHEET OBSOLETE. DO NOT USE.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
11/11/2022

BRIDGE OR RETAINING WALL SIGN MOUNTING

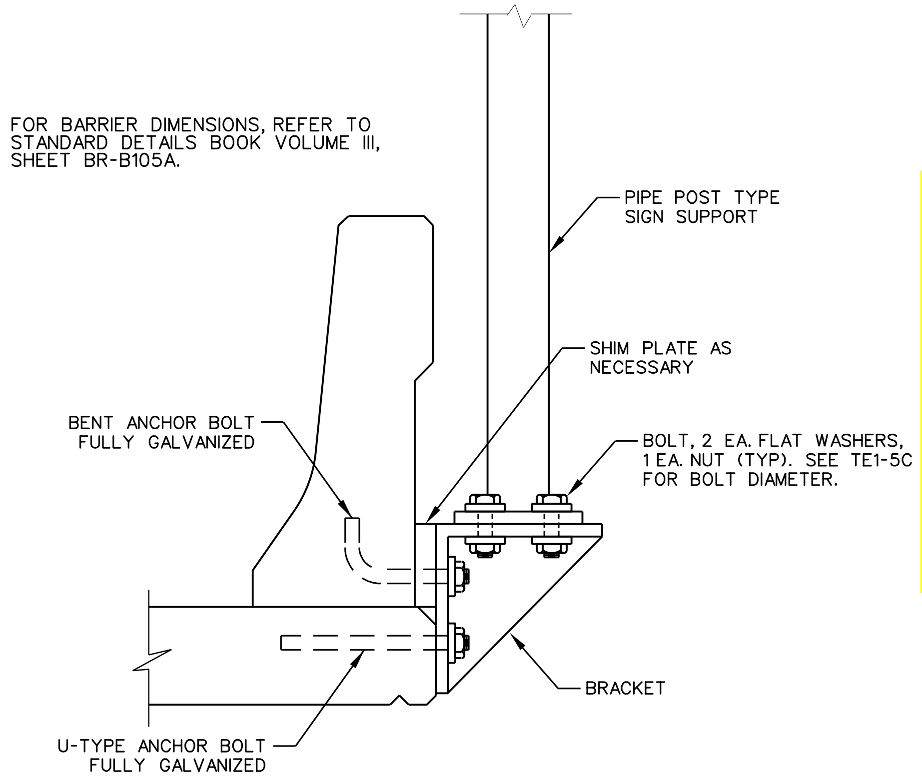
TYPE K
3 SUPPORTS

STANDARD SHEET TE2-1B

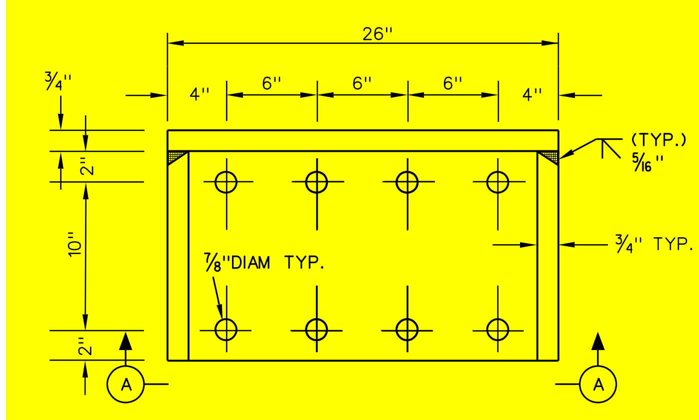
TRAFFIC ENGINEERING DIVISION

NOTES:

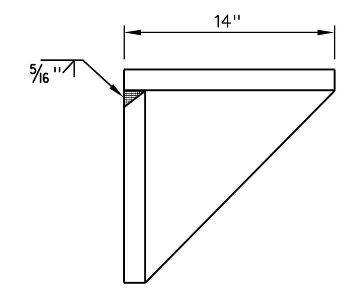
1. MATERIAL USED TO FABRICATE THE BRACKET, GALVANIZING, ANCHOR BOLTS, AND SUPPORT TO BRACKET CONNECTION BOLTS SHALL MEET THE REQUIREMENTS CONTAINED IN THE SPECIFICATIONS.
2. ANY AND ALL MATERIALS, EQUIPMENT, LABOR, INCIDENTALS, ETC. NECESSARY TO COMPLETE THE INSTALLATION SHALL BE BID AS ITEM 657050-001, BIRDGE OR RETAINING WALL BRACKET, TYPE L.
3. ⚠ TYPE L BRACKET FOR USE WITH PIPE POST TYPES 6 & 9 ONLY. SEE STANDARD SHEET TE1-5B AND TE1-5C FOR PIPE POST DETAILS.
4. ⚠ EACH ANCHOR SHALL BE DESIGNED FOR A MAXIMUM SERVICE TENSILE LOAD OF 4,200 LBS AND SHEAR SERVICE LOAD OF 1,600 LBS. A FACTOR OF SAFETY OF 4 SHALL BE APPLIED TO THESE LOADS WHEN SELECTING THE ANCHORS. THE DESIGNER SHALL VERIFY THAT THE STRUCTURE (BARRIER, BRIDGE DECK, WALL, ETC.) HAS ADEQUATE CAPACITY TO SUPPORT THE SIGN STRUCTURE LOADING.



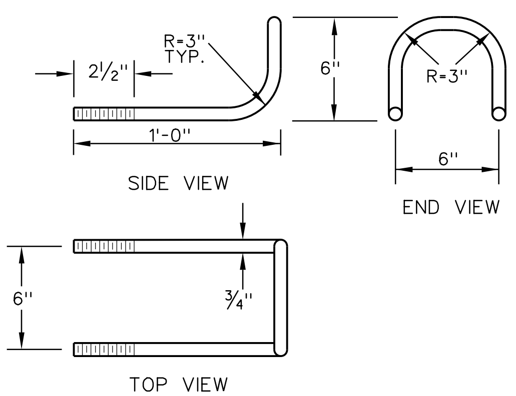
TYPE L - PIPE POST MOUNT
NEW CONSTRUCTION



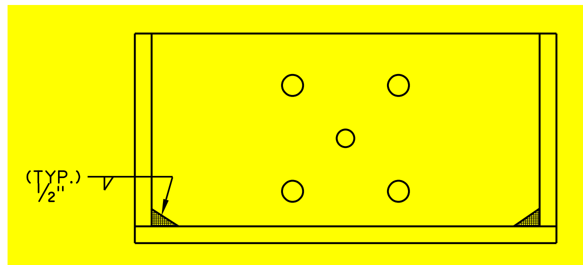
BRACKET FRONT VIEW ⚠



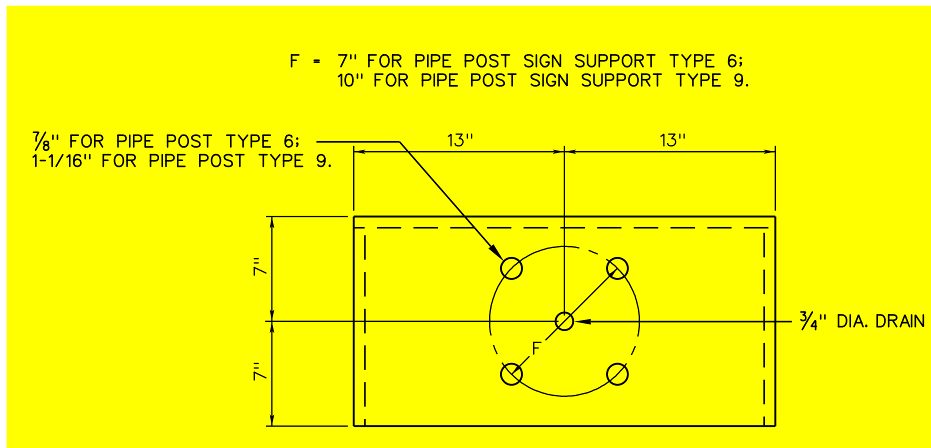
BRACKET SIDE VIEW



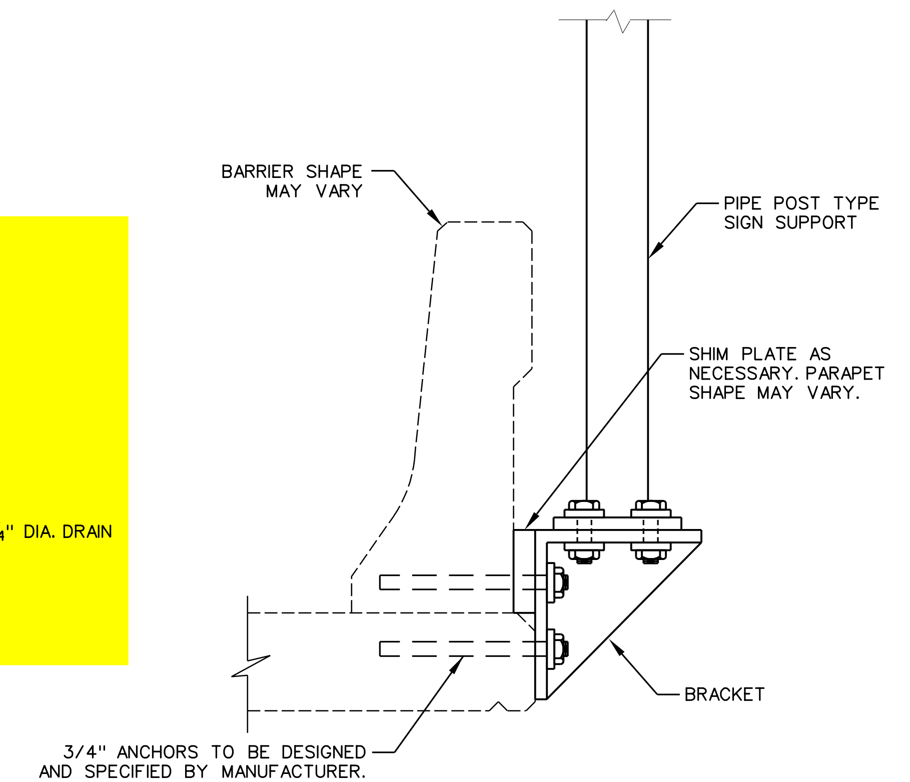
BENT ANCHOR BOLT
2 REQUIRED ⚠



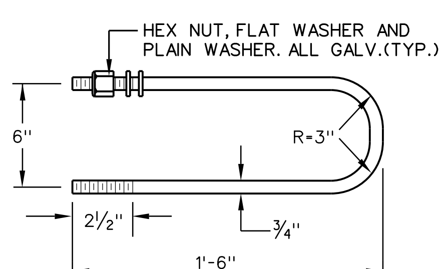
SECTION A-A ⚠



BRACKET TOP VIEW ⚠



TYPE L - PIPE POST MOUNT
RETROFIT



U-TYPE ANCHOR BOLT
2 REQUIRED ⚠

FOR SIGNS TWELVE (12) INCHES OR LESS IN ACTUAL WIDTH TO BE INSTALLED ON PARAPETS, THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET DESCRIBED IN SECTION 657 OF THE STANDARD SPECIFICATIONS SHALL BE SPECIFIED IN LIEU OF THE TYPE K OR L BRIDGE OR RETAINING WALL SIGN MOUNTING BRACKETS. THIS IS PROVIDED THE ALLOWABLE LOADING ON THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET WILL NOT BE EXCEEDED. THE TYPE A BARRIER WALL SIGN SUPPORT BRACKET IS REQUIRED TO WITHSTAND LOADING WHICH MEETS OR EXCEEDS THAT WHICH WILL BE GENERATED BASED ON THE LIMITS PROVIDED FOR THE THREE (3) LB PER FOOT U-CHANNEL SUPPORT ON THE SUPPORT SIZE SELECTION CHART ON SHEET TE1-7A. IF THE TYPE A BRACKET IS SPECIFIED, THE "SQUARE TUBE SUPPORT," 2.00X14GA" BID ITEM SHALL BE SPECIFIED AND USED FOR PAYMENT OF THE SUPPORT.

⚠1 ADDED NOTE 4.
REMOVED REFERENCE TO TYPES 7 & 8.
INCREASED WIDTH OF BRACKET AND
INCREASED NO. OF ANCHORS TO 8.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018

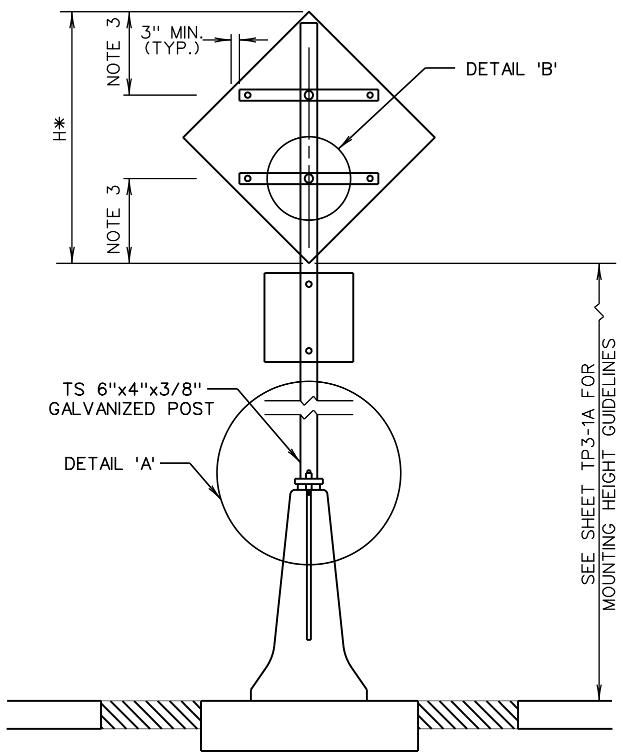
REVISION DATE
⚠1 11/11/2022

BRIDGE OR RETAINING WALL SIGN MOUNTING

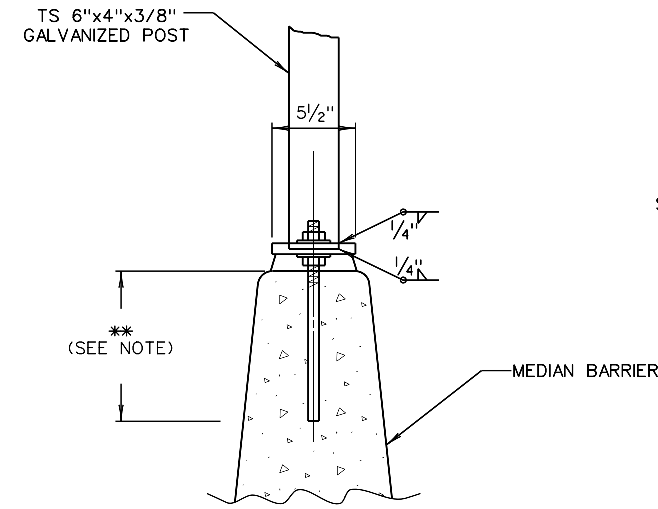
TYPE L PIPE POST MOUNT

STANDARD SHEET TE2-2

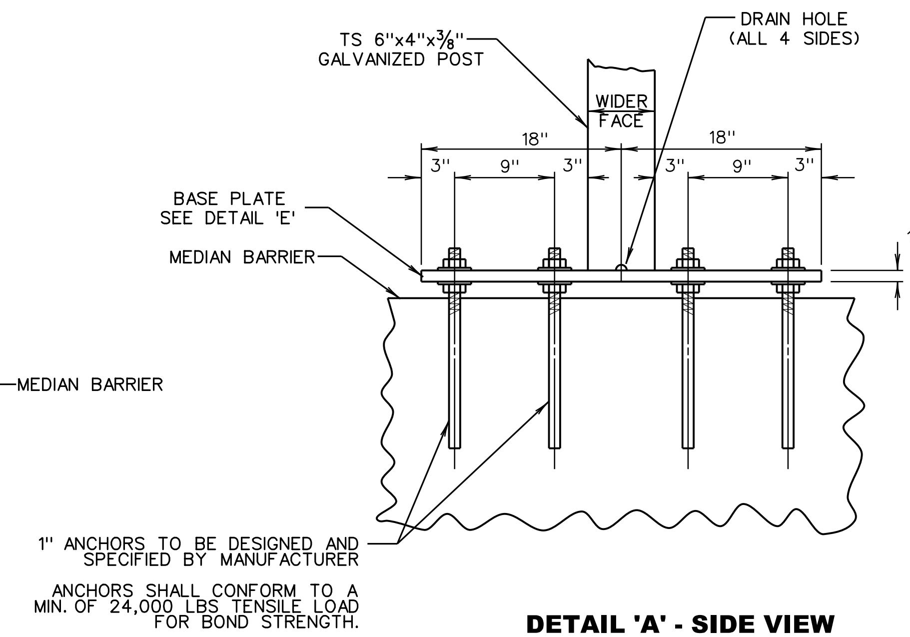
✱ - SIZES AND SHAPES VARY



SECTION VIEW
N.T.S.



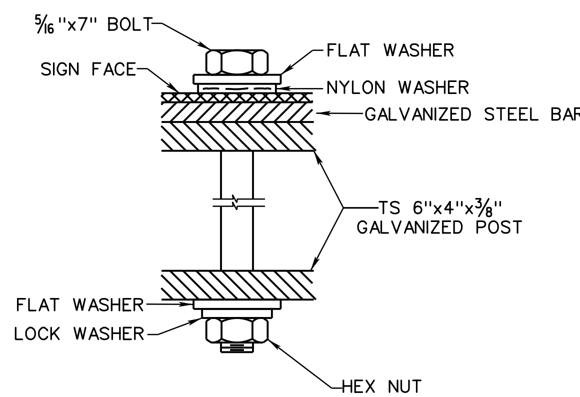
DETAIL 'A' - FRONT VIEW
N.T.S.



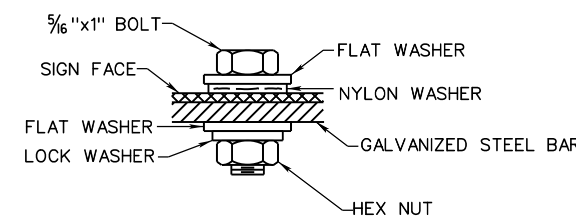
DETAIL 'A' - SIDE VIEW
N.T.S.

NOTES:

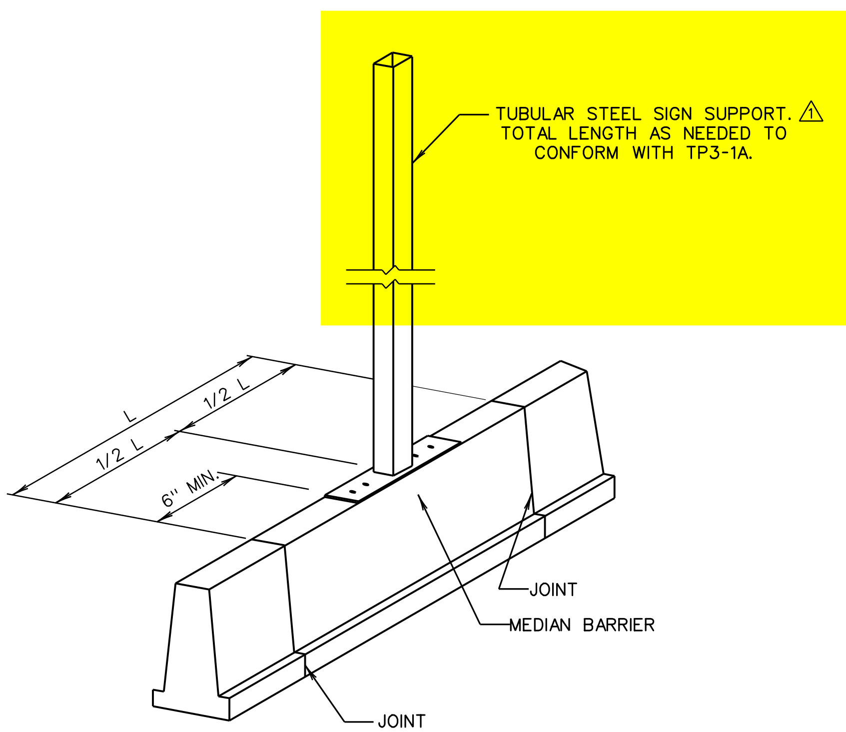
1. MATERIALS USED TO MANUFACTURE ANCHOR BOLTS, TS POST, PLATES, AND HARDWARE SHALL BE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS. ALL COMPONENTS SHALL BE GALVANIZED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS.
2. ALL SIGNS LESS THAN 36 INCHES IN WIDTH MAY BE MOUNTED TO THE TS SUPPORT WITHOUT THE GALVANIZED STEEL BAR USING THE STANDARD PUNCHING PATTERN FOR DIRECT MOUNT TYPES SHOWN ON TP1 SERIES STANDARDS.
3. VERTICAL PLACEMENT OF GALVANIZED STEEL BARS SHALL MATCH THE VERTICAL PLACEMENT OF THE STANDARD PUNCHING PATTERN SHOWN ON THE TPI SERIES STANDARDS. THE GALVANIZED STEEL BARS MAY BE TRIMMED AS NEEDED TO ACHIEVE THE 3 INCH MIN. EDGE CLEARANCE. ADDITIONAL HOLES SHALL BE FIELD PUNCHED IN THE CENTER OF THE SIGN FOR ATTACHMENT TO THE STEEL BARS AND THE TS SUPPORT.
4. COSTS FOR CONCRETE BARRIER SIGN SUPPORT SHALL BE INCLUDED IN ITEM 657060-001, BARRIER WALL BRACKET, TYPE D.
5. EVERY EFFORT SHALL BE MADE TO LOCATE THE CENTER OF BASE PLATE AT THE MIDPOINT OF THE SPACE BETWEEN TWO JOINTS OF THE BARRIER. IN NO CASE SHALL THE EDGE OF THE BASE PLATE BE LESS THAN 6 INCHES FROM JOINTS IN BARRIER.
6. SIGN WIDTHS AND MOUNTING HEIGHTS SHALL BE IN CONFORMANCE WITH TP3-1A.
7. BEFORE SPECIFYING THE USE OF THE TYPE D BARRIER WALL SIGN SUPPORT BRACKET, DUE CONSIDERATION SHALL BE GIVEN TO THE USE OF EITHER THE TYPE A OR B BARRIER WALL SIGN SUPPORT BRACKET, AS DESCRIBED IN SECTION 657 OF THE STANDARD SPECIFICATIONS. FOR BARRIER SECTIONS TEN (10) INCHES OR WIDER IN WIDTH AT THE TOP, THE TYPE B BRACKET SHALL BE CONSIDERED. FOR BARRIER SECTIONS LESS THAN TEN (10) INCHES IN WIDTH AT THE TOP, THE TYPE A BRACKET SHOULD BE CONSIDERED. BOTH THE TYPE A AND B BARRIER WALL SIGN SUPPORT BRACKETS ARE REQUIRED TO WITHSTAND A LOADING WHICH MEETS OR EXCEEDS THAT WHICH WILL BE GENERATED BASED ON THE LIMITS PROVIDED FOR THE THREE (3) LB PER FOOT U-CHANNEL SUPPORT ON THE SUPPORT SIZE SELECTION CHART ON SHEET TE1-7A. IF EITHER THE TYPE A OR B BRACKET IS SPECIFIED, THE "SQUARE TUBE SUPPORT, 2.00X14GA" BID ITEM SHALL BE SPECIFIED AND USED FOR PAYMENT OF THE SUPPORT.



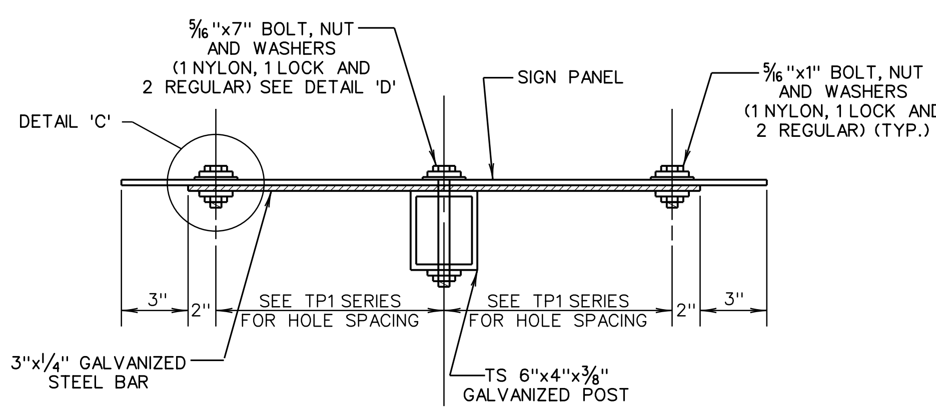
DETAIL 'D'



DETAIL 'C'

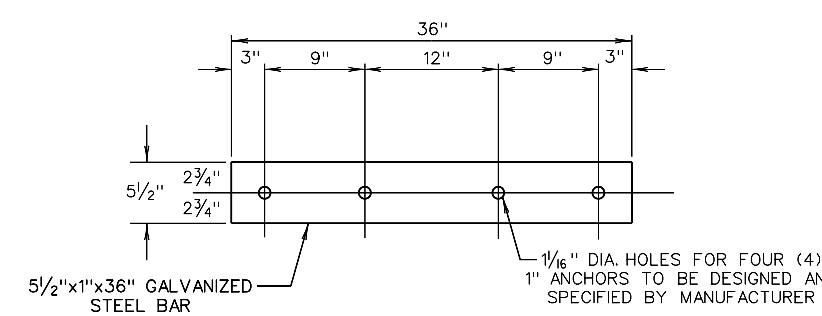


ISOMETRIC VIEW
N.T.S.



FABRICATOR SHALL DETERMINE LENGTH OF STEEL BAR BASED ON SIGN SIZE.

DETAIL 'B' - TOP VIEW
N.T.S.



DETAIL 'E'
N.T.S.

TYPE D BARRIER WALL SIGN SUPPORT BRACKET

⚠ CLARIFIED TUBULAR STEEL POST

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

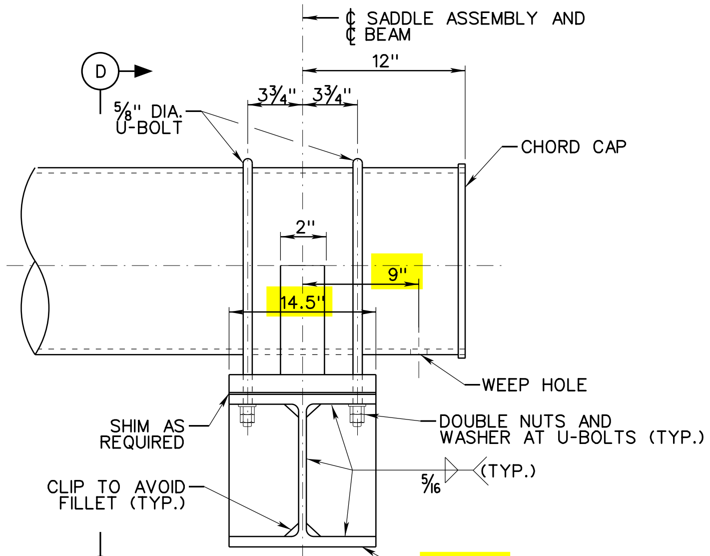
PREPARED: 8/2018
REVISION DATE
⚠ 4/2022

BARRIER WALL SIGN SUPPORT BRACKET TYPE D

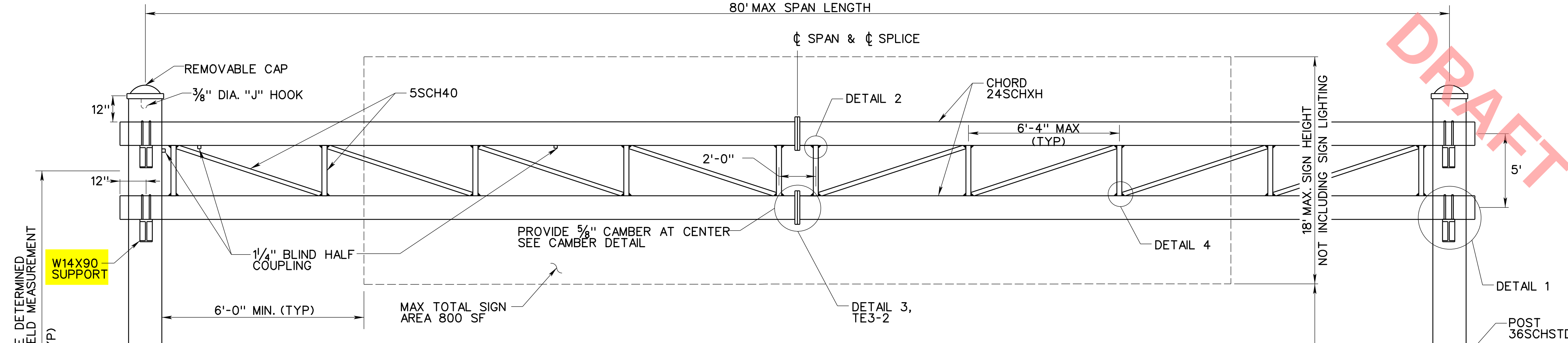
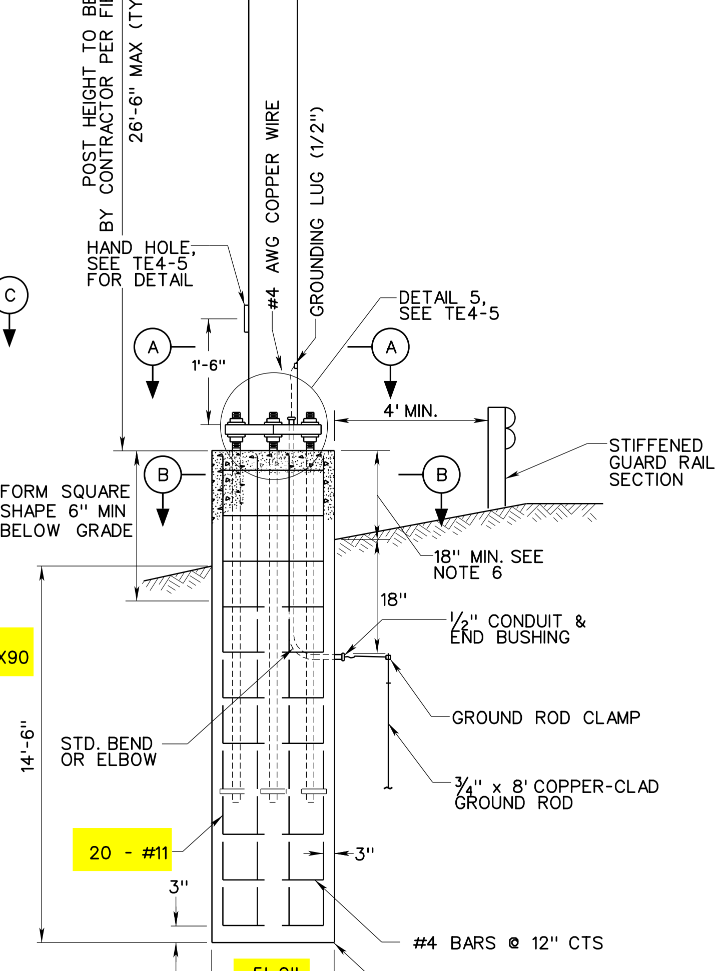
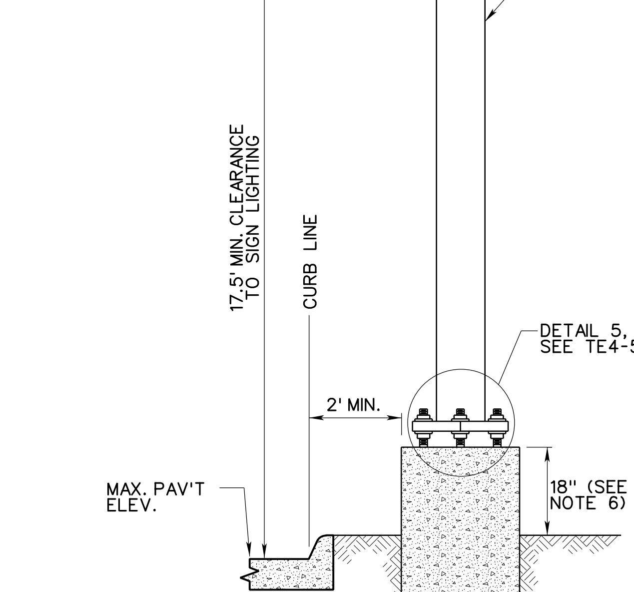
STANDARD SHEET TE2-3

TRAFFIC ENGINEERING DIVISION

DRAFT

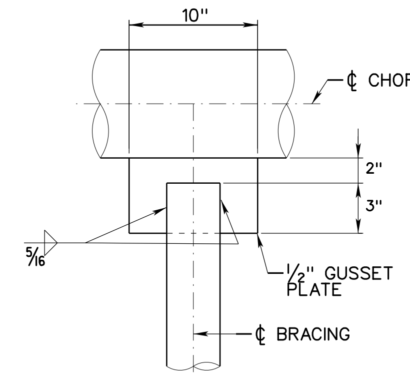


DETAIL 1

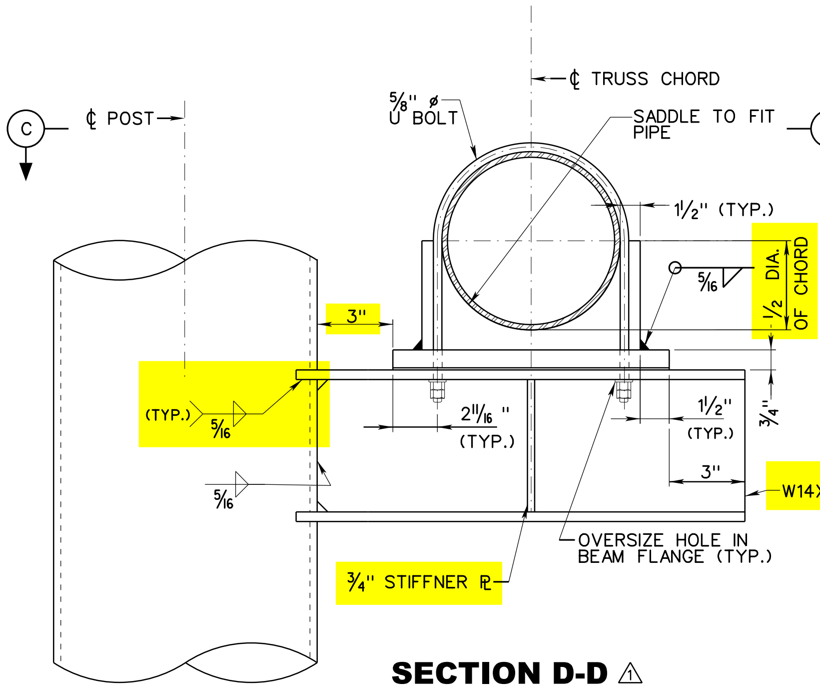




ELEV.

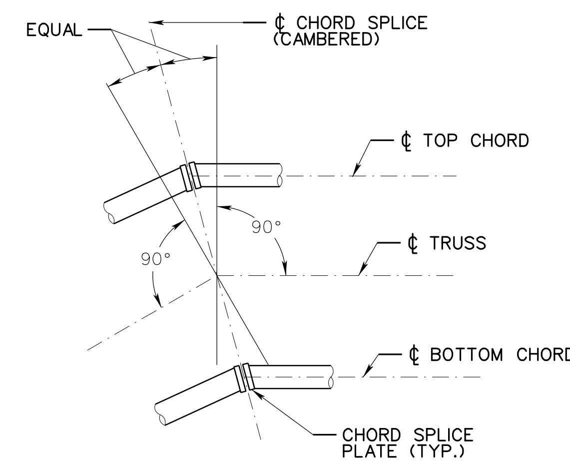
SEE NOTE 4



DETAIL 2



SECTION D-D

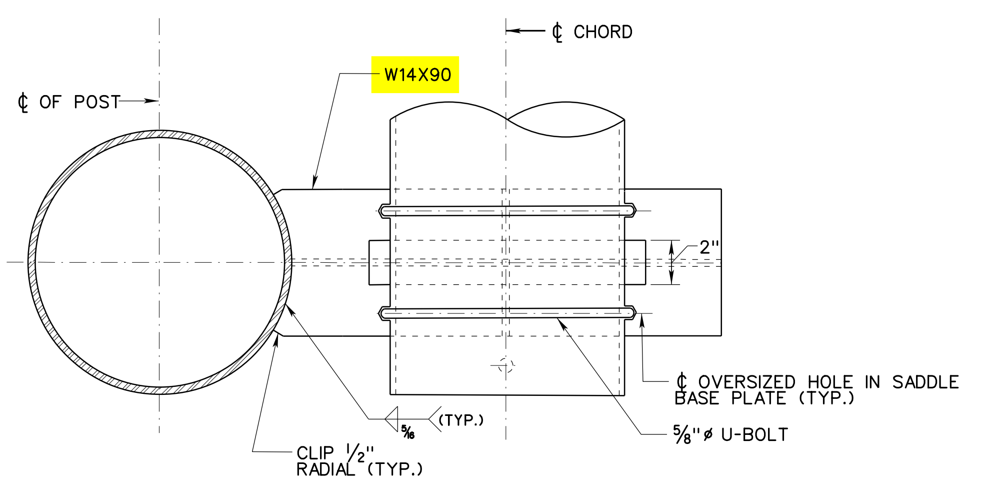


CAMBER DETAIL

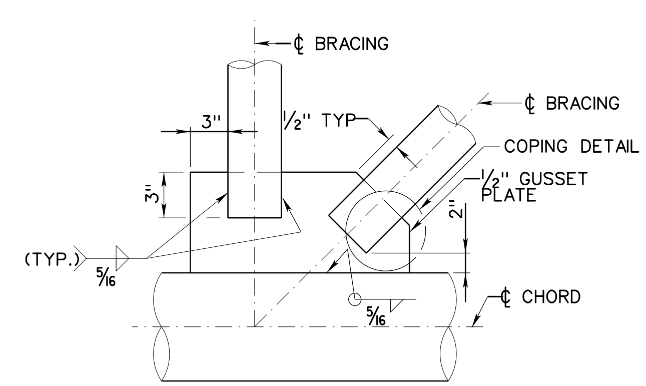
SEE NOTE 5

NOTES:

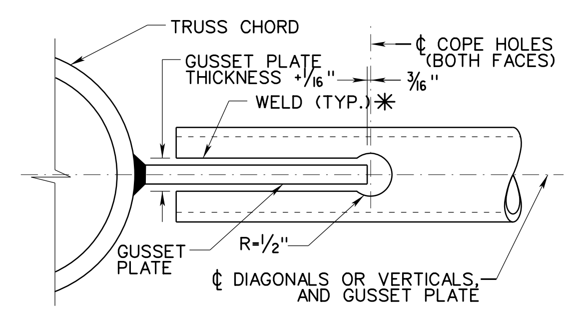
1. FOR SIGN BRACKETS AND/OR SIGN LIGHTING DETAILS, SEE TE6-3D.
2. HIGH STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS BY TURN OF NUT METHOD IN ACCORDANCE WITH SECTION 615 OF THE SPECIFICATIONS.
3. ALL SIGNS CENTERED VERTICALLY, EXCEPT THOSE WITH LIGHTING FIXTURES WHERE CENTER OF SIGN IS 3 IN. ABOVE THE CENTER OF THE TRUSS.
4. FOR CHORD SPLICE DIMENSIONS, SEE SHEET TE3-2. FOR SECTIONS A-A & B-B AND ANCHOR BOLT DETAILS, SEE TE4-5.
5. ALTERNATIVELY THE CAMBER CAN BE BUILT UNIFORMLY INTO THE TRUSS.
6. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.
7. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013, USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
8. SEE SHEET TE6-3A FOR GROUNDING NOTES.



SECTION C-C



DETAIL 4



COPING DETAIL

✱ PROVIDE A WELD 'HOLDBACK' AT THE EDGE OF THE GUSSET PLATE IN THE BRACING MEMBERS EQUAL TO THE WELD SIZE REQUIRED.

⚠ REVISED BRACKET DETAILS AND FOUNDATION DIAMETER

DETAILS SHOWN ON THIS DRAWING ARE NOT TO SCALE FOR VISUAL CLARITY.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 2/22/2023

OVERHEAD SIGN SUPPORT-STEEL TWO TUBE SPAN (TTS)

STANDARD SHEET TE3-1

TRAFFIC ENGINEERING DIVISION

DRAFT

J04C02C03-STDBDR c

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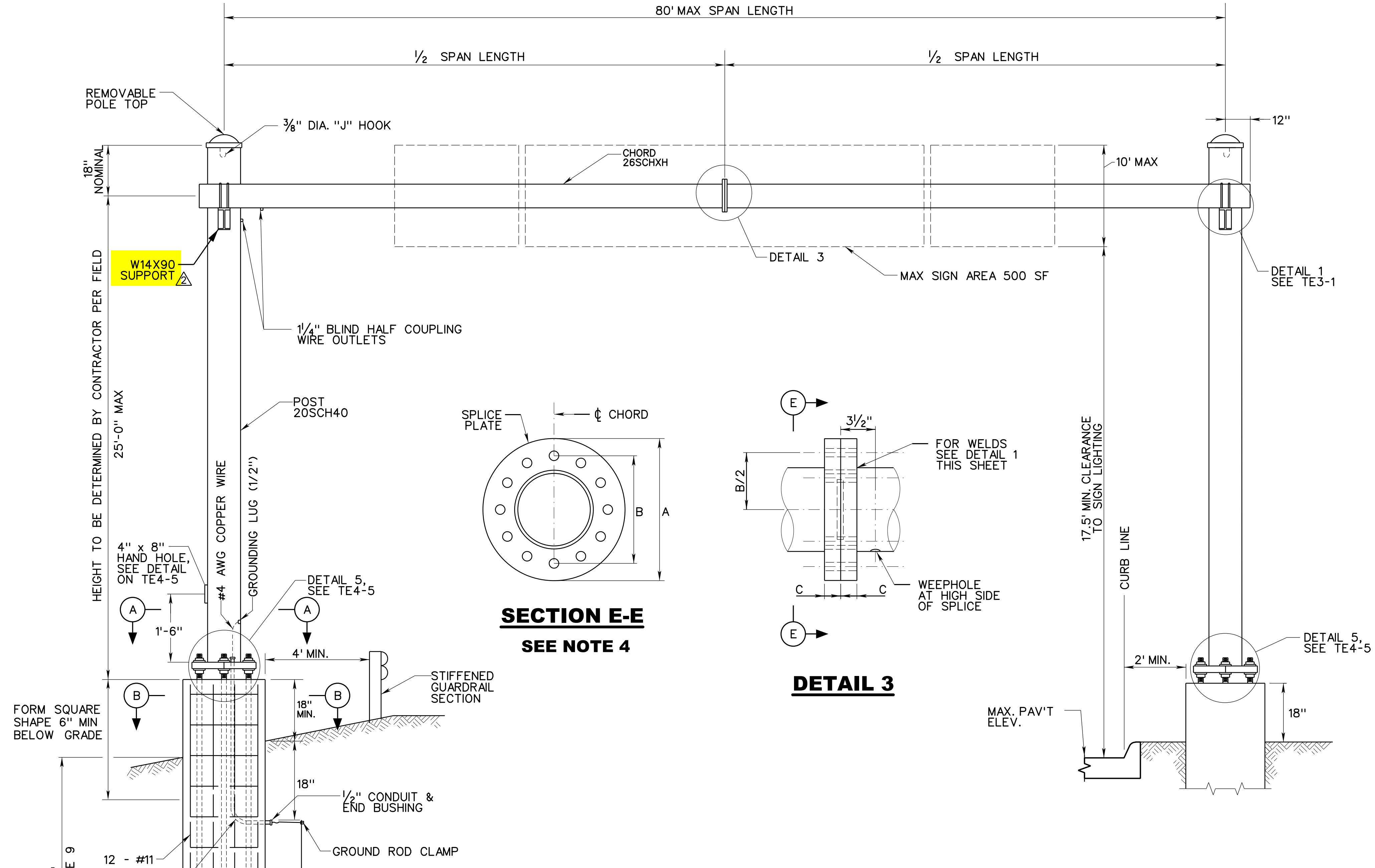
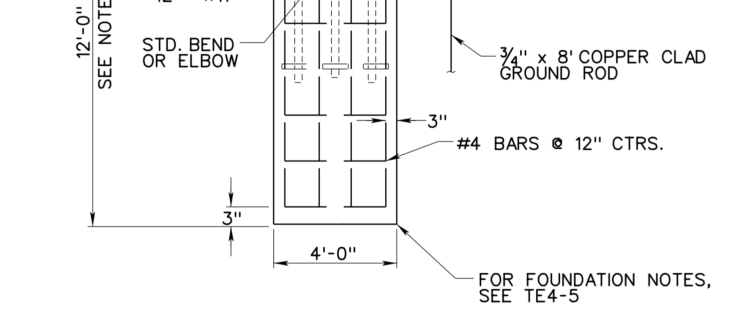


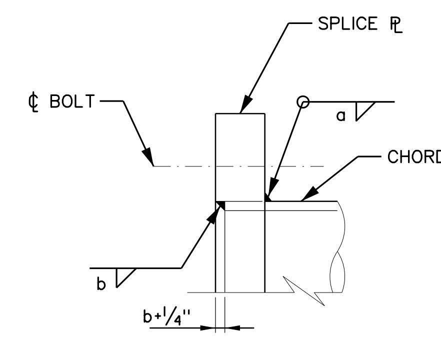


ELEVATION

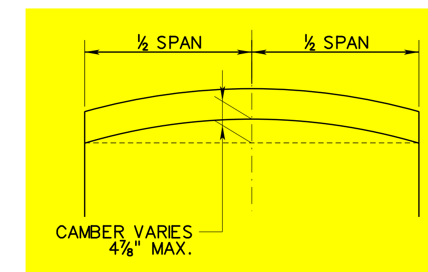
(FOR SECTION A-A, B-B, SEE TE4-5)

NOTES:

1. FOR SIGN BRACKETS AND/OR SIGN LIGHTING DETAILS, SEE TE6-3D.
2. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS BY TURN OF NUT METHOD IN ACCORDANCE WITH THE SPECIFICATIONS.
3. ALL SIGNS CENTERED VERTICALLY, EXCEPT THOSE WITH LIGHTING FIXTURES WHERE CENTER OF SIGN IS 3 IN. ABOVE THE CENTER OF THE TRUSS.
4. FOR ANCHOR BOLT DETAILS, SEE TE4-5.
5. FOR SECTIONS A-A & B-B, SEE TE4-5.
6. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.
7. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013, USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
8. SEE SHEET TE6-3A FOR GROUNDING NOTES.
9. DEPTH OF FOUNDATION IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SAND CLAY PROVIDING AN UNCONFINED COMPRESSIVE STRENGTH NOT LESS THAN 2500 LBS/SQFT. THESE FOUNDATIONS MAY BE USED IN COHESIONLESS TYPE SOILS PROVIDING THAT THE FRICTION ANGLE IS NOT LESS THAN 30 DEGREES.



DETAIL 1



CAMBER REQUIRED

DESIGN NO.	MAXIMUM SIGN AREA (SF)	CHORD SPLICE TABLE: CHORD NPS	PLATE A	PLATE B	PLATE C	HIGH STRENGTH BOLTS NUMBER	HIGH STRENGTH BOLTS DIA.	FILLET WELD a	FILLET WELD b	BASE PLATE TABLE (SEE TE4-5 FOR SECTIONS & DETAILS): POST (NPS)	PLATE DIMENSION S	F	B	T	CENTER HOLE DIA.	BOLT HOLE	ANCHOR BOLTS NO.	ANCHOR BOLTS DIA.
TTS-XX	800	24SCHXH	32"	28"	2½"	12	1"	½"	¼"	36SCHSTD	59"	29.5"	43"	2"	25"	2⅜"	6	2"
OTS-XX	500	26SCHXH	34"	30"	2¾"	12	1"	¾"	¼"	20SCH40	38"	19"	26"	2"	10"	1⅞"	6	1½"

XX TO DENOTE THE SPAN LENGTH REQUIRED.

DRAFT

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

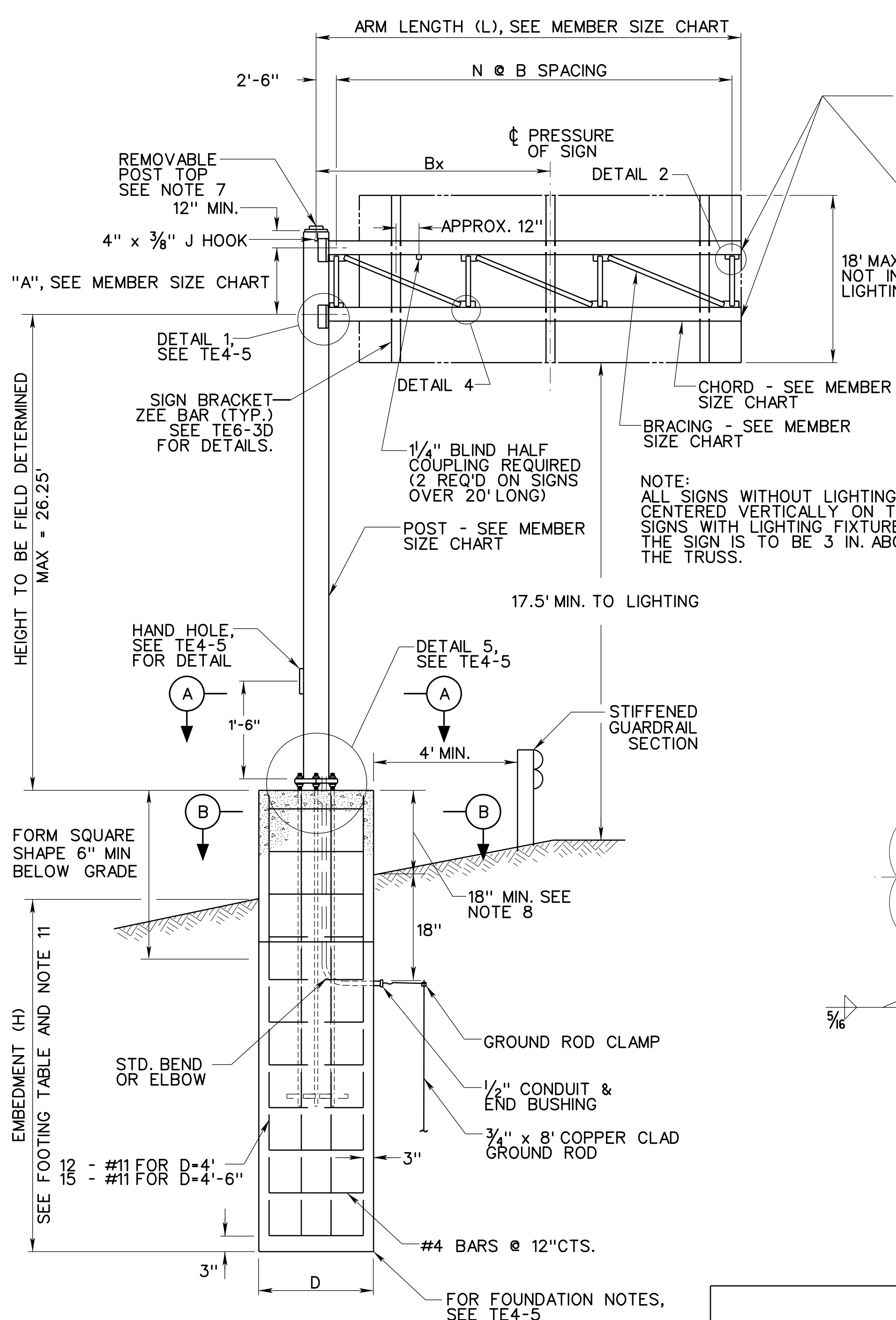
PREPARED: 8/2018
REVISION DATE
1 6/2022
2 2/22/2023

1 ADDED CAMBER INFORMATION
2 REVISED TABLE, REVISED BRACKET SIZE

OVERHEAD SIGN SUPPORT-STEEL ONE TUBE SPAN (OTS)

STANDARD SHEET TE3-2

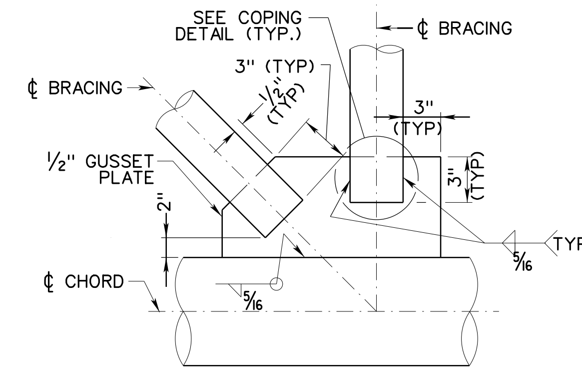
TRAFFIC ENGINEERING DIVISION



ELEVATION

POST = VERTICAL LEG SUPPORT

BASE PLATE = LEG PLATE



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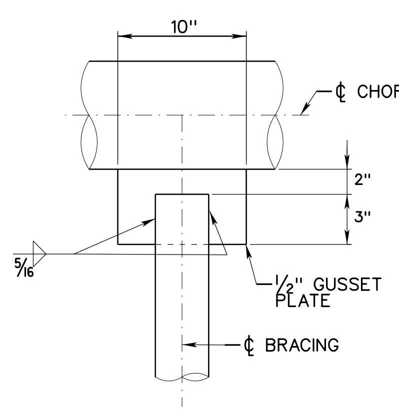
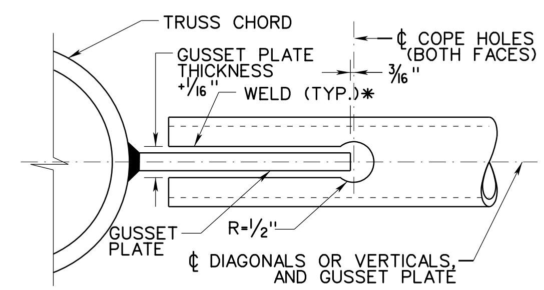


DETAIL 2

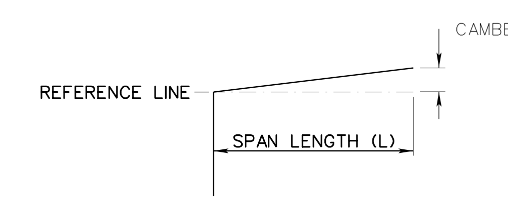


COPING DETAIL

* PROVIDE A WELD 'HOLDBACK' AT THE EDGE OF THE GUSSET PLATE IN THE BRACING MEMBERS EQUAL TO THE WELD SIZE REQUIRED.

NOTES:

1. THE STRUCTURES ARE DESIGNED IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013, USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
2. FOR SECTION A-A, B-B & D-D, SEE TE4-5.
3. FOR FOUNDATION NOTES, SEE TE4-5.
4. FOR ANCHOR BOLT DETAIL, SEE TE4-5.
5. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS IN ACCORDANCE WITH THE SPECIFICATIONS.
6. DETAILS LABELED AS 'NOT TO SCALE' ARE INTENTIONALLY NOT DRAWN TO SCALE FOR VISUAL CLARITY.
7. THE REMOVABLE CAP SHOULD BE A FRICTION TYPE CAP. FOR REQUIREMENTS AND DETAILS, SEE NOTES ON SHEET TE1-5A.
8. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.
9. FOR A STRUCTURE WITH ARM LENGTH VARYING FROM THE DESIGN LENGTHS SPECIFIED, SIZE MEMBER DIMENSIONS BASED ON THE NEXT LONGER ARM LENGTH IN THE CHART AND ADJUST PANEL WIDTH (B) ACCORDINGLY WHILE RETAINING THE NUMBER OF PANELS (N).
10. SEE SHEET TE6-3A FOR GROUNDING NOTES.
11. DEPTH OF FOUNDATION IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SAND CLAY PROVIDING AN UNCONFINED COMPRESSIVE STRENGTH NOT LESS THAN 2500 LBS/SQFT. THESE FOUNDATIONS MAY BE USED IN COHESION-LESS TYPE SOILS PROVIDING THAT THE FRICTION ANGLE IS NOT LESS THAN 30 DEGREES.



CAMBER DETAIL

MEMBER SIZE CHART ⚠1

DESIGN NUMBER	L (FT)	Bx	A	B	N	MAX. CAMBER	CHORD (NPS)	BRACING (NPS)	POST (NPS)	MAX SIGN AREA (SF)
DAC-16	16	9'-3"	5'-0"	4'-4"	3	7/8"	10SCH40	2.5SCH40	24SCHXH	245
DAC-24	24	13'-3"	5'-6"	5'-3"	4	1 1/2"	16SCH40	4SCH40	24SCH40	390
DAC-32	32	19'-6"	6'-0"	5'-9"	5	3 1/8"	16SCH40	4SCH40	30SCHXH	450
DAC-40	40	29'-0"	6'-6"	6'-2"	6	5 1/2"	18SCH40	5SCH40	30SCHXH	400

L=ARM LENGTH
Bx=℄ POST TO ℄ SIGN PRESSURE
A=℄ OF CHORD TO ℄ OF CHORD
B=LENGTH OF EACH PANEL
N=NUMBER OF TRUSS PANELS
d=OUTSIDE DIAMETER (IN.)
t=PIPE THICKNESS (IN.)
NPS=NOMINAL PIPE SIZE
CAMBER MAY VARY.

FOOTING TABLE ⚠1

		PLATE DIMENSION					ANCHOR BOLTS			FOOTING	
DESIGN NUMBER	POST (DIA. IN.)	S	F	T	B	MAX. HOLE DIA.	NO.	DIA.	HOLE	EMBEDMENT (H)	DIAMETER (D)
DAC-16	24	44"	22"	2"	31"	14"	6	1 3/4"	2 1/8"	11'-0"	4'-0"
DAC-24	24	44"	22"	3"	31"	4"	6	2"	2 3/8"	12'-6"	4'-0"
DAC-32	30	48"	24"	4 1/4"	37"	4"	6	2"	2 3/8"	13'-2"	4'-6"
DAC-40	30	48"	24"	4 1/4"	37"	4"	6	2 1/4"	2 5/8"	14'-10"	4'-6"

BOX CONNECTION TABLE ⚠1

DESIGN NUMBER	CHORD SIZE (NPS)	THICKNESS OF END PLATE (A)	THICKNESS OF BOX FLANGE PLATE (B)	HOLE DIA.	BOX HEIGHT (HB)	OFFSET (X)	NO. OF BOLTS TOP AND BOTTOM	SPACING (W)	NO. OF INTERM. ROWS	TOTAL NO. OF BOLTS
DAC-16	10	2 1/4"	1 1/8"	4"	9"	8"	5	24"	2	14
DAC-24	16	2 1/4"	1 3/4"	7"	14"	7"	6	26"	2	16
DAC-32	16	3"	2 1/8"	4"	14"	10"	8	28"	2	20
DAC-40	18	3 1/2"	2 1/2"	10"	16"	9"	8	30"	2	20

⚠1 REVISED MEMBER SIZE CHART, FOOTING TABLE, AND BOX CONNECTION TABLE

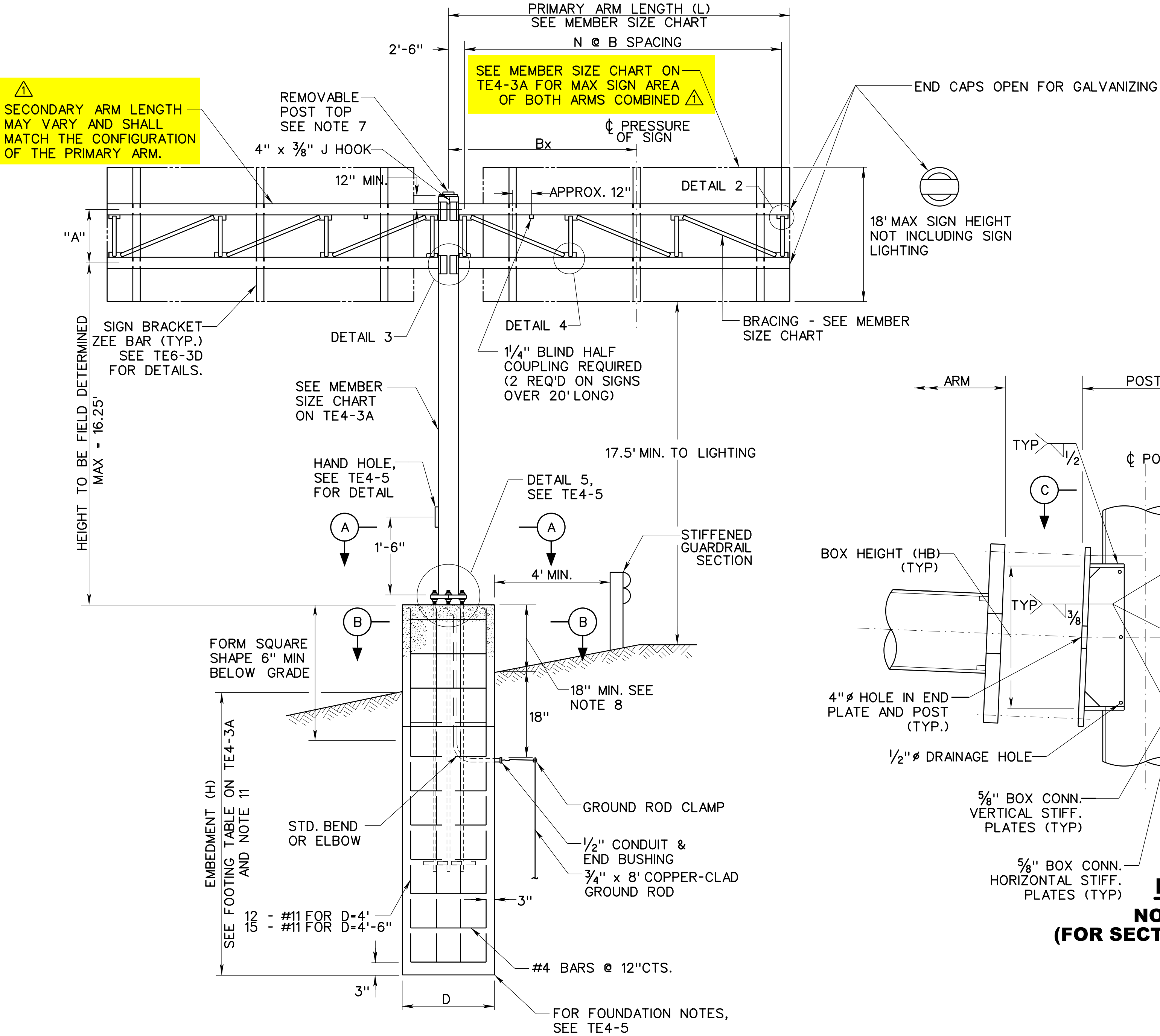
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠1 2/22/2023

OVERHEAD SIGN SUPPORT-STEEL

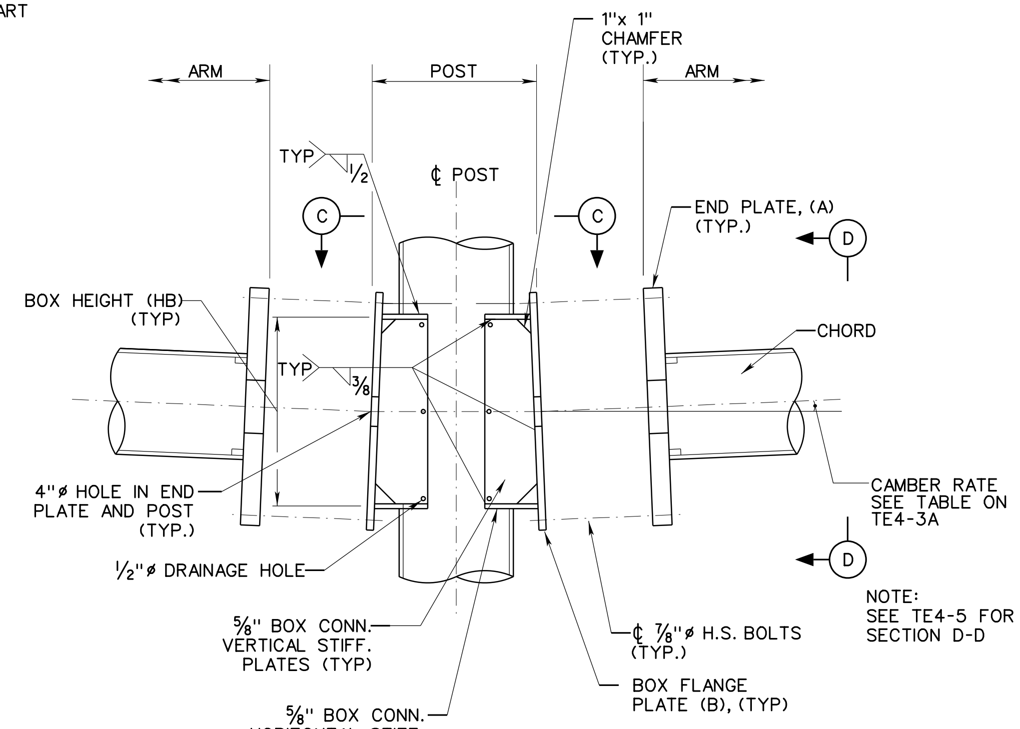
DOUBLE ARM CANTILEVER

STANDARD SHEET TE4-3A



ELEVATION

SEE NOTE 2



DETAIL 3

NOT TO SCALE

(FOR SECTION D-D, SEE TE4-5)

NOTES:

1. THE STRUCTURES ARE DESIGNED IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013, USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
2. FOR SECTION A-A, B-B & D-D, SEE TE4-5.
3. FOR FOUNDATION NOTES, SEE TE4-5.
4. FOR ANCHOR BOLT DETAIL, SEE TE4-5.
5. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS IN ACCORDANCE WITH THE SPECIFICATIONS.
6. DETAILS LABELED AS 'NOT TO SCALE' ARE INTENTIONALLY NOT DRAWN TO SCALE FOR VISUAL CLARITY.
7. THE REMOVABLE CAP SHOULD BE A FRICTION TYPE CAP. FOR REQUIREMENTS AND DETAILS, SEE NOTES ON SHEET TE1-5A.
8. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.
9. FOR A STRUCTURE WITH ARM LENGTH VARYING FROM THE DESIGN LENGTHS SPECIFIED, SIZE MEMBER DIMENSIONS BASED ON THE NEXT LONGER ARM LENGTH IN THE CHART AND ADJUST PANEL WIDTH (B) ACCORDINGLY WHILE RETAINING THE NUMBER OF PANELS (N).
10. SEE SHEET TE6-3A FOR GROUNDING NOTES.
11. DEPTH OF FOUNDATION IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SAND CLAY PROVIDING AN UNCONFINED COMPRESSIVE STRENGTH NOT LESS THAN 2500 LBS/SQFT. THESE FOUNDATIONS MAY BE USED IN COHESIONLESS TYPE SOILS PROVIDING THAT THE FRICTION ANGLE IS NOT LESS THAN 30 DEGREES.

⚠ DESIGN NUMBER DESIGNATION

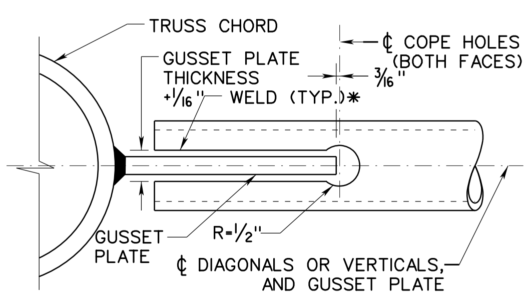
BUTTERFLY STYLE CANTILEVER SIGN SUPPORTS ARE MADE UP OF TWO DOUBLE ARM CANTILEVER ARMS ON OPPOSITE SIDES OF ONE SUPPORT POST, THE PRIMARY ARM AND THE SECONDARY ARM. IF DIFFERENT, THE PRIMARY ARM SHALL ALWAYS BE THE LONGER OF THE TWO. POST SIZE AND ARM CONFIGURATION (CHORD, BRACING, AND 'A' DIMENSION, ETC.) SHALL BE DETERMINED BASED ON THE PRIMARY ARM.

THE TOTAL SIGN AREA OF BOTH ARMS COMBINED SHALL NOT EXCEED THE MAX SIGN AREA LISTED IN THE MEMBER SIZE CHART ON TE4-3A FOR THE PRIMARY ARM.

SEE TABLES ON TE4-3A FOR STRUCTURE FABRICATION AND FOUNDATION DETAILS.

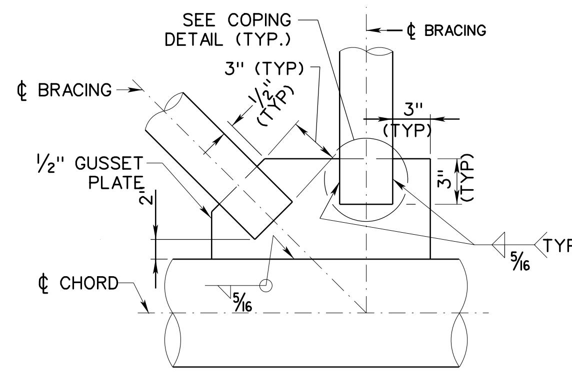
BUTTERFLY CANTILEVERS SHALL HAVE DESIGN NUMBERS IN THE FORMAT OF BC-XX-YY, WHERE XX = LENGTH OF PRIMARY ARM AND YY = LENGTH OF SECONDARY ARM.

FOR EXAMPLE, A BC-32-16 WOULD HAVE A PRIMARY ARM 32 FEET IN LENGTH AND A SECONDARY ARM 16 FEET IN LENGTH. IT WOULD HAVE A 30 INCH DIAMETER POST AND BOTH ARMS WOULD HAVE 16SCH40 CHORDS, 4SCH40 BRACING, AND 'A' DIMENSION OF 6'-0". THE TOTAL AREA OF SIGNS ON BOTH ARMS COMBINED CANNOT EXCEED 450 SF.

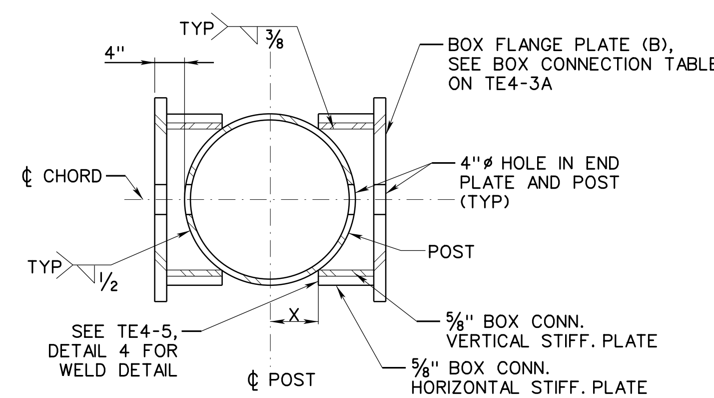


COPING DETAIL

✱ PROVIDE A WELD 'HOLDBACK' AT THE EDGE OF THE GUSSET PLATE IN THE BRACING MEMBERS EQUAL TO THE WELD SIZE REQUIRED.

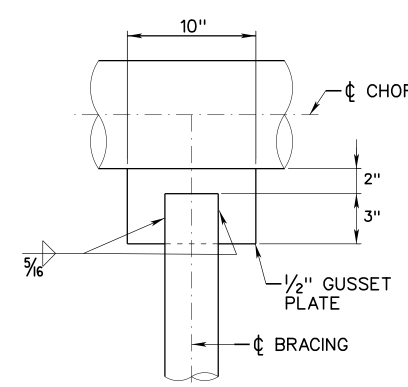


DETAIL 4



SECTION C-C

NOT TO SCALE



DETAIL 2

⚠ REVISED RULES FOR ALLOWABLE SIGN AREA AND SECONDARY ARM MEMBER SIZES

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 2/22/2023

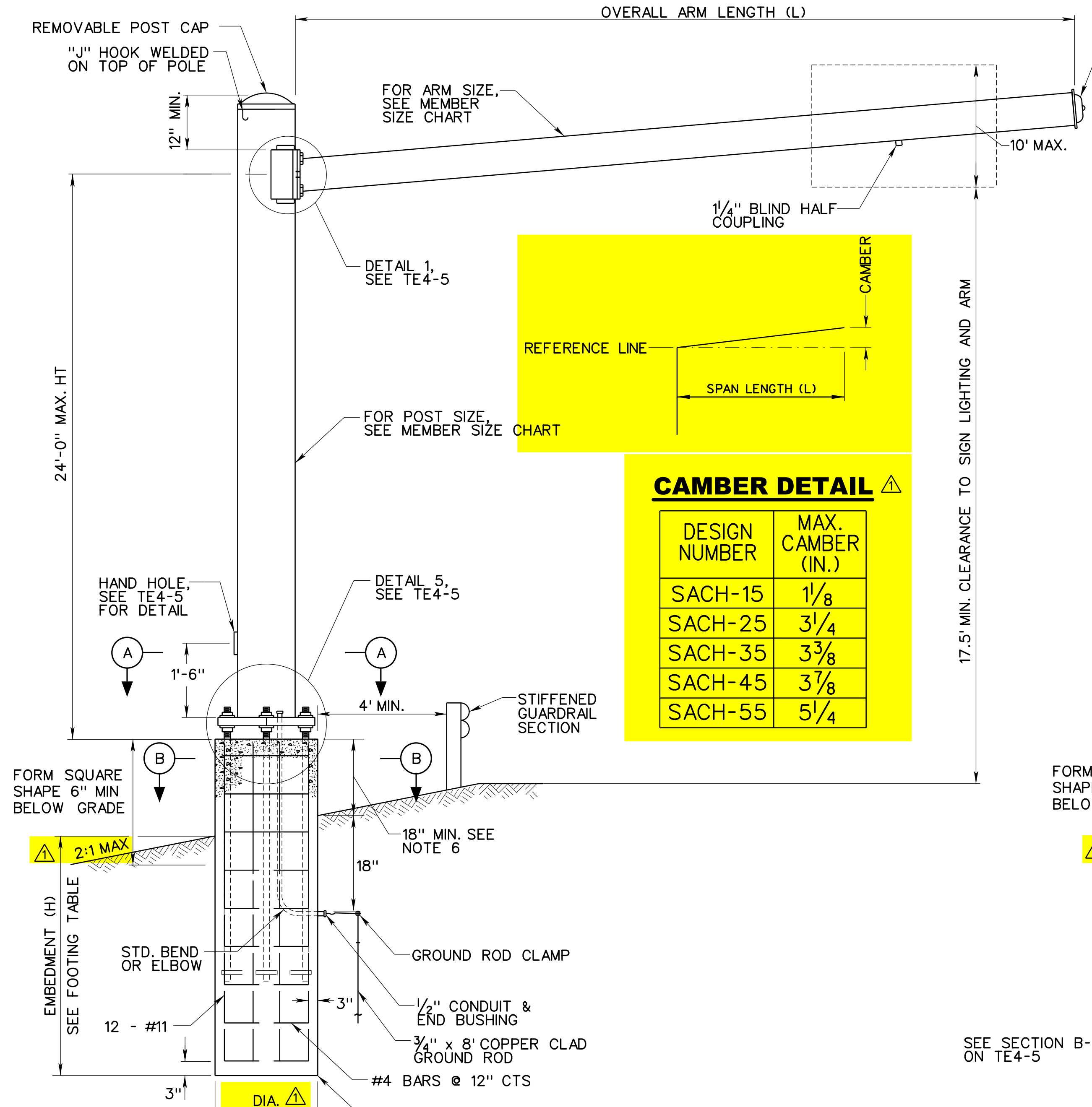
OVERHEAD SIGN SUPPORT-STEEL

BUTTERFLY CANTILEVER

STANDARD SHEET TE4-3B

TRAFFIC ENGINEERING DIVISION

DRAFT

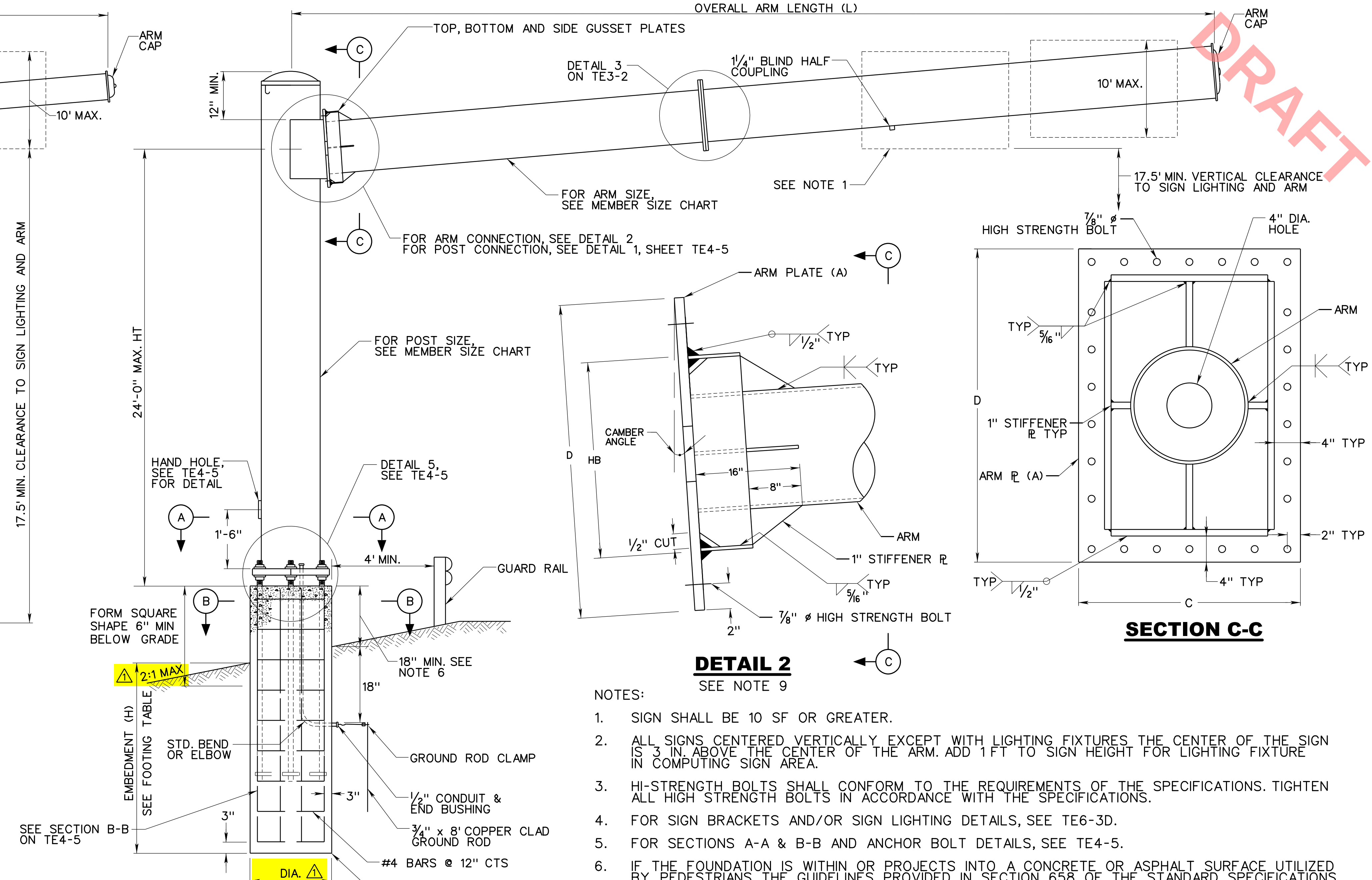


ELEVATION

(L=15', 25', 35')

CAMBER DETAIL ⚠

DESIGN NUMBER	MAX. CAMBER (IN.)
SACH-15	1⅛
SACH-25	3¼
SACH-35	3⅜
SACH-45	3⅞
SACH-55	5¼



ELEVATION

(L=45', 55')

DETAIL 2

SEE NOTE 9

SECTION C-C

NOTES:

1. SIGN SHALL BE 10 SF OR GREATER.
2. ALL SIGNS CENTERED VERTICALLY EXCEPT WITH LIGHTING FIXTURES THE CENTER OF THE SIGN IS 3 IN. ABOVE THE CENTER OF THE ARM. ADD 1 FT TO SIGN HEIGHT FOR LIGHTING FIXTURE IN COMPUTING SIGN AREA.
3. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS IN ACCORDANCE WITH THE SPECIFICATIONS.
4. FOR SIGN BRACKETS AND/OR SIGN LIGHTING DETAILS, SEE TE6-3D.
5. FOR SECTIONS A-A & B-B AND ANCHOR BOLT DETAILS, SEE TE4-5.
6. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.
7. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013 USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
8. SEE SHEET TE6-3A FOR GROUNDING NOTES.
9. FOR ANY ARM CONNECTION DETAIL DIFFERENT THAN SHOWN, THE DESIGN AND CHECKING WILL BE THE RESPONSIBILITY OF THE MANUFACTURER AND MUST BE APPROVED BY TRAFFIC ENGINEERING DIVISION.
10. ⚠ DEPTH OF FOUNDATION IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SAND CLAY PROVIDING AN UNCONFINED COMPRESSIVE STRENGTH NOT LESS THAN 750 LBS/SQFT. THESE FOUNDATIONS MAY BE USED IN COHESIONLESS TYPE SOILS PROVIDING THAT THE FRICTION ANGLE IS NOT LESS THAN 30 DEGREES.

BOX CONNECTION TABLE (SEE TE4-5 FOR SECTIONS) ⚠

DESIGN NUMBER	ARM SIZE (NPS)	ARM PLATE THICKNESS (A) (IN)	FLANGE PLATE THICKNESS (B) (IN)	BOX HEIGHT (HB) (IN)	BOLT SIZE (IN)	NO. OF BOLTS TOP AND BOTTOM	NO. OF INTERM. ROWS	TOTAL NO. OF BOLTS	W (IN)
SACH-15	8	1½	1	8	⅞	5	2	14	19⅞
SACH-25	12	1⅞	1⅛	12	⅞	5	2	14	19⅞
SACH-35	20	2¾	1¾	20	1	5	4	18	29⅞

FOOTING TABLE (SEE TE4-5 FOR SECTIONS & ANCHOR BOLT DETAIL) ⚠

DESIGN NUMBER	POST (NPS)	PLATE DIMENSION						ANCHOR BOLTS		FOOTING	
		S (IN)	F (IN)	T (IN)	B (IN)	HOLE DIA. (MIN-MAX)	BOLT HOLE (IN)	NO.	DIA. (IN)	DIA.	EMBEDMENT (H)
SACH-15	14	22	11	2	18	4"-10"	1⅝	6	1¼	4'-0"	11'-0"
SACH-25	14	22	11	2	18	4"-10"	1⅝	6	1¼	4'-0"	14'-0"
SACH-35	24	35	17½	2	29	4"-20"	2⅛	6	1¾	4'-0"	21'-0"
SACH-45	36	52	26	2	42	4"-7"	2⅜	6	2	5'-6"	21'-0"
SACH-55	42	58	29	2½	48	4"-12"	2⅝	6	2¼	6'-0"	23'-0"

MEMBER SIZE CHART ⚠

DESIGN NUMBER	L (FT.)	MAX SIGN AREA (SF)	POST	ARM
SACH-15	15	120	14SCH40	8SCH80
SACH-25	25	120	14SCH60	12SCH40
SACH-35	35	240	24SCHXH	20SCHXH
SACH-45	45	360	36SCHXH	26SCHXH
SACH-55	55	360	42SCHXH	30SCHSTD

CHORD SPLICE TABLE (SEE TE3-2, DETAIL 3 & SECTION E-E)

DESIGN NUMBER	PLATE			HIGH STRENGTH BOLTS		FILLET WELD	
	A	B	C	NUMBER	DIA.	a	b
SACH-45	35"	31"	1¼"	30	1"	⅝"	¼"
SACH-55	39"	35"	1¼"	36	1"	⅝"	¼"

BOX CONNECTION TABLE ⚠

DESIGN NUMBER	ARM SIZE (NPS)	THICKNESS OF ARM PLATE (A) (IN)	THICKNESS OF BOX FLANGE PLATE (B) (IN) SEE DETAIL 1 ON TE4-5	BOX HEIGHT (HB) (IN)	BOLT SIZE	C (IN.)	D (IN.)	NO. OF BOLTS TOP & BOTTOM	NO. OF INTERM. ROW	TOTAL NO. OF BOLTS
SACH-45	26	1½	1¾	37	⅞	47	46	9	11	40
SACH-55	30	1½	2	43	⅞	53	52	10	12	44

DETAILS SHOWN ON THIS DRAWING ARE NOT TO SCALE FOR VISUAL CLARITY.

⚠ REVISED FOUNDATION DIAMETER AND EMBEDMENT DEPTH FOR 45' & 55' ARM LENGTHS.
ADDED SOIL PARAMETER NOTE AND 2:1 MAX. ALLOWABLE SLOPE TO ELEVATIONS.
REVISED BOX CONNECTION TABLE TO ADD W DIMENSION.
REVISED POST AND ARM SIZES FOR 45' & 55' ARM LENGTHS AND AFFECTED BASE PLATE DIMENSIONS.
MOVED FOOTING DIAMETER INFORMATION TO THE CHART.
ADDED BASE PLATE HOLE SIZE INFORMATION.
ADDED CAMBER DETAIL AND CHART.

DRAFT

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018

REVISION DATE
⚠ 11/18/2022

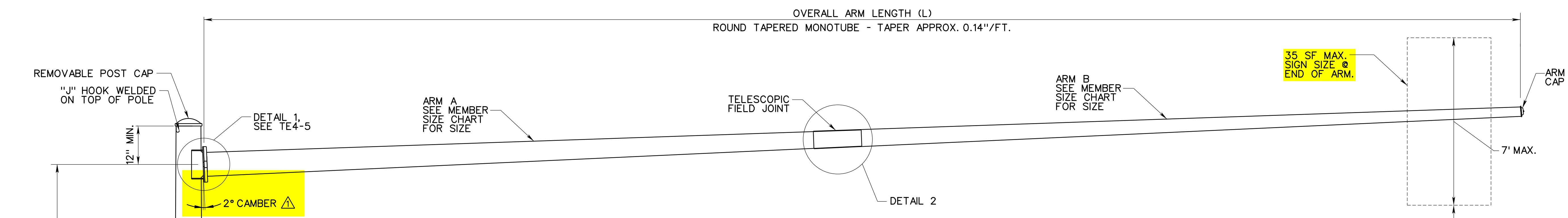
OVERHEAD SIGN SUPPORT-STEEL

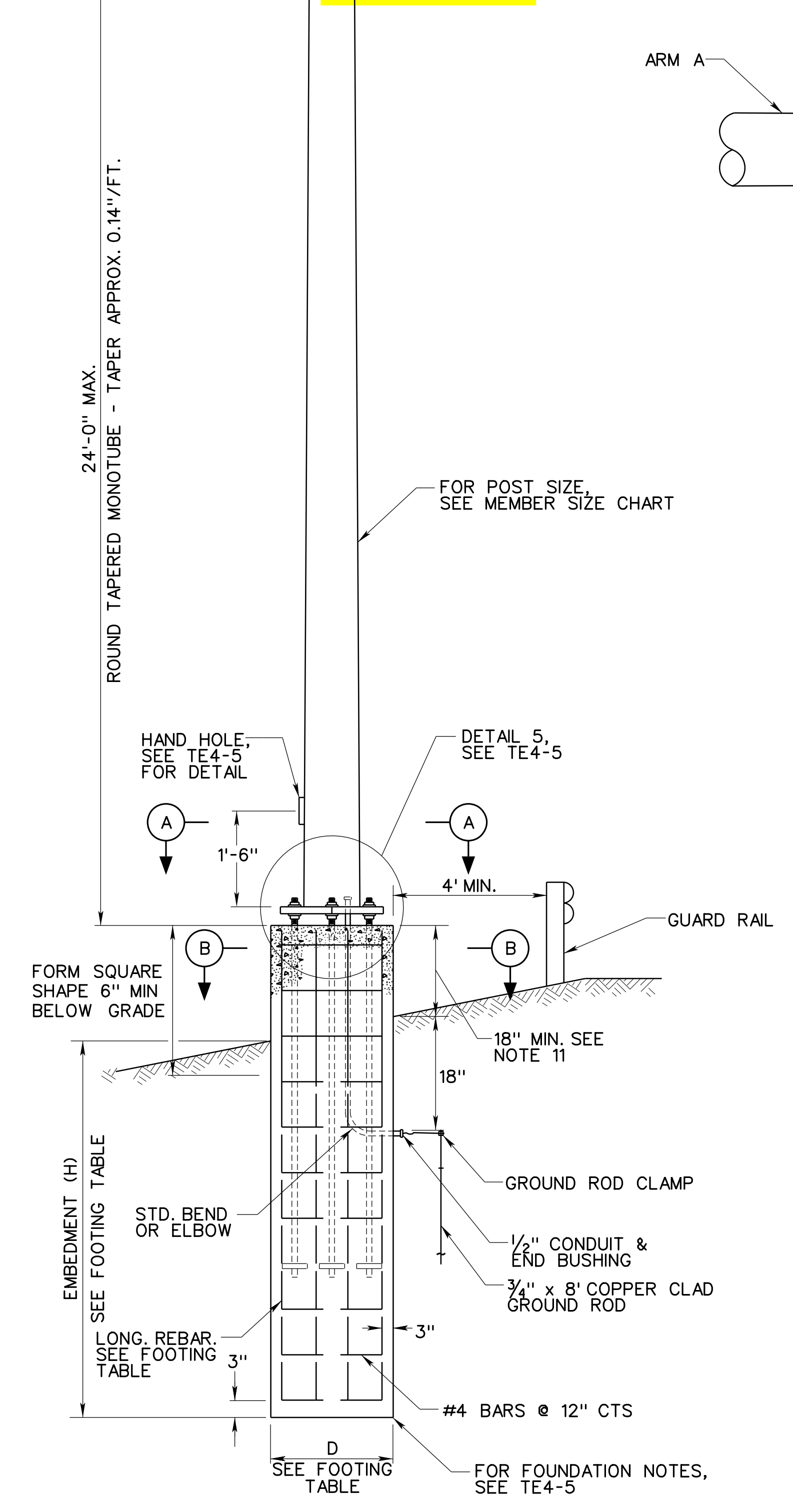
SINGLE ARM CANTILEVER (HEAVY)

STANDARD SHEET TE4-4A

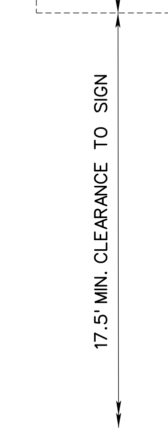
TRAFFIC ENGINEERING DIVISION

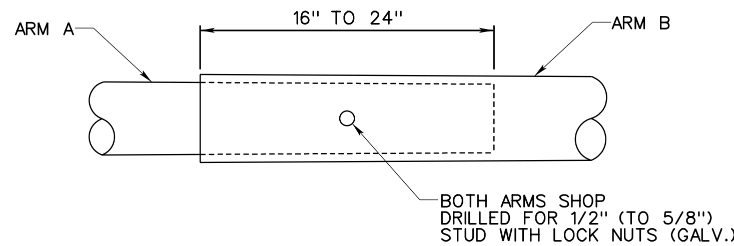
J04C02C03-STDBOR c



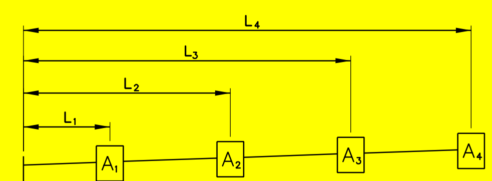


ELEVATION





DETAIL 2
NOT TO SCALE



L=DISTANCE FROM POLE TO CENTER OF SIGN IN FT
A=AREA OF SIGN IN SF

TOTAL MOMENT=$(L_1 \times A_1)+(L_2 \times A_2)+(L_3 \times A_3)+(L_4 \times A_4)$

MULTIPLE SMALLER SIGNS ARE ALLOWED AS LONG AS THE TOTAL MOMENT DOES NOT EXCEED THE MAX. MOMENT.

MOMENT CALCULATION ⚠

NOTES:

1. SIGN SHALL BE 35 SF OR SMALLER, BUT NO SMALLER THAN 10 SF.
2. ALL SIGNS TO BE CENTERED VERTICALLY.
3. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS BY IN ACCORDANCE WITH THE SPECIFICATIONS.
4. FOR SIGN BRACKETS DETAILS, SEE TE6-3D.
5. FOR SECTION A-A & B-B, SEE TE4-5.
6. FOR FOUNDATION NOTES, SEE TE4-5.
7. FOR ANCHOR BOLT DETAIL, SEE TE4-5.
8. DETAILS LABELED AS 'NOT TO SCALE' ARE INTENTIONALLY NOT DRAWN TO SCALE FOR VISUAL CLARITY.
9. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013 USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
10. SEE SHEET TE6-3A FOR GROUNDING NOTES.
11. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.

MEMBER SIZE CHART ⚠

DESIGN NUMBER	L (FT.)	ARM A	ARM B	POST	MAX MOMENT ⚠
SACL-45	45	3 GA. 12 X 22.5'	7 GA. 9.5 X 24.5'	0 GA. 13"	1,540
SACL-55	55	0 GA. 12 X 27.5'	7 GA. 8.8 X 29.5'	2 PLY 7 GA. 16"	1,890
SACL-65	65	0 GA. 13 X 32.5'	7 GA. 9.1 X 34.5'	2 PLY 7 GA. 18"	2,240

BOX CONNECTION TABLE (SEE TE4-5 FOR SECTIONS) ⚠

DESIGN NUMBER	ARM A SIZE (NPS)	ARM PLATE THICKNESS (A) (IN)	FLANGE PLATE THICKNESS (B) (IN)	BOX HEIGHT (HB) (IN)	BOLT SIZE (IN)	NO. OF BOLTS TOP AND BOTTOM	NO. OF INTERM. ROWS	TOTAL NO. OF BOLTS	W (IN)	X *
SACL-45	12	1¾	1⅝	16	⅞	4	2	12	16	0 IF ARM MTD. > 8' ABOVE BASE
SACL-55	12	2½	1⅝	16	⅞	4	2	12	16	0 IF ARM MTD. > 18.75' ABOVE BASE
SACL-65	13	2½	1⅝	16	1	4	2	12	17	0 IF ARM MTD. > 22.5' ABOVE BASE

FOOTING TABLE (SEE TE4-5 FOR SECTIONS & ANCHOR BOLT DETAIL) ⚠

DESIGN NUMBER	POST (NPS)	PLATE DIMENSION					ANCHOR BOLTS		FOOTING		
		S (IN)	F (IN)	T (IN)	B (IN)	HOLE (IN)	NO.	DIA. (IN)	DIAM. (D)	EMBED-MENT (H)	LONG. REBAR
SACL-45	13	31 3/16	15 9/16	2½	20	2⅛	6	1¾	4'-0"	6'-0"	12 - #11
SACL-55	16	34⅝	17 5/16	2½	23	2⅛	6	1¾	4'-0"	6'-0"	12 - #11
SACL-65	18	37	18½	2½	25	2⅛	6	1¾	4'-6"	7'-0"	15 - #11

* THE X DIMENSION WILL VARY DUE TO THE USE OF A TAPERED POST.

X = 0 UNLESS THE DIAMETER OF THE POST AT THE POINT WHERE THE ARM IS TO BE ATTACHED EXCEEDS W-(2"+2"+5/8"+5/8").

X SHOULD NOT EXCEED ¼ POST DIAMETER.

⚠1 ADDED MOMENT ARM CALCULATION, REVISED PLATE HOLE DIAMETER, ADDED W DIMENSION TO TABLE, ADDED CAMBER ANGLE.

⚠2 REVISED ARM SIZES.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

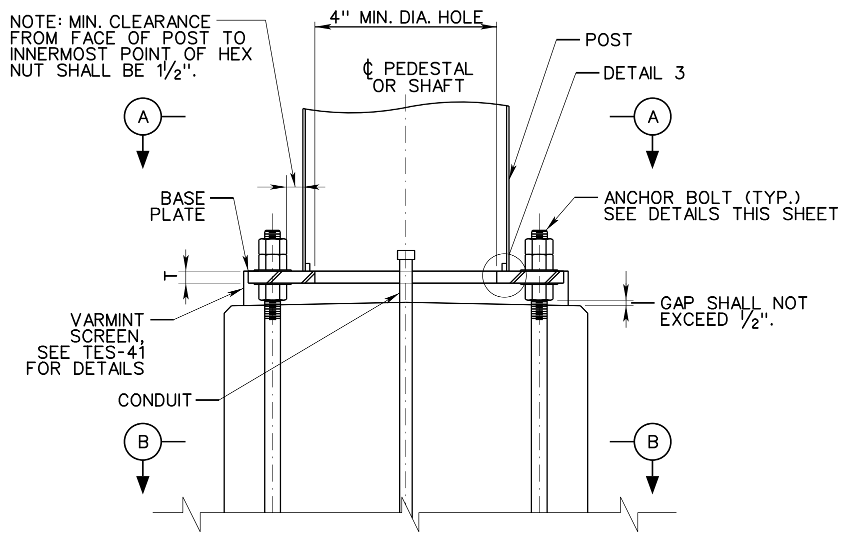
PREPARED: 8/2018

REVISION DATE
⚠1 9/2020
⚠2 5/2022

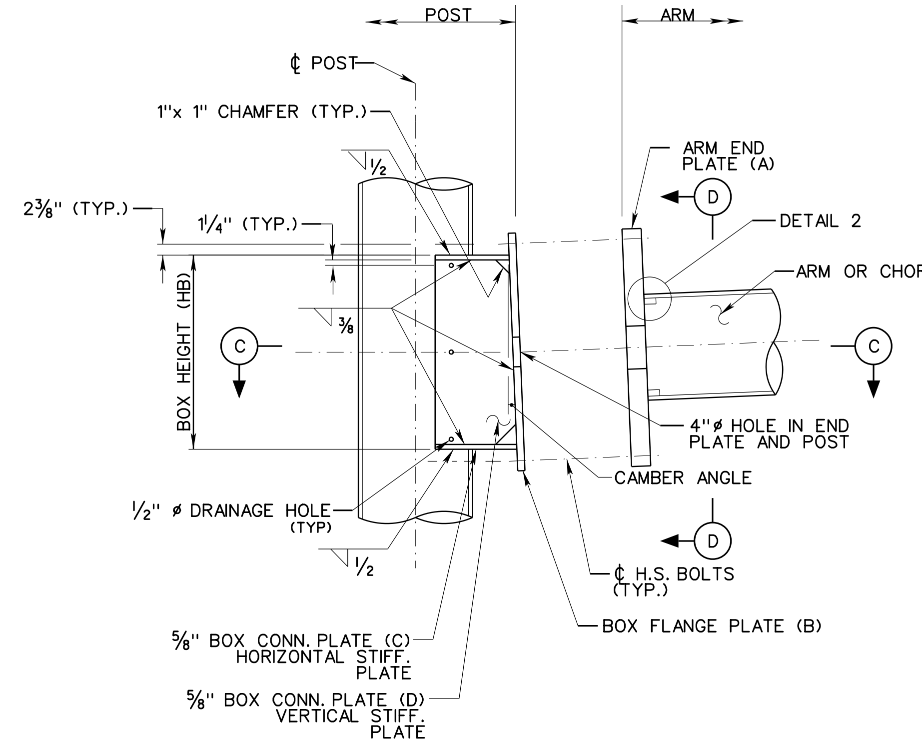
OVERHEAD SIGN SUPPORT-STEEL

SINGLE ARM CANTILEVER (LIGHT)

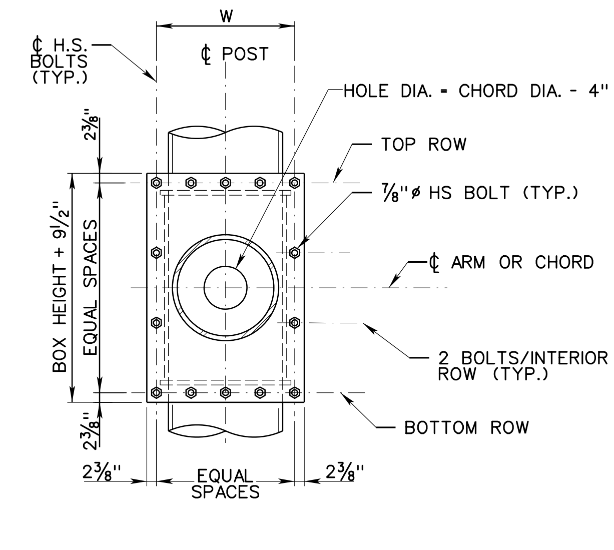
STANDARD SHEET TE4-4B



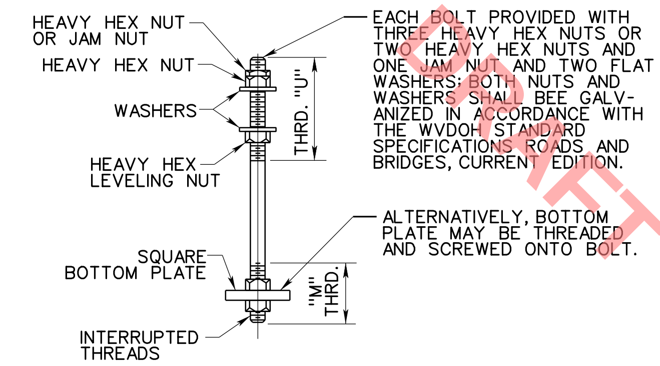
DETAIL 5



DETAIL 1
(SEE TE4-3A TE4-4A & TE4-4B FOR DIMENSIONS A, B, & HB)

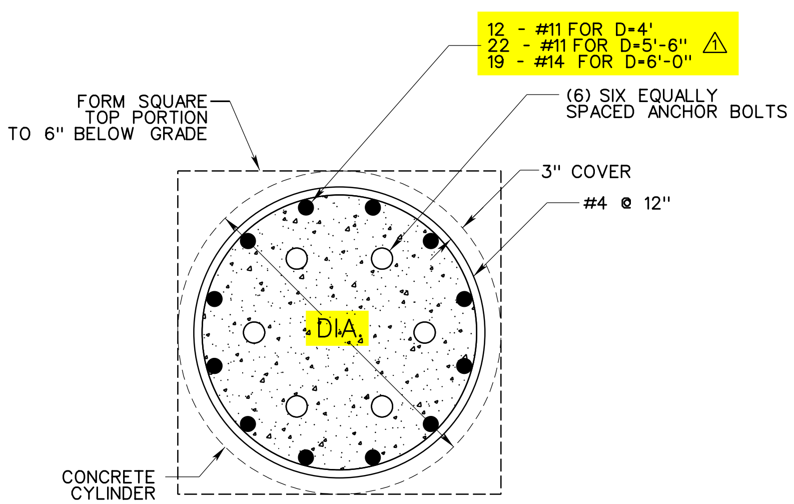


SECTION D-D
NOT TO SCALE

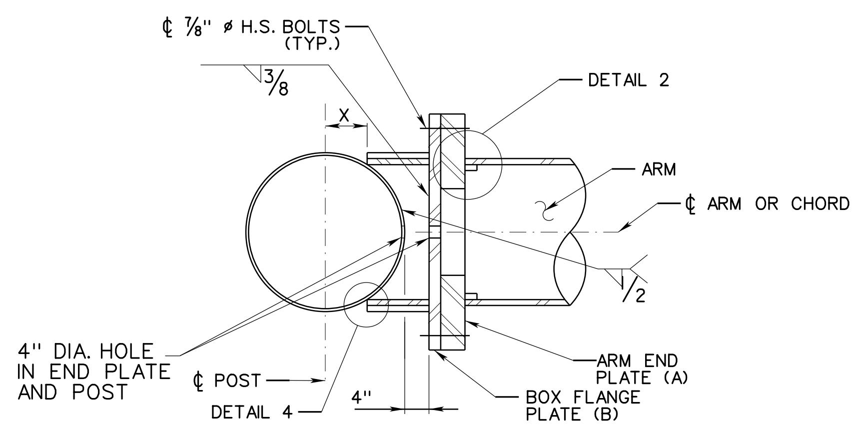


ANCHOR BOLT DETAIL

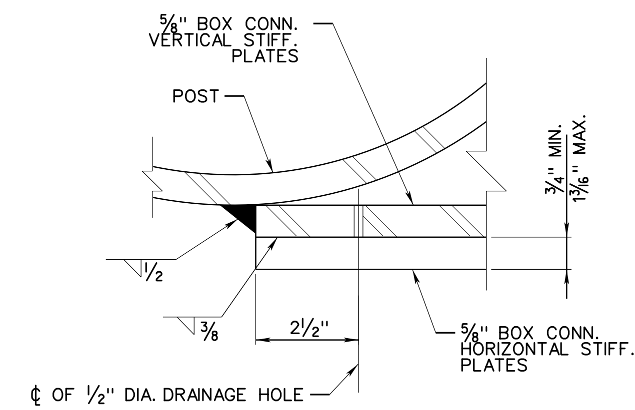
ANCHOR BOLT CHART			
ANCHOR BOLTS (IN)	BOTTOM PLATE (IN)	"M" (IN)	"U" (IN)
1 1/4x42	5x5x1 1/2	4 1/2	8
1 1/2x54	6x6x1 3/4	5 1/4	9
1 3/4x84	6 3/4x6 3/4x2	6	10
2x90	7 3/4x7 3/4x2 1/4	6 3/4	11
2 1/4x96	9x9x2 1/2	7 1/2	12



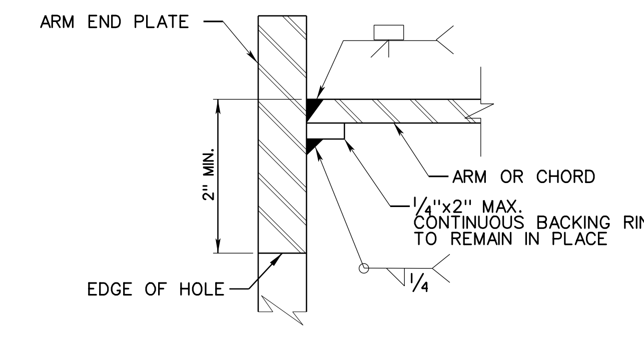
SECTION B-B



SECTION C-C
NOT TO SCALE



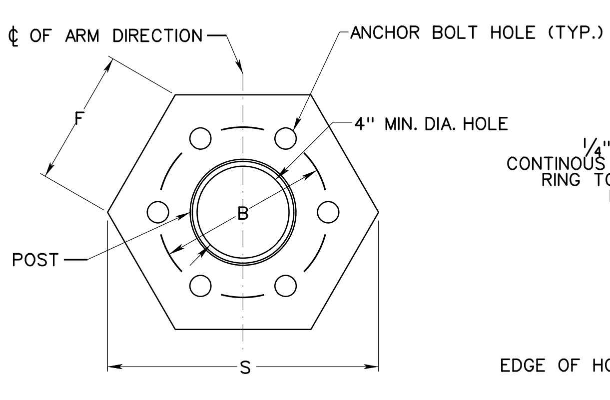
DETAIL 4
NOT TO SCALE



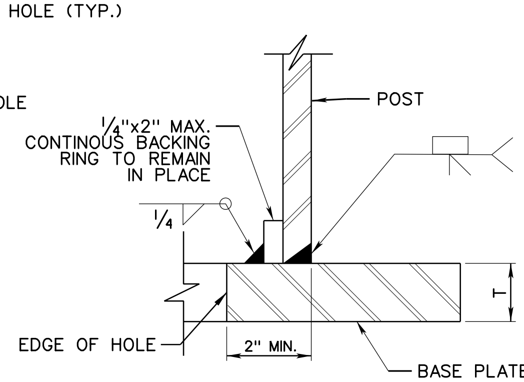
DETAIL 2
NOT TO SCALE

NOTES:

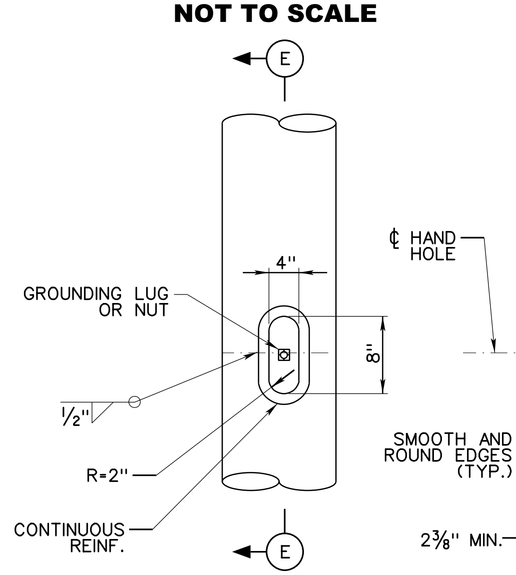
1. BOX CONNECTION ASSEMBLY PROCEDURE:
   A. FIT-UP PLATES B, C AND D (TACK WELD).
   B. MAKE ALL FILLET WELDS. SEQUENCE AS REQUIRED TO MINIMIZE DISTORTION.
   C. WELD BOX CONNECTION ASSEMBLY TO POST.
2. ANCHOR BOLTS SHALL CONFORM TO SECTION 658 OF THE SPECIFICATIONS.
3. DETAILS SHOWN ON THIS DRAWING ARE NOT TO SCALE FOR VISUAL CLARITY.
4. GALVANIZE ALL ANCHOR BOLTS AND ASSOCIATED HARDWARE IN THEIR ENTIRETY.



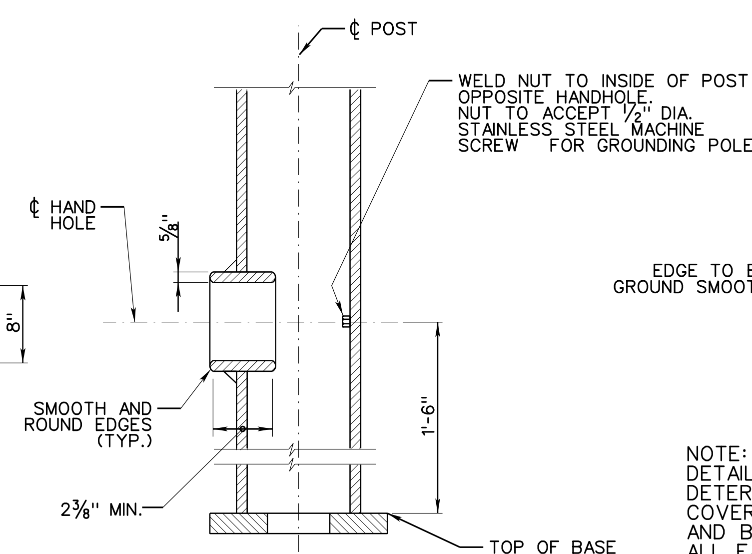
SECTION A-A



DETAIL 3

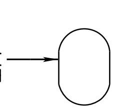


ELEVATON



SECTION E-E

POST HANDHOLE DETAIL



COVER

NOTE:
DETAILS OF THE COVER TO BE DETERMINED BY THE FABRICATOR. COVER TO FIT TIGHTLY,EXCLUDE WATER, AND BE REMOVABLE WITH A WRENCH. ALL FASTENERS, NUTS, AND WASHERS SHALL BE STAINLESS STEEL.

⚠ REVISED REINFORCING BASED ON FOOTING SIZE CHANGES ON TE4-4A

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 11/18/2022

OVERHEAD SIGN SUPPORT-STEEL COMMON DETAILS

STANDARD SHEET TE4-5

TRAFFIC ENGINEERING DIVISION

J04C02C03-STDBDR c

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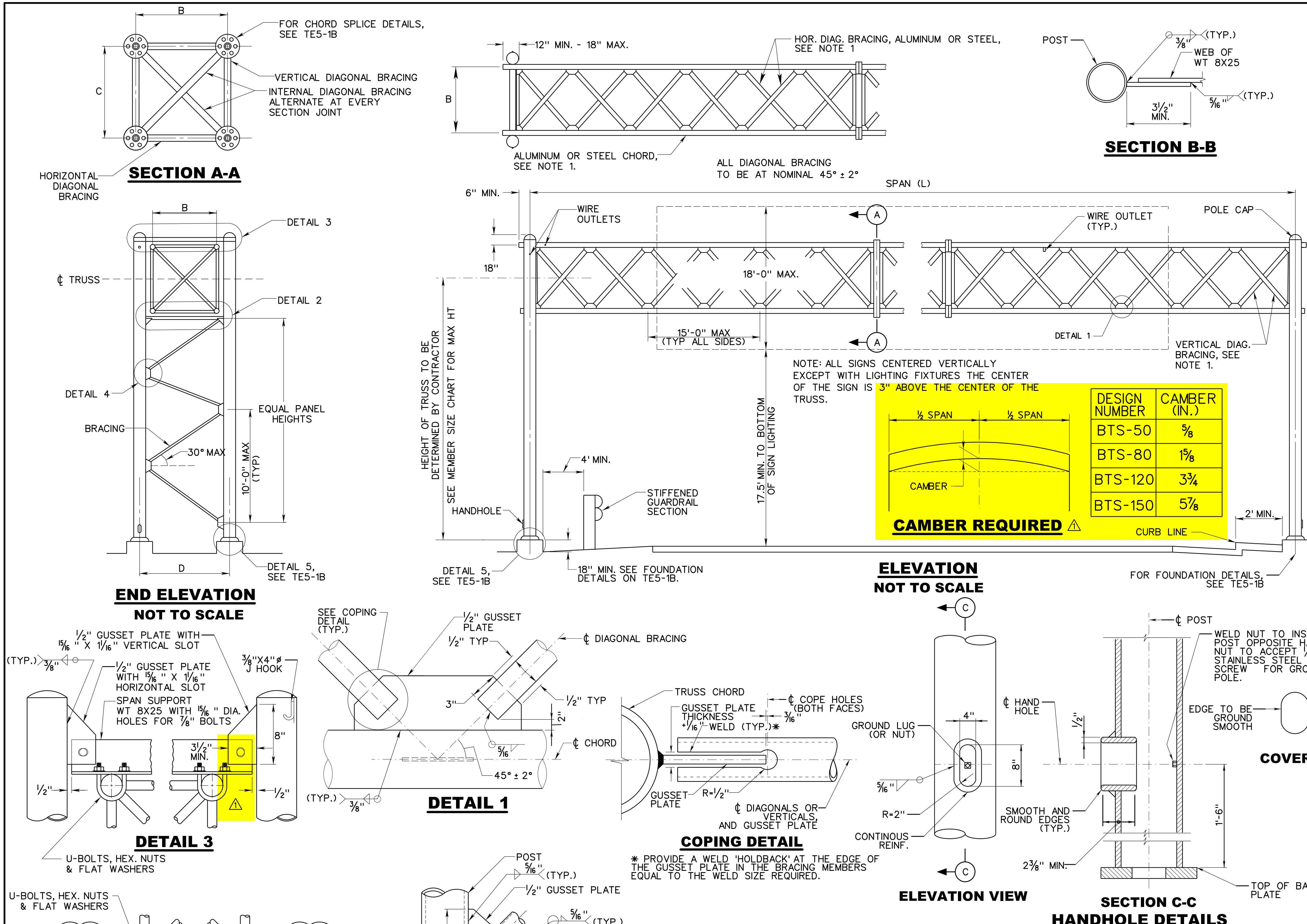
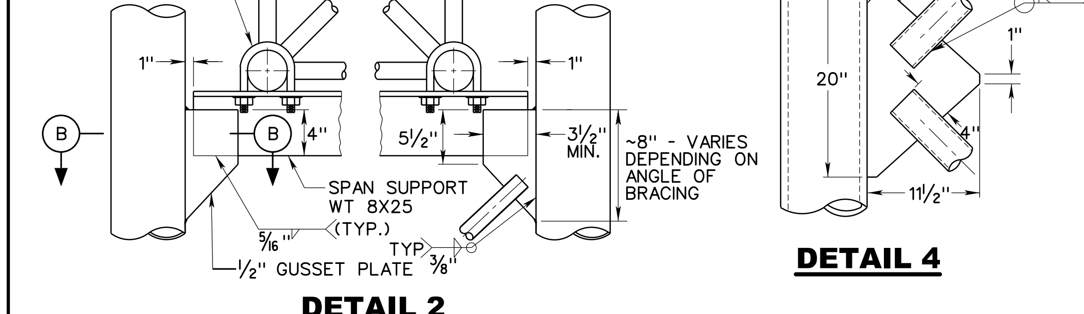


DESIGN NUMBER	CAMBER (IN.)
BTS-50	⅝
BTS-80	1⅝
BTS-120	3¾
BTS-150	5⅞



NOTES:

1. FOR SPAN LENGTHS 120 FT OR LESS, THE OVERHEAD SPAN TRUSS SHALL BE ALUMINUM ROUND STRAIGHT TUBES. FOR ALUMINUM TRUSS SPAN, A 31 LB ALUMINUM STOCKBRIDGE DAMPER SHALL BE INSTALLED NEAR THE SPAN CENTER. FOR SPAN LENGTHS MORE THAN 120 FT, UP TO 150 FT, THE OVERHEAD SPAN TRUSS SHALL BE STEEL ROUND TUBES. POSTS FOR ALL SPANS SHALL BE STEEL ROUND TUBES. THE STEEL TUBES, INCLUDING HARDWARE, SHALL BE IN ACCORDANCE WITH THE SPECIFICATIONS, UNLESS OTHERWISE NOTED.
2. DESIGN IS IN ACCORDANCE WITH AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, 6TH EDITION, 2013 USING 90 MPH WIND SPEED AND FATIGUE CATEGORY I.
3. MAXIMUM LENGTH OF SPAN SECTION SHALL BE PER MANUFACTURER'S DISCRETION TO MAXIMIZE USE OF MATERIALS. THE STEEL SPAN TRUSS AND POST TRUSS SHALL BE HOT-DIP GALVANIZED.
4. FOR OVERHEAD SPAN MOUNTED ON BRIDGES, THE OVERHEAD TRUSS SHALL BE STEEL ROUND STRAIGHT TUBES, REGARDLESS OF SPAN LENGTHS.
5. CAMBER SHALL BE OBTAINED BY INCREASING THE TOP CHORD LENGTHS AND DECREASING THE BOTTOM CHORD LENGTHS AS SHOWN, CHORD ENDS AND SPLICE PLATES SHALL BE PREPARED TO THE PROPER ANGLE BEFORE SPLICE PLATES ARE WELDED TO THE CHORDS. ALTERNATIVELY THE CAMBER CAN BE BUILT UNIFORMLY INTO THE TRUSS.
6. THE TOPS OF FOUNDATIONS SHALL BE CONSTRUCTED SO THAT THE 17.5 FT. CLEARANCE IS MAINTAINED OVER THE ENTIRE WIDTH OF THE PAVEMENT AND SHOULDERS.
7. FOR GROUNDING DETAILS SEE TE6-3A. GROUNDING ALWAYS REQUIRED, REGARDLESS IF SIGN LIGHTING REQUIRED OR NOT.
8. FOR SIGN BRACKETS AND/OR SIGN LIGHTING DETAILS, SEE TE6-3D.
9. WIRE OUTLETS: ONE THREADED STEEL 1¼ IN. PIPE COUPLING OR SHORT NIPPLE SHALL BE WELDED TO THE REAR POLE OF EACH END FRAME. THREADED ALUMINUM OR STEEL, AS APPROPRIATE, 1¼ IN. PIPE COUPLINGS OR SHORT NIPPLES SHALL BE WELDED TO THE FRONT TOP CHORD OF TRUSS APPROXIMATELY 12 IN. OUTBOARD OF THE FIRST SIGN BRACKET AND AT OTHER LOCATIONS AS PORTRAYED ON TE6-3A FOR EACH SIGN. ALL SHARP EDGES INSIDE THE POLES, CHORDS AND PIPES OR COUPLINGS SHALL BE REMOVED.
10. TRUSS SPAN FLANGE CONNECTION BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS. GALVANIZED STEEL SHALL BE USED FOR STEEL SPANS AND STAINLESS STEEL SHALL BE USED FOR ALUMINUM SPANS. BOLTS SHALL BE TIGHTENED IN ACCORDANCE WITH THE SPECIFICATIONS.
11. DETAILS OF THE HANDHOLE COVER TO BE DETERMINED BY THE FABRICATOR TO FIT TIGHTLY, EXCLUDE WATER, AND BE REMOVABLE WITH A WRENCH. ALL FASTENERS, NUTS, AND WASHERS SHALL BE STAINLESS STEEL.
12. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT.

MEMBER SIZE CHART									CHORD BOX TRUSS	POST AND BRACING	
DESIGN NUMBER	SPAN LENGTH L (FT)	B (FT)	C (FT)	D (FT)	MAX HT (FT)	MAX SIGN AREA (SF)	CHORD	U BOLT DIAMETER (IN)	BRACING	POST	BRACING
BTS-50	50	5	5	8	28	800	5SCH80	½	2.5SCH40	10SCH60	4SCH40
BTS-80	80	6	6	9	28.5	1050	6SCH80	⅝	3SCH40	10SCH60	4SCH40
BTS-120	120	9	6.5	12	29.5	1480	8SCH60	⅝	3SCH40	12SCH40	4SCH80
BTS-150	150	9	6.5	12	29.5	1480	10SCH60	⅝	3SCH80	12SCH80	5SCH80

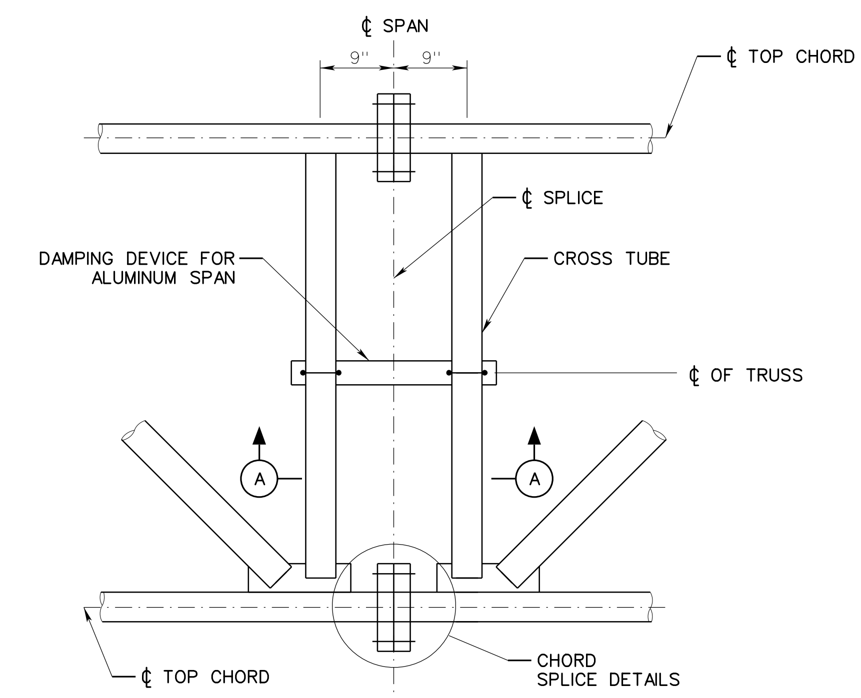
REVISED CHORD MEMBER SIZES, DELETED WELD
ADDED CAMBER INFORMATION, REVISED MAX SPAN SECTION LENGTH

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
12/19/2022

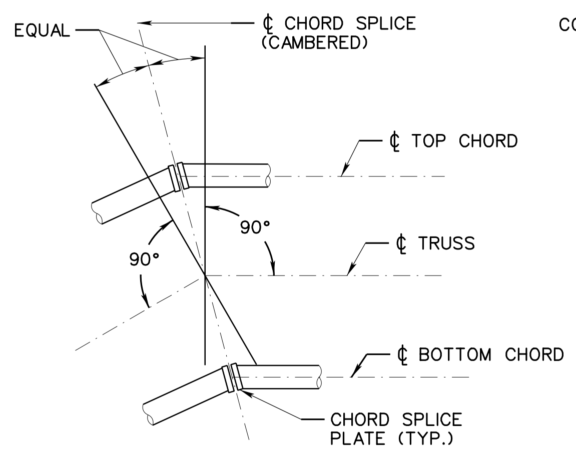
OVERHEAD SIGN SUPPORT BOX TRUSS SPAN

STANDARD SHEET TE5-1A

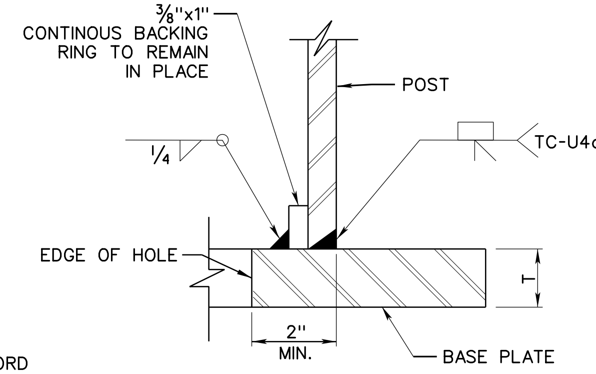


PLAN

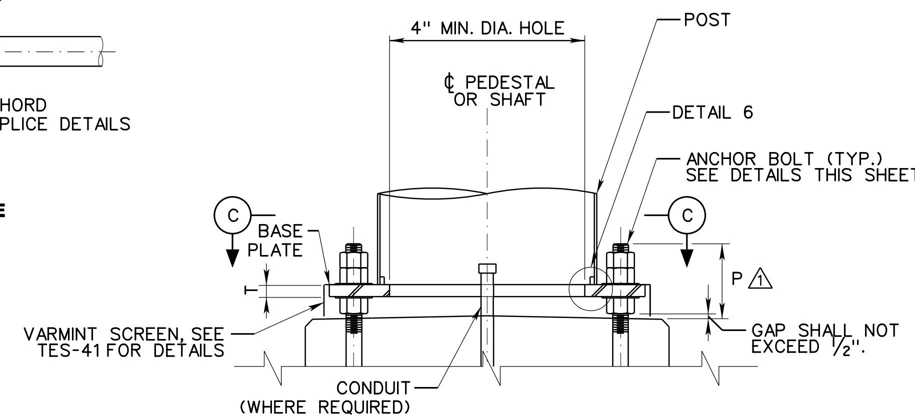
FOR TRUSS DAMPING DEVICE (50', 80', & 120' SPANS)



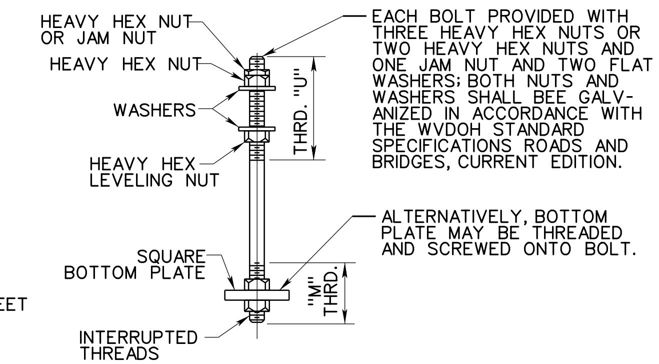
CAMBER DETAIL
(SEE TE5-1A, NOTE 5)



DETAIL 6



DETAIL 5



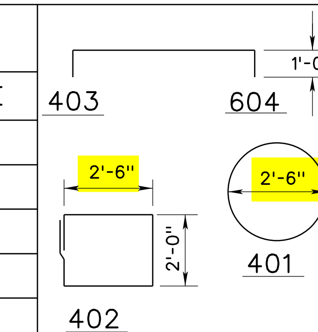
ANCHOR BOLT DETAIL

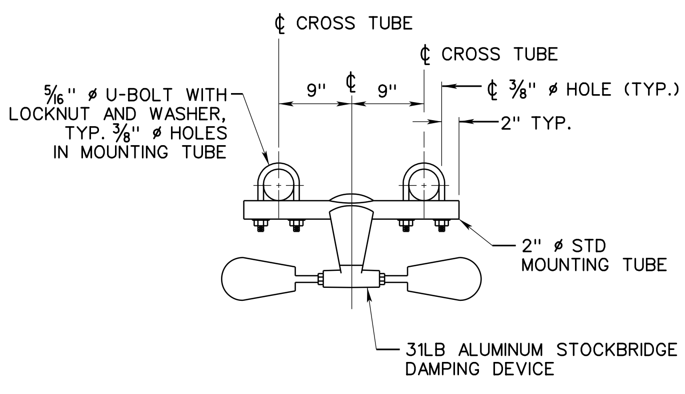
CHORD SPLICE TABLE △							
CHORD NPS	PLATE			BOLTS		FILLET WELD	
	A	B	C	NUMBER	DIA.	a	b
5SCH80	1'-1"	10"	1/2"	6	7/8"	3/8"	1/4"
6SCH80	1'-1 1/2"	10 1/4"	1/2"	6	7/8"	3/8"	1/4"
8SCH60	1'-2 1/2"	11 1/4"	1 3/4"	8	7/8"	3/8"	1/4"
10SCH60	1'-4 3/4"	1'-1 1/4"	2 1/4"	8	7/8"	3/8"	1/4"

BASE PLATE TABLE △								
POST (NPS)	PLATE (IN)				ANCHOR BOLTS			FOOTING DEPTH
	F	T	E	HOLE DIA (IN.)	NUMBER	SIZE DIA.	P △	
10	17.0	2 1/4	13.0	1 5/8"	4	1 1/4"	7"	9'-6"
12	18.0	2 1/2	14.0	1 7/8"	4	1 1/2"	8"	10'-10"

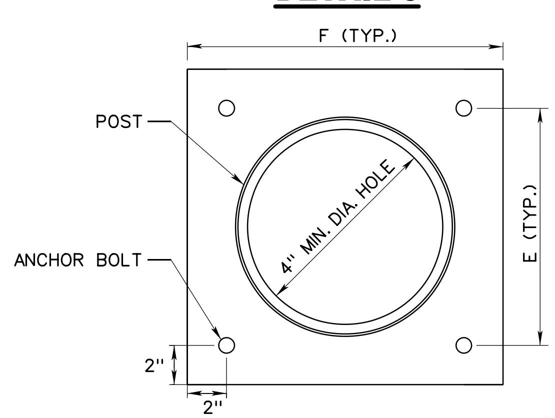
ANCHOR BOLT CHART			
ANCHOR BOLTS (IN)	BOTTOM PLATE (IN)	"M" (IN)	"U" (IN)
1 1/4x42	5x5x1 1/2	4 1/2	8
1 1/2x54	6x6x1 3/4	5 1/4	9

△ REINFORCEMENT SCHEDULE (FOR EACH FOUNDATION)			
MARK	NO	LENGTH	TYPE
401	12"C/C-#4	9'-2"	401
402	12"C/C-#4	9'-6"	402
403	2-#4	D+4'-6"	403
404	8-#4	2'-6"	STR.
604	4-#6	D+2'-0"	604
801	28-#8	VARIES	STR.

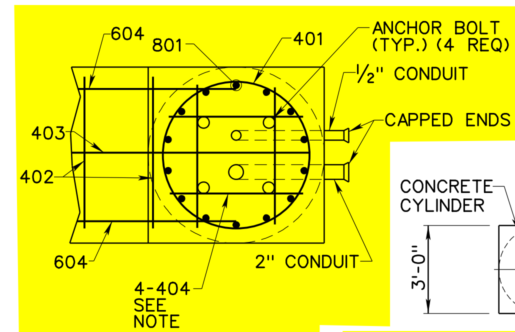




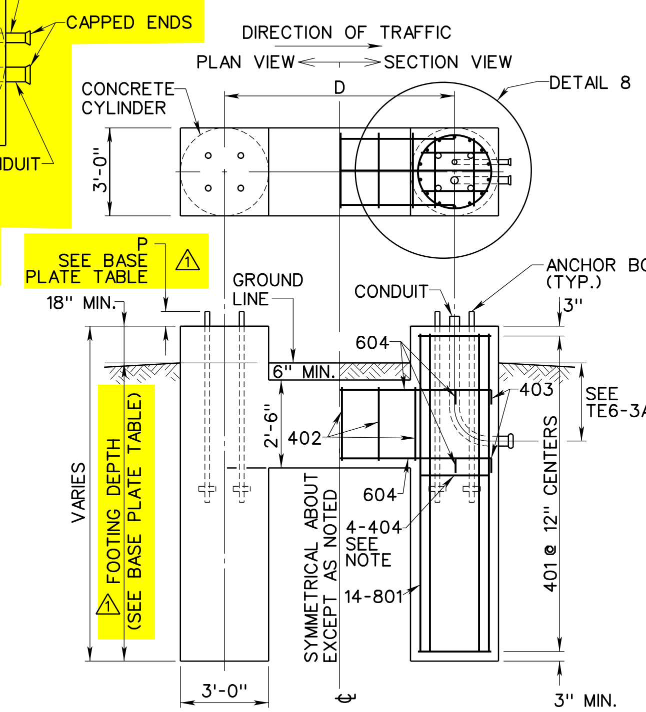
SECTION A-A



SECTION C-C

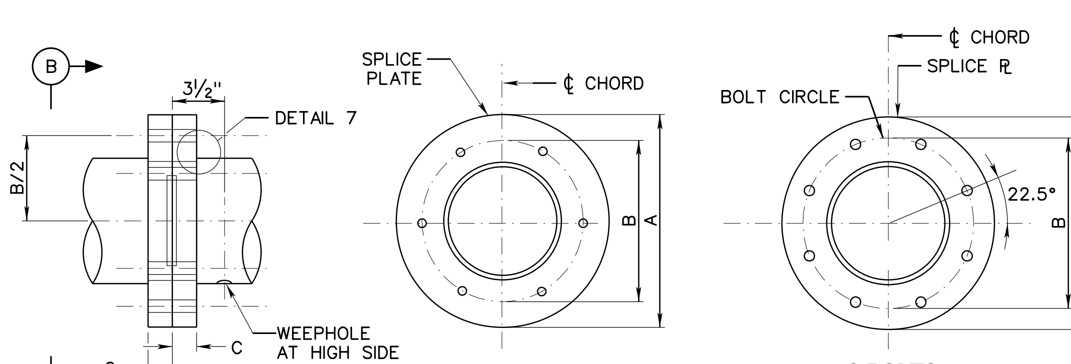


△ DETAIL 8



NOTE: TIE ANCHOR BOLTS TO REBAR CAGE NEAR BOTTOM OF ANCHOR BOLTS.

FOUNDATION DETAIL △
(RIGHT HAND SHOWN - LEFT HAND OPPOSITE)

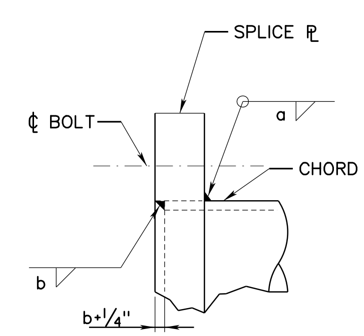


ELEVATION

6 BOLTS SECTION B-B

8 BOLTS SECTION B-B

CHORD SPLICE DETAILS



DETAIL 7

NOTES:

1. DEPTH OF FOUNDATION IS BASED ON AN ASSUMED SOIL SUCH AS MEDIUM CLAY OR SAND CLAY PROVIDING AN UNCONFINED COMPRESSIVE STRENGTH NOT LESS THAN 2500 LBS/FT. THESE FOUNDATIONS MAY BE USED IN COHESIONLESS TYPE SOILS PROVIDED THAT THE FRICTION ANGLE IS NOT LESS THAN 30 DEGREES.
2. HI-STRENGTH BOLTS SHALL CONFORM TO THE REQUIREMENTS OF THE SPECIFICATIONS. TIGHTEN ALL HIGH STRENGTH BOLTS IN ACCORDANCE WITH THE SPECIFICATIONS.
3. ANCHOR BOLTS SHALL CONFORM TO SECTION 658 OF THE SPECIFICATIONS.
4. DETAILS ON THIS DRAWING ARE NOT TO SCALE FOR VISUAL CLARITY.
5. GALVANIZE ANCHOR BOLTS AND ASSOCIATED HARDWARE IN THEIR ENTIRETY.
6. SEE TE6-3A FOR GROUNDING NOTES.
7. IF THE FOUNDATION IS WITHIN OR PROJECTS INTO A CONCRETE OR ASPHALT SURFACE UTILIZED BY PEDESTRIANS, THE GUIDELINES PROVIDED IN SECTION 658 OF THE STANDARD SPECIFICATIONS SHALL BE FOLLOWED IN REGARDS TO PLACEMENT AND PEDESTAL HEIGHT. OTHERWISE, ALL FACES OF THE FOUNDATION SHALL BE A MINIMUM OF 18 IN. ABOVE GROUND LEVEL. WHEN FOUNDATION IS INSTALLED ON A SLOPE, THE 18 IN. MIN. SHALL BE APPLIED TO THE UPHILL FACE.

△ REVISED CHORD SPLICE TABLE AND BASE PLATE TABLE.

△ REVISED FOUNDATION REINFORCEMENT; ADDED DETAIL 8; REVISED BOLT PROJECTION; AND FOOTING DEPTH DIM.

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

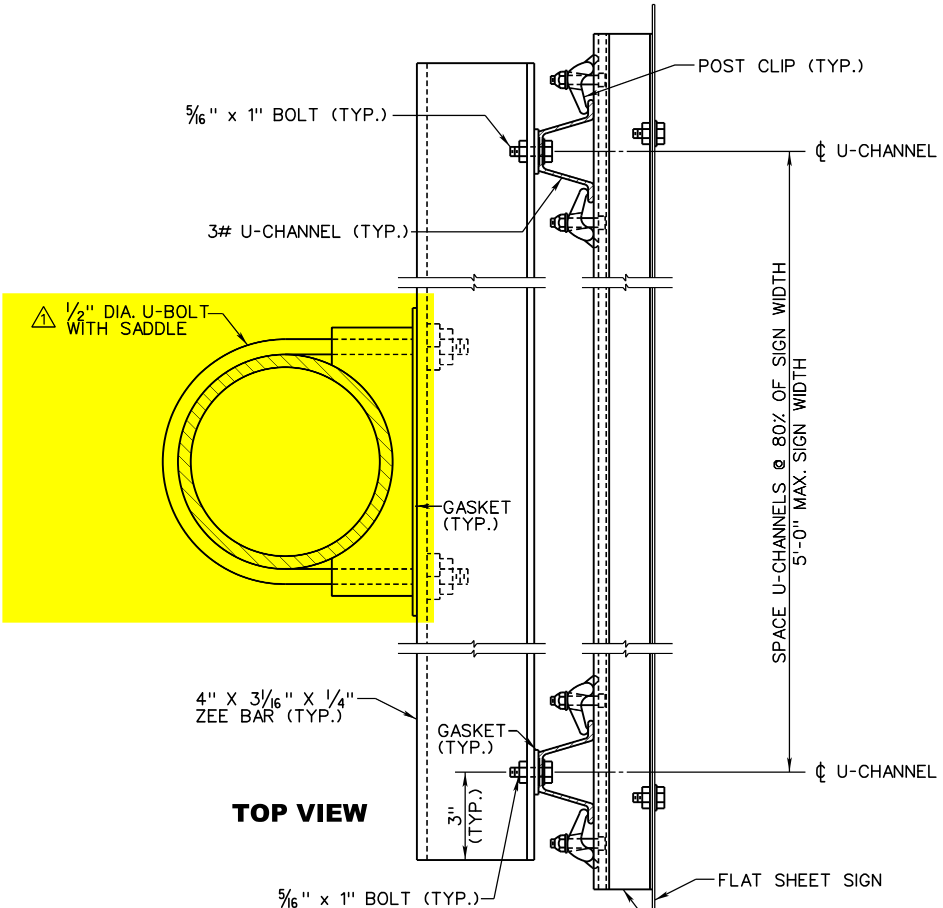
PREPARED: 8/2018
REVISION DATE
△ 2/28/2022
△ 12/19/2022

OVERHEAD SIGN SUPPORT BOX TRUSS SPAN

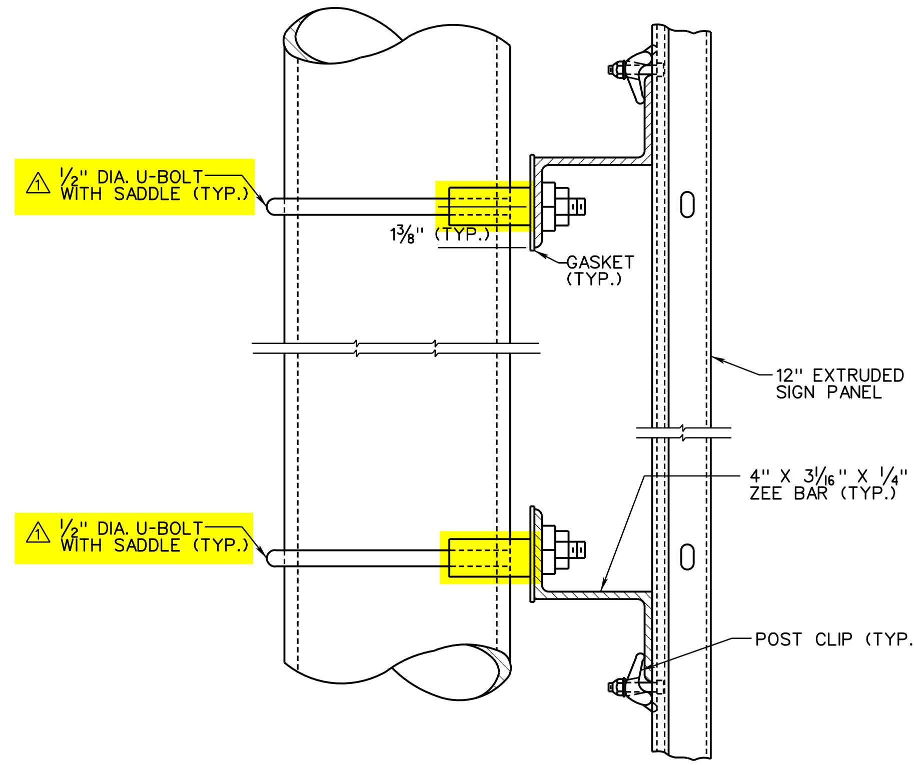
STANDARD SHEET TE5-1B

TRAFFIC ENGINEERING DIVISION

J04C02C03-STDBDR c



TOP VIEW

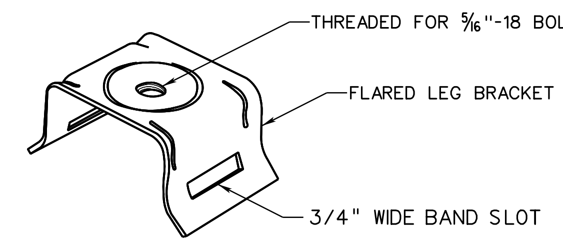


TOP VIEW

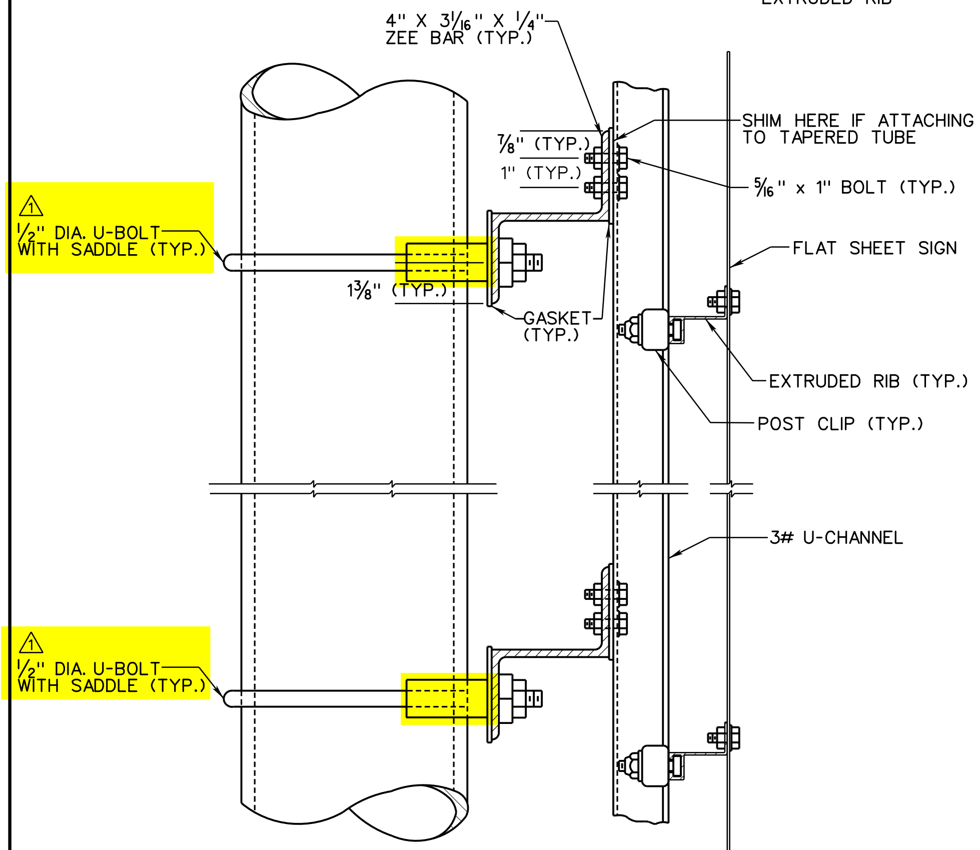
NOTES:

1. TYPE 1 CLAMP:
   - FOR USE WITH FLAT SHEET SIGNS ONLY.
   - MUST HAVE AT LEAST 2 CLAMPS (BANDS) PER SIGN.
   - MAX. AREA PER BAND TO BE 9 SF.
   - MAX. SIGN WIDTH TO BE 3 FT. (INCLUDES 3 FT. DIAMOND).
2. TYPE 2 CLAMP:
   - USED FOR ATTACHMENT OF SIGNS TO VERTICAL TUBES.
   - CAN BE USED FOR FLAT SHEET OR EXTRUDED PANEL SIGNS.
   - FLAT SHEET SIGNS MUST HAVE EXTRUDED RIBBING.
   - USE SHIMS (SEE SHEET TE17-1) AT UPPER ZEE TO U-CHANNEL CONNECTION ON TAPERED POSTS.
3. TYPE 3 CLAMP:
   - USED FOR ATTACHMENT OF SIGNS TO HORIZONTAL TUBES.
   - CAN BE USED FOR FLAT SHEET OR EXTRUDED PANEL SIGNS.
   - FLAT SHEET SIGNS MUST HAVE EXTRUDED RIBBING.
4. CONTACT BETWEEN ALUMINUM AND GALVANIZED PARTS SHALL BE PREVENTED WITH A MINIMUM 1/16 INCH THICK GASKET. GASKETS ARE NOT REQUIRED BETWEEN STAINLESS STEEL AND ALUMINUM.
5. SIGNS MOUNTED USING TYPE 1 CLAMPS SHALL BE MOUNTED USING THE STANDARD PUNCHING AS SHOWN IN THE TP SERIES IF POSSIBLE. IF HOLES ARE REQUIRED TO BE FIELD PUNCHED, THE PUNCHING SHALL BE APPROVED BY THE ENGINEER. THE HOLES SHALL BE PUNCHED SUCH THAT SPACING BETWEEN THE HOLES AND FROM THE OUTERMOST HOLES TO THE EDGES OF THE SIGN ARE UNIFORM. IN ADDITION, THE HOLE LOCATIONS SHALL BE PLACED SUCH THAT THE ATTACHMENT HARDWARE WILL NOT UNNECESSARILY INTERFERE WITH THE SIGN MESSAGE.
6. SEE SHEET TE17-1 REGARDING DETAILS FOR ATTACHMENT OF FLAT SHEET SIGN FACE TO EXTRUDED RIB AND FOR EXTRUDED RIB DIMENSIONING DETAILS.
7. SEE SHEET TE7-1 FOR EXTRUDED SIGN PANEL, POST CLIP, AND STITCH BOLT DETAILS.
8. ⚠ ALL U-BOLTS TO INCLUDE SADDLE BETWEEN TUBE AND ZEE BAR.

DRAFT



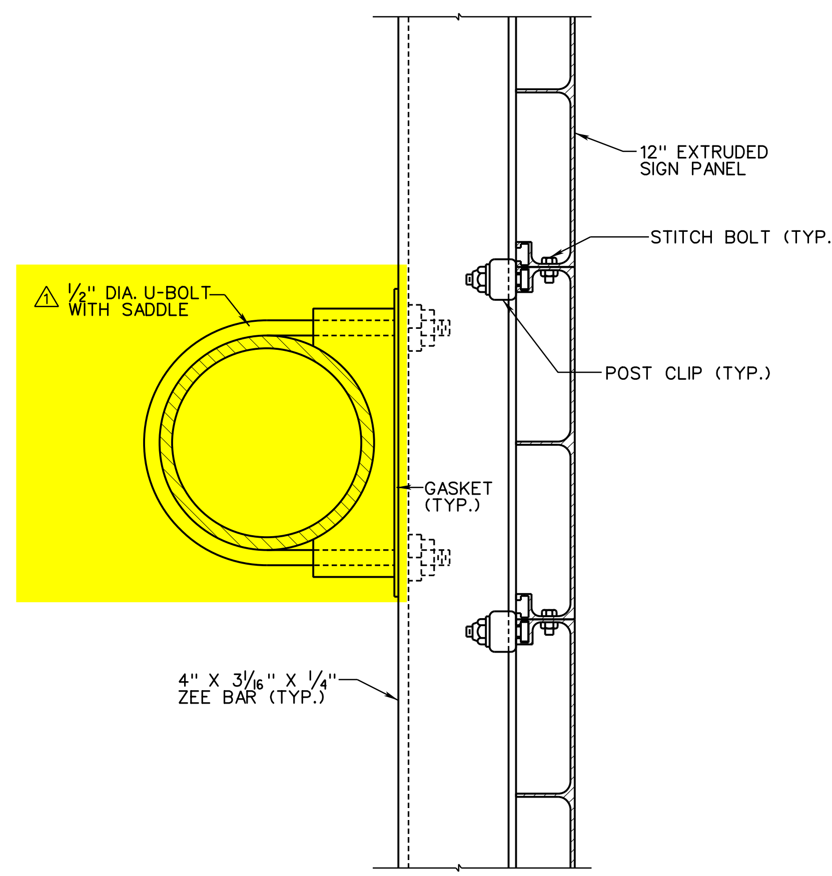
FLARED LEG BRACKET



ELEVATION

TYPE 2

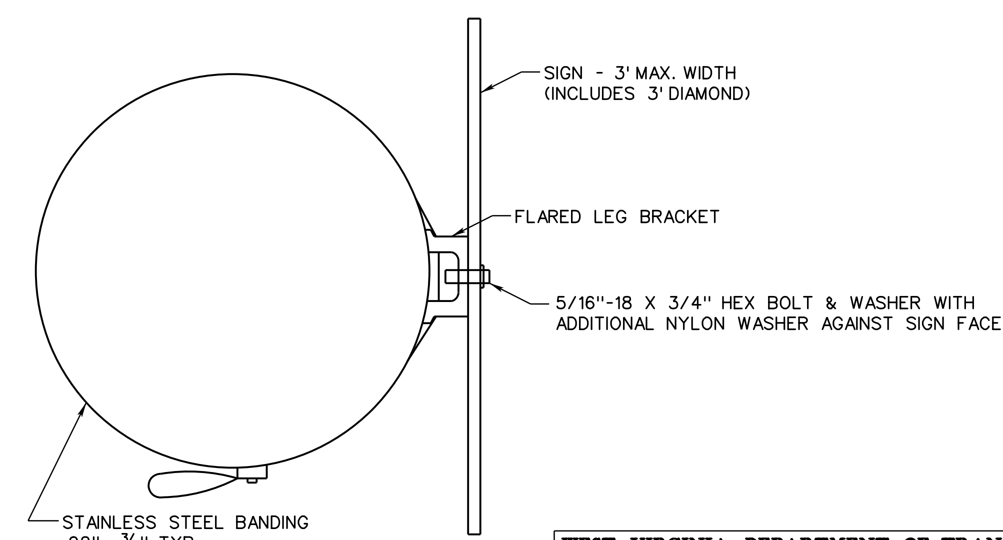
VERTICAL TUBE MOUNT
FLAT SHEET SIGN W/
EXTRUDED RIB SHOWN



ELEVATION

TYPE 3

HORIZONTAL TUBE MOUNT
EXTRUDED PANEL SIGN SHOWN



TYPE 1

VERTICAL OR HORIZONTAL MOUNT
MAX. 9 SQ. FT. PER BAND
MIN. 2 BANDS PER SIGN

⚠ ADDED SADDLE TO U-BOLTS

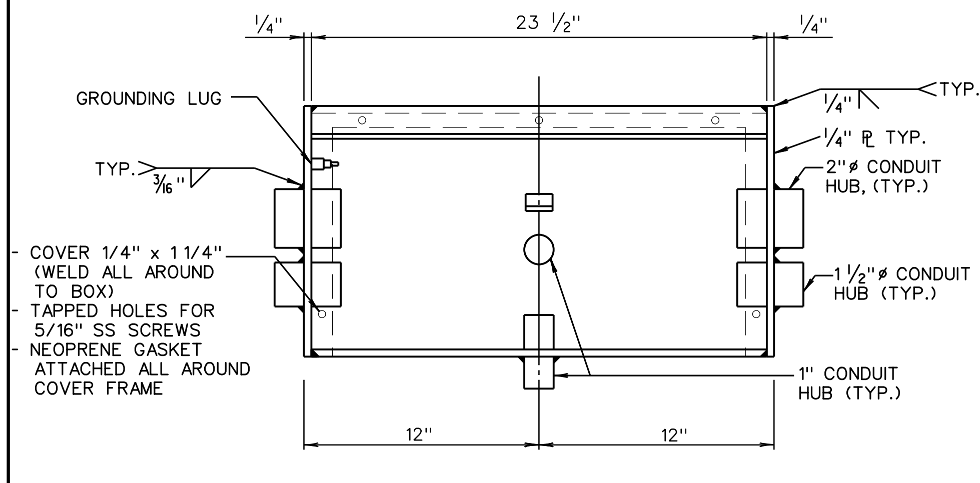
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 4/2022

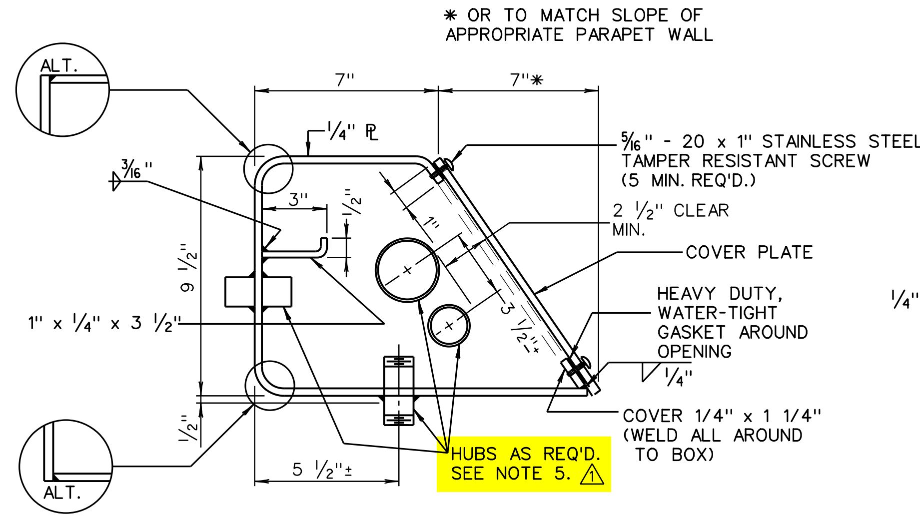
SIGN CLAMPS FOR TUBULAR SUPPORTS

STANDARD SHEET TE9-1

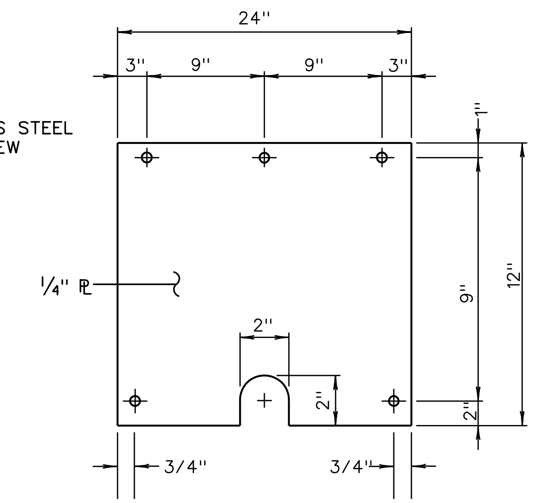
TRAFFIC ENGINEERING DIVISION



FRONT VIEW WITH COVER REMOVED

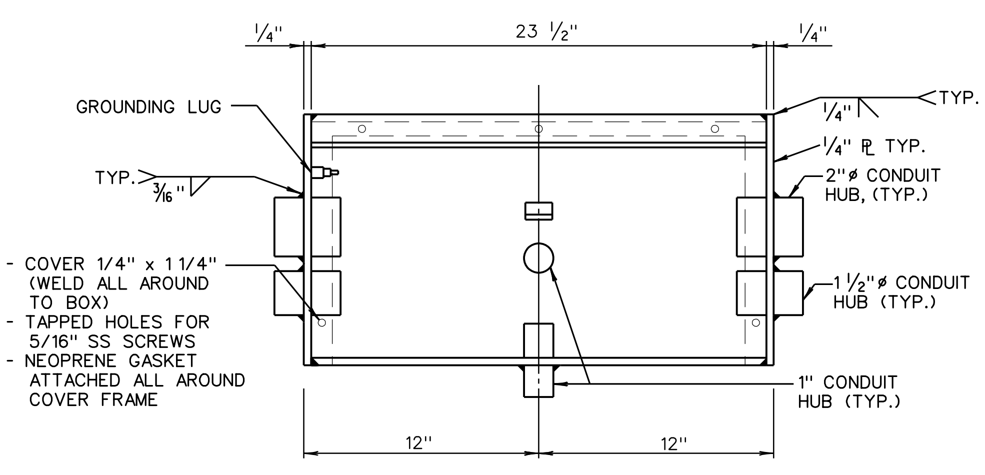


SIDE VIEW

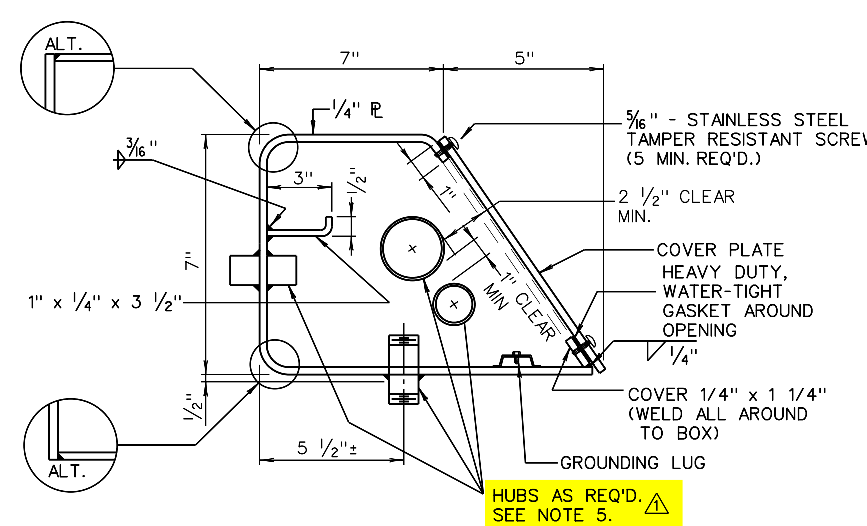


COVER PLATE

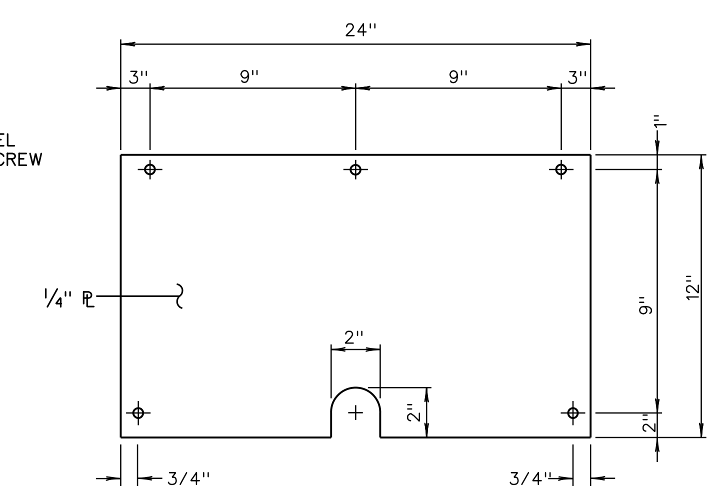
FOR N-J SHAPE WALL



FRONT VIEW WITH COVER REMOVED



SIDE VIEW



COVER PLATE

FOR F SHAPE WALL

GENERAL NOTES

1. TYPE A BOXES ARE TO BE FABRICATED FROM STEEL (1/8 IN. THICKNESS MIN.) AND HOT-DIPPED GALVANIZED AFTER ASSEMBLY.
2. REINFORCING STEEL THAT CONFLICTS WITH TYPE A BOX SHALL BE APPROPRIATELY MODIFIED AS SHOWN ON THE BRIDGE PLANS OR AS DIRECTED BY THE ENGINEER.
3. UNUSED CONDUIT TO BE FIELD CAPPED.
4. JUNCTION BOXES SHOULD BE NEMA 3R RATED.
5. ⚠ HUB SIZE AND NUMBER ARE TO BE AS REQUIRED FOR EACH SPECIFIC APPLICATION.

⚠ ADDED NOTE 5.

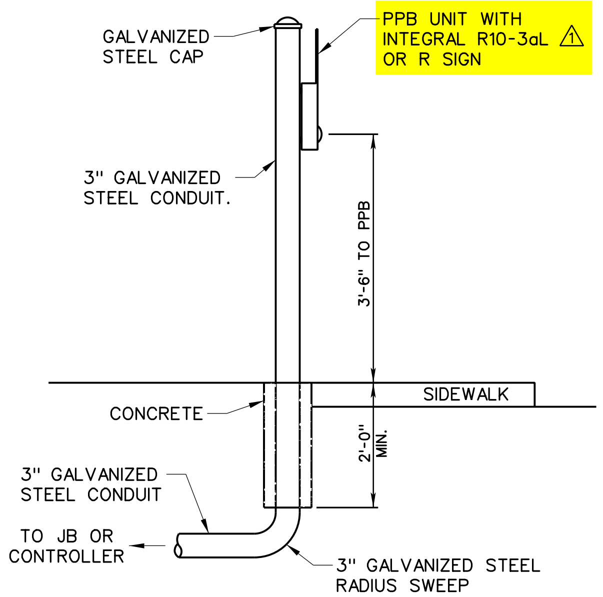
WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 4/2022

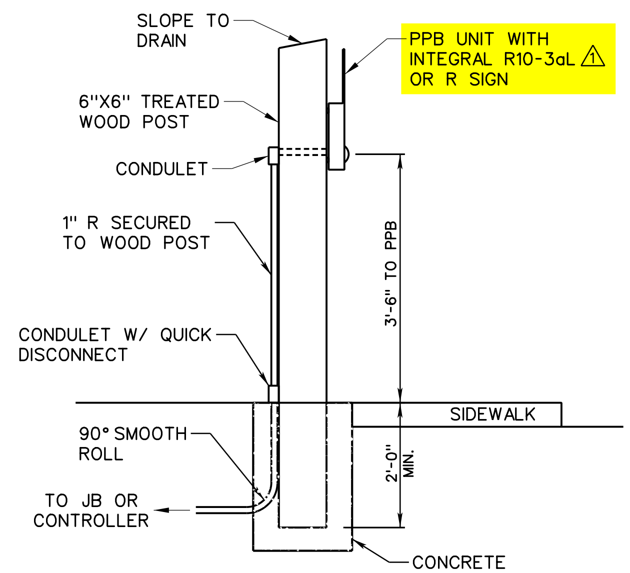
JUNCTION BOX DETAILS TYPE A

STANDARD SHEET TEL-41

TRAFFIC ENGINEERING DIVISION

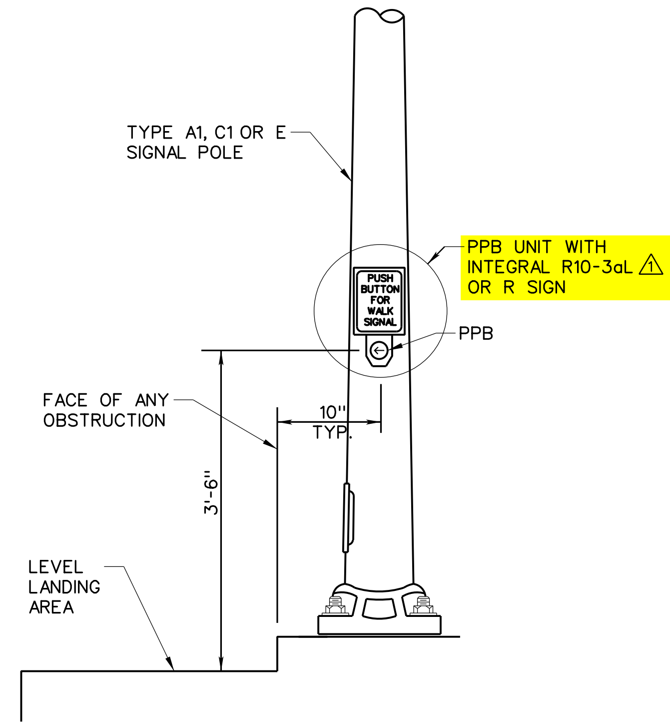


3" CONDUIT POST WITH PPB



6"X6" WOOD POST WITH PPB

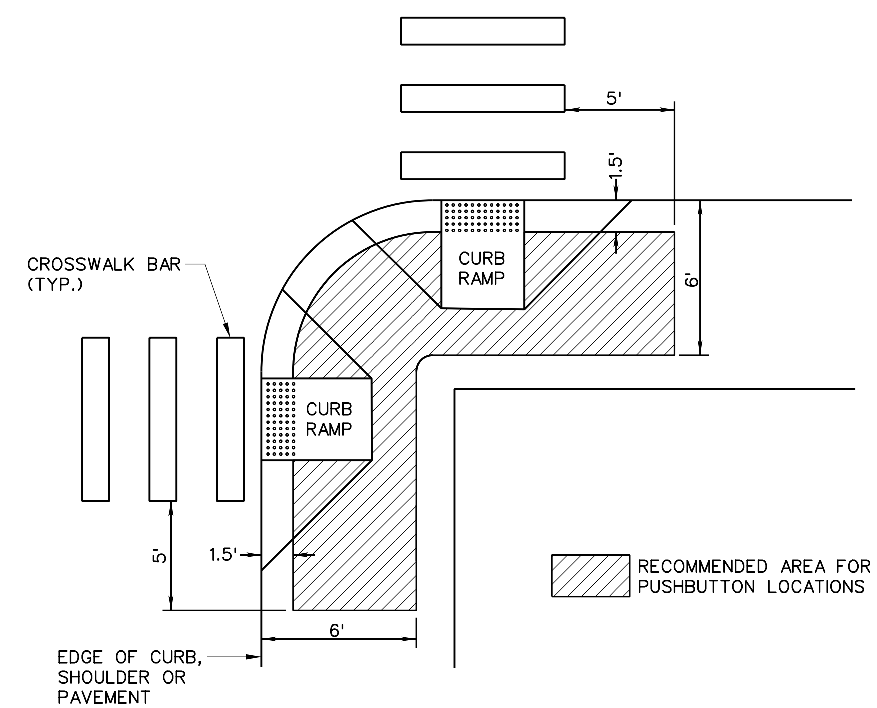
PPB INSTALLATION ON WOOD OR METAL STUB POST



PPB INSTALLATION ON TYPE A1, C1 OR E POLE

GENERAL NOTES

1. LOCATION:
   - A. THE PUSH BUTTON MUST BE WITHIN ACCESSIBLE REACH RANGE OF A LEVEL LANDING FOR USE FROM A WHEELCHAIR. THE BUTTON MAY BE PLACED UP TO 10 INCHES FROM THE LEVEL LANDING AREA.
   - B. THE OPTIMAL LOCATION FOR THE PUSH BUTTON IS BETWEEN THE CURB RAMP AND THE EDGE OF THE CROSSWALK LINE (EXTENDED) FARTHER FROM THE CORNER. IF THE OPTIMAL LOCATION IS NOT POSSIBLE, THE PUSH BUTTON NEEDS TO BE LESS THAN 5 FEET FROM THE EDGE OF THE CROSSWALK LINE (EXTENDED) FARTHER FROM THE CORNER.
   - C. THE PUSH BUTTON SHOULD BE BETWEEN 1.5 FEET AND 6 FEET, BUT NO FURTHER THAN 10 FEET FROM THE EDGE OF THE CURB, SHOULDER, OR PAVEMENT UNLESS OTHERWISE SHOWN IN THE CONTRACT PLANS.
2. PUSH BUTTON UNIT:
   - A. THE PUSH BUTTON SHALL BE MOUNTED AT A HEIGHT OF 3 FT-6 IN ABOVE THE SURFACE OF THE SIDEWALK UNLESS OTHERWISE SPECIFIED ON THE CONTRACT PLANS.
   - B. TACTILE ARROWS ON PEDESTRIAN PUSH BUTTONS SHALL BE ORIENTED PARALLEL TO THE DIRECTION OF TRAVEL ON THE CROSSWALK CONTROLLED BY THE PUSH BUTTON.
   - C. PUSH BUTTON SHALL BE MOUNTED AS PER MANUFACTURER'S RECOMMENDATIONS.
   - D. AUDIBLE PEDESTRIAN PUSH BUTTONS SHALL INCORPORATE A PUSH BUTTON WITH VIBRATOR, AUDIBLE MESSAGE AND TACTILE RELIEF SYMBOLS.
   - E. THE PPB UNIT SHALL BE A COMBINATION PUSHBUTTON/SIGN COMBINATION AND A MODEL LISTED IN THE APL.
3. SIGN:
   - A. THE SIGN SHALL CONFORM TO THE SIGN DESIGNATED AS R10-3aL OR R AS SHOWN IN THE WEST VIRGINIA SIGN FABRICATION DETAILS MANUAL.
   - B. THE SIGN SHALL BE MOUNTED IMMEDIATELY ABOVE THE PUSH BUTTON AND BE AN INTEGRAL PART OF THE PPB UNIT.
   - C. SIGNS SHALL BE 0.080 IN. FLAT SHEET ALUMINUM AND FABRICATED ACCORDING TO WVDOH STANDARDS FOR SHEETING AND DESIGN UNLESS OTHERWISE SPECIFIED ON THE CONTRACT PLANS.
4. STUB POST SUPPORT:
   - A. USE STUB POST TYPE SUPPORT WHEN A TYPE A1, C1 OR E POLE IS NOT WITHIN REACH RANGE OF AN ACCESSIBLE LEVEL LANDING AREA.
   - B. STUB POST HEIGHT TO BE BASED ON MINIMUM REQUIRED CLEARANCE TO PPB.
   - C. MOUNT PPB AS PER MANUFACTURER'S RECOMMENDATIONS.



PPB LOCATION

SEE NOTE 1

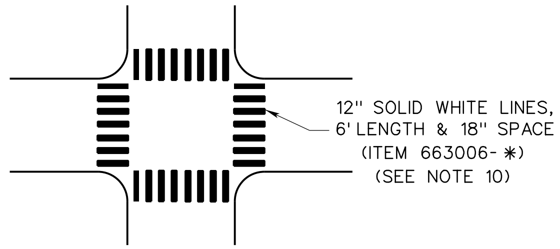
⚠ REVISED SIGN NUMBER

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 3/2020

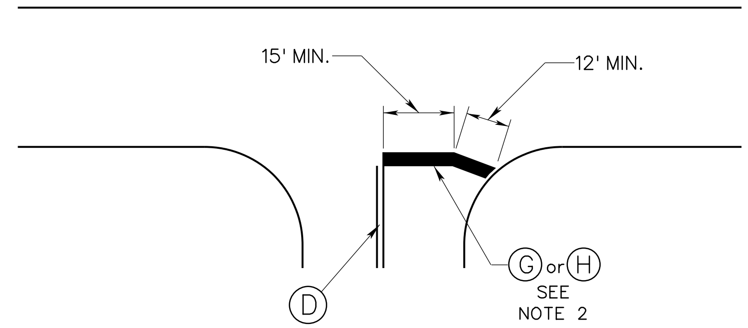
PEDESTRIAN PUSH BUTTONS (PPB)

STANDARD SHEET TES-31

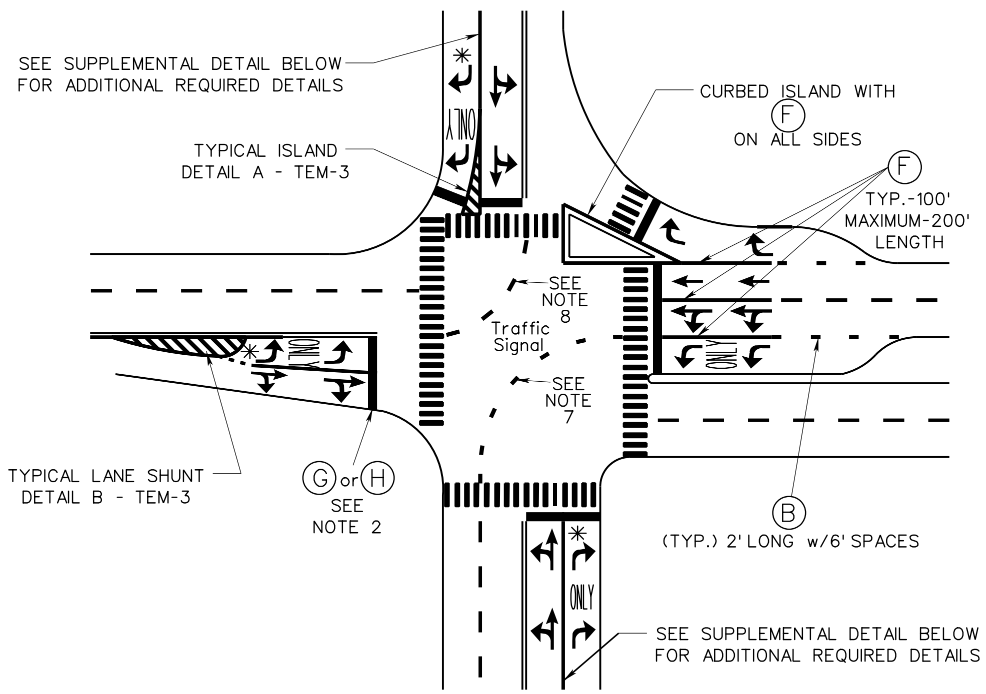


(F) TYPE V PARALLEL CROSSWALK LINE DETAILS

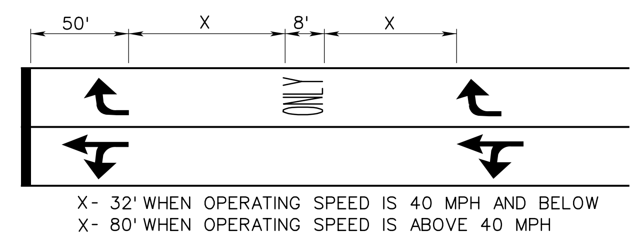
(OFFSET MARKINGS AS REQUIRED IN ORDER TO AVOID WHEEL TRACKING AREAS)



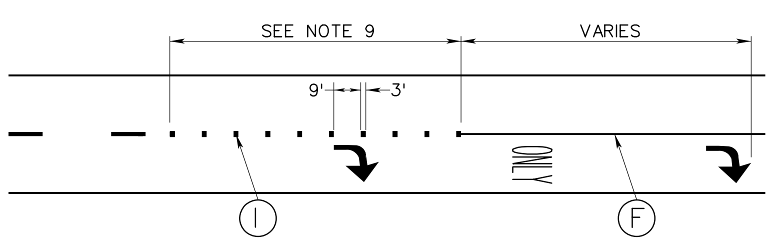
(G) METHODOLOGY FOR INSTALLING (BENDING) STOP LINES AT WIDE THROATED INTERSECTIONS



NOTE: IF A RAILROAD CROSSING IS CLOSE TO THE INTERSECTION PLACE ARROWS SO THAT DRIVERS ARE NOT DIRECTED ONTO TRACKS.



(I) TYPICAL LANE-USE MARKING SPACING



SUPPLEMENTAL DETAIL
MANDATORY TURN LANE MARKINGS

(H) TYPICAL INTERSECTIONS MARKINGS

NOTE:
∗ ALL LANE USE MARKINGS SHOWN IN THIS LANE ARE REQUIRED. ALL OTHER LANE USE ARROWS SHOWN ON THIS SHEET ARE OPTIONAL AS CALLED FOR ON PLANS.

GENERAL NOTES

1. BROKEN LINES SHALL BE 10 FEET IN LENGTH WITH 30 FEET SPACES, UNLESS OTHERWISE SPECIFIED. THE RATIO OF PAINTED LINE LENGTH TO SKIP LENGTH SHALL BE 1 TO 3.

2. STOP LINES SHALL BE 12 INCHES IN WIDTH UNLESS ONE OF THE FOLLOWING CONDITIONS ARE MET, IN WHICH CASE THE WIDTH SHALL BE 24 INCHES:
   - THE STOP LINE IS ON THE APPROACH TO A SIGNALIZED INTERSECTION;
   - THE STOP LINE IS AT THE END OF AN INTERSTATE OR EXPRESSWAY INTERCHANGE EXIT RAMP;
   - THE POSTED SPEED LIMIT OF THE ROADWAY THAT THE STOP LINE IS PLACED IS 45 MPH OR GREATER.

   STOP LINES SHOULD BE PLACED 4 FEET IN ADVANCE OF AND PARALLEL TO THE NEAREST CROSSWALK LINE. THE STOP LINE SHOULD BE PLACED AT THE DESIRED STOPPING POINT, BUT IN NO CASE MORE THAN 30 FEET OR LESS THAN 4 FEET FROM THE NEAREST EDGE OF THE INTERSECTING TRAVELED WAY.

3. SUPPLEMENTAL PAVEMENT WORD AND/OR SYMBOL MARKINGS SHOULD BE LIMITED TO NOT MORE THAN A TOTAL OF THREE LINES OF INFORMATION (WORDS AND/OR SYMBOLS). THEY SHALL BE WHITE IN COLOR. LETTERS, SYMBOLS AND NUMERALS SHALL BE A MINIMUM OF 8 FEET IN HEIGHT. THE WORD MARKING "ONLY" AND THE ARROW SHALL BE USED WHERE A MOVEMENT THAT WOULD OTHERWISE BE LEGAL IS TO BE PROHIBITED. THE SPACE BETWEEN LINES SHOULD BE AT LEAST FOUR TIMES THE HEIGHT OF THE CHARACTERS FOR LOW SPEEDS BUT NOT MORE THAN TEN TIMES THE HEIGHT OF THE CHARACTERS UNDER ANY CONDITIONS. LOCATION OF SUPPLEMENTAL PAVEMENT MARKINGS SHALL BE AS SHOWN OR AS DIMENSIONED ON THE PLANS.

4. THE SPACING BETWEEN ADJACENT YELLOW CENTERLINE MARKINGS SHALL BE EQUAL TO THE LINE WIDTHS.

5. ALL LONGITUDINAL MARKINGS SHALL BE OFFSET FROM THE PAVEMENT JOINTS AS SPECIFIED IN THE STANDARD SPECIFICATIONS.

6. NORMALLY, THE MAXIMUM LANE WIDTH SHALL BE 12 FEET. SINGLE LANE RAMP WIDTHS SHALL BE 16 FEET.

7. ⚠ DUAL LEFT TURN LANES SHALL BE SEPARATED BY DASHED WHITE LINES 2 FEET LONG WITH 6 FEET SPACES. THE WIDTH OF THE DASHES SHALL BE EQUAL TO THE WIDTH OF THE LINE THAT THE DASHES ORIGINATE FROM. THESE LINES SHALL BE TYPE V.

8. ⚠ LEFT TURN MOVEMENTS MAY BE GUIDED BY DASHED YELLOW LINES 2 FEET LONG WITH 6 FEET SPACES WHERE ENGINEERING JUDGEMENT DETERMINES THAT SUCH ADDITIONAL MARKINGS ARE NEEDED. THE WIDTH OF THE DASHES SHALL BE EQUAL TO THE WIDTH OF THE LINE THAT THE DASHES ORIGINATE FROM. THESE LINES SHALL BE TYPE V.

9. IF THE DISTANCE BETWEEN THE PRECEDING INTERSECTION AND THE APPROACH INTERSECTION IS 1 MILE OR LESS, THE DASHED LANE LINE SHALL BE EXTENDED BACK TO THE PRECEDING INTERSECTION. OTHERWISE, THE DASHED LANE LINE SHOULD BEGIN A DISTANCE IN ADVANCE OF THE INTERSECTION AS DETERMINED BY ENGINEERING JUDGEMENT AS BEING SUITABLE TO ENABLE DRIVERS WHO DO NOT DESIRE TO MAKE THE MANDATORY TURN TO MOVE OUT OF THE LANE BEING DROPPED PRIOR TO REACHING THE QUEUE OF VEHICLES THAT ARE WAITING TO MAKE THE TURN. THE DASHED LANE LINE SHOULD BEGIN NO CLOSER TO THE INTERSECTION THAN THE MOST UPSTREAM REGULATORY OR WARNING SIGN ASSOCIATED WITH THE LANE DROP.

10. THE TYPE V MATERIAL USED FOR CROSSWALK MARKINGS SHALL BE ENHANCED SKID RESISTANT MATERIAL, AS CATEGORIZED ON THE DIVISION'S APL FOR TYPE V MATERIALS. ENHANCED SKID RESISTANT MATERIAL SHALL ALSO BE USED FOR OTHER TYPE V MARKINGS WHEN INDICATED IN THE PROJECT PLANS.

NOTE:
⇦ THIS ARROW ONLY INDICATES DIRECTION OF TRAVEL.

LEGEND

- (A)-ITEM 663001-∗ , EDGE LINE (6" WHITE)
- (B)-ITEM 663002-∗ , LANE LINE (6" WHITE)
- (C)-ITEM 663001-∗ , EDGE LINE (6" YELLOW)
- (D)-ITEM 663002-∗ , CENTERLINE (6" YELLOW)
- (E)-ITEM 663002-∗ , CENTERLINE (6" YELLOW)
- (F)-ITEM 663004-∗ , CHANNELIZING LINE (8", TYPE V)
- (G)-ITEM 663005-∗ , STOP LINE (12")
- (H)-ITEM 663005-∗ , STOP LINE (24")
- (I)-ITEM 663002-∗ , LANE LINE (8" DASHED)

⚠ SPECIFIED TYPE V MARKINGS

DRAFT

WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
STANDARD DETAIL

PREPARED: 8/2018
REVISION DATE
⚠ 4/2022

TYPICAL PAVEMENT MARKINGS
(SHEET 2 of 2)

STANDARD SHEET TEM-2

TRAFFIC ENGINEERING DIVISION

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