September 19, 2024

Foundation Design Updates for Ancillary Traffic Structures

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Geotechnical Branch Manager – Bridge Division

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Types of Ancillary Traffic Structures

Structure	Standard	Soil Strength Parameters	Design Loading Conditions
Large Road Signs	SMD (8W2) – 08	N_{TCP}, C, ϕ	Not Specified
Overhead Sign Bridge	OSB – FD OSB – FD – SC	N_{TCP}, C, ϕ	Uplift Loading and Moment
Monotube Sign Structure (Cantilever)	MC(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
Monotube Sign Structure (Span)	MS(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
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Roadway Illumination Pole	RID(2) – 20	N_{TCP}	Not Specified
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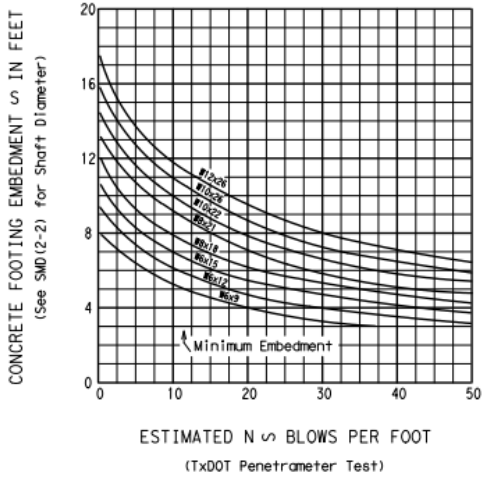
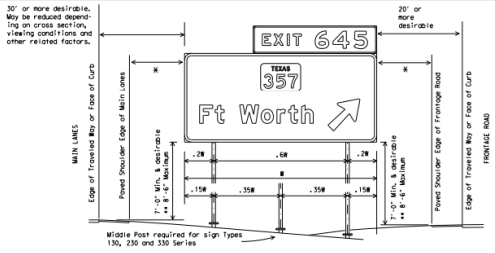
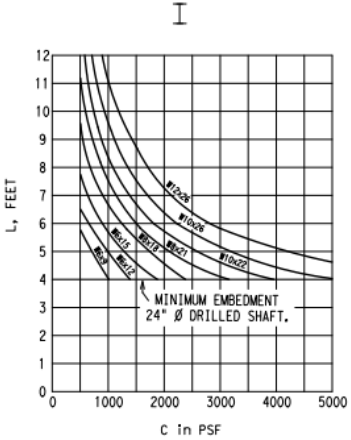
Large Roadside Signs

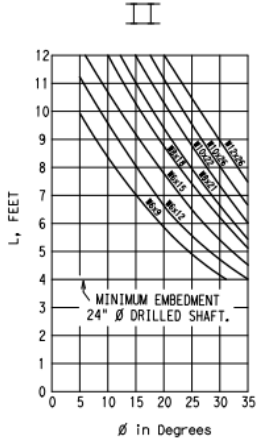




TYPICAL SIGN INSTALLATION AND LOCATION

NOTE: ESTIMATED N SHOULD BE BASED AT APPROXIMATELY THE UPPER ONE-THIRD POINT OF THE DRILLED CONCRETE FOOTING BELOW THE GROUND LINE





NOTE: THESE CHARTS MAY BE USED AS AN ALTERNATE TO THE CHART BELOW, PROVIDED THAT SOIL COHESION AND INTERNAL FRICTION (COHFRIC) DATA ARE AVAILABLE.

Types of Ancillary Traffic Structures

Structure	Standard	Soil Strength Parameters	Design Loading Conditions
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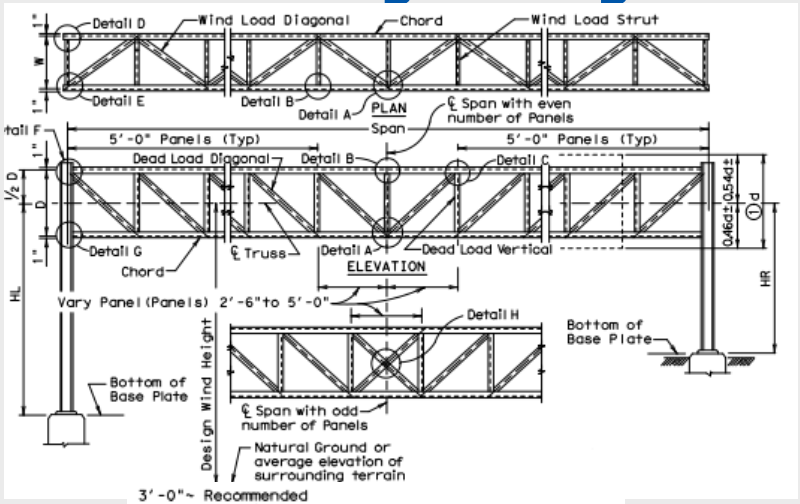
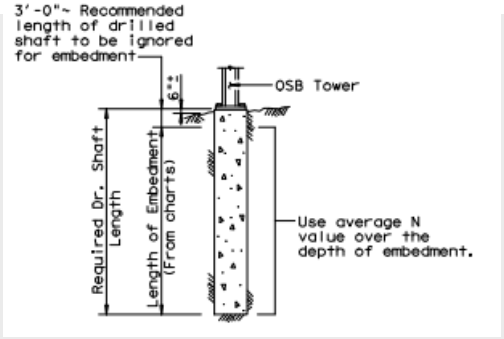
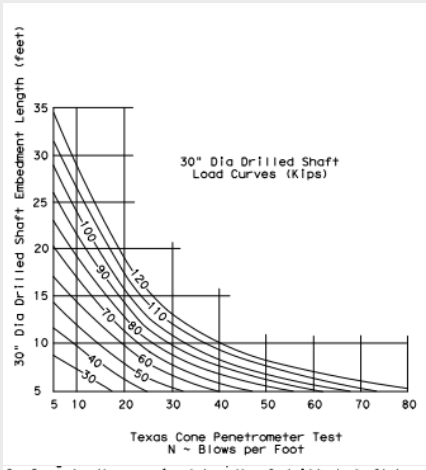
Overhead Sign Bridges



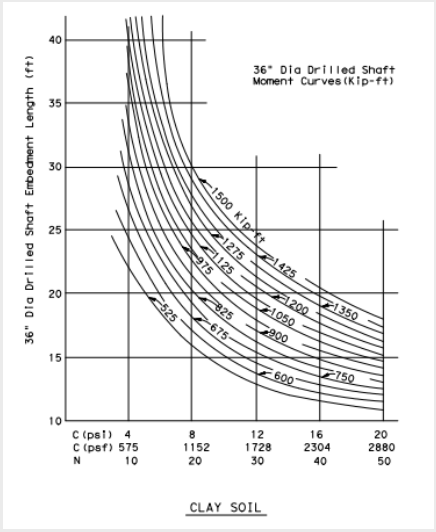




9. Compute the required length of drilled shaft by adding 3'-0" to the required embedment length.

GENERAL NOTES:

These charts are to be used for Simple Span Overhead Sign Bridges with two shafts per tower.
Numbers shown on curved lines are uplift in kip.
Dead load of concrete in drilled shafts is included in curves.
Minimum embedment of drilled shafts is two diameters.
Load curves shall not be extrapolated below the N value of 5 blows per foot.



GENERAL NOTES:

Minimum embedment of drilled shafts is two diameters. Add 3'-0" to required embedment length to determine required length of drilled shaft.
These graphs are intended for use with Overhead Sign Bridges, with one shaft footing. (Not suitable for cantilever structures).
C = Cohesive shear strength of soil, in psf.

Types of Ancillary Traffic Structures

Structure	Standard	Soil Strength Parameters	Design Loading Conditions
Large Road Signs	SMD (8W2) – 08	N_{TCP}, C, ϕ	Not Specified
Overhead Sign Bridge	OSB – FD OSB – FD – SC	N_{TCP}, C, ϕ	Uplift Loading and Moment
Monotube Sign Structure (Cantilever)	MC(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
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Cantilever Overhead Sign Support	COSS – FD	N_{TCP}, C, ϕ	Moment and Torsion
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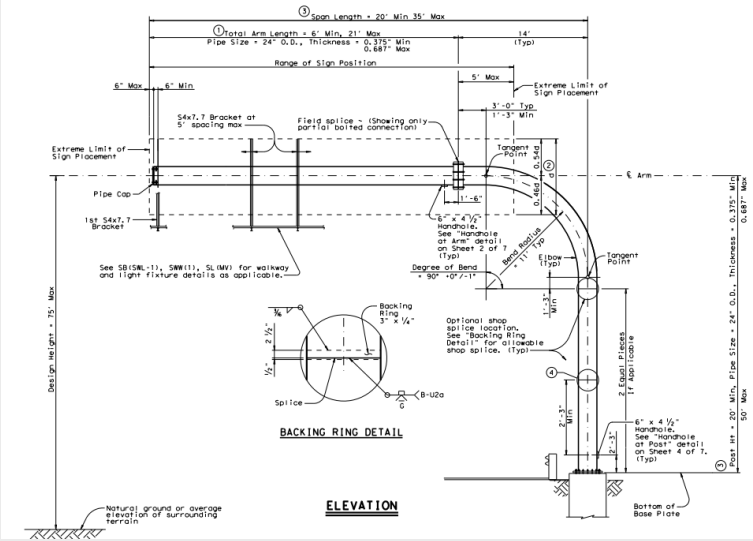
High Mast Illumination Pole	HMIF(2) – 98	N_{TCP}	Not Specified
Traffic Signal Pole	TS – FD – 12	N_{TCP}	Moment and Shear
Intelligent Transportation Systems Pole	ITS(4) – 15	N_{TCP}	Not Specified

Monotube Sign Structure - Cantilever



TOP OF DRILLED SHAFT DESIGN LOADS					
90 MPH WIND SPEED					
Span Length	Post Height	Axial (kips)	Moment (k-ft)	Torsion (k-ft)	Shear (kips)
20'	20'	9	138	77	6
	25'	9	166	77	6
	30'	10	195	77	7
	40'	13	256	77	7
	50'	19	321	77	7
25'	20'	13	189	121	8
	25'	14	225	121	8
	30'	15	262	121	8
	40'	18	340	121	9
	50'	16	418	121	8

DRILLED SHAFT EMBEDMENT LENGTHS					
90 MPH WIND SPEED					
Span Length	Post Height	TCP 10 bl/ft (ft)	TCP 20 bl/ft (ft)	TCP 30 bl/ft (ft)	TCP 40+bl/ft (ft)
20'	20'	35	31	29	27
	25'	36	31	29	27
	30'	37	31	29	27
	40'	38	31	29	27
	50'	40	31	29	27
25'	20'	37	31	29	27
	25'	38	31	29	27
	30'	39	31	29	27
	40'	41	31	29	27
	50'	42	31	29	27

Determine foundation embedment length based on the blow counts in the upper 20 ft of soil.

Terminate shafts encountering rock with a minimum rock penetration of 13 ft, while maintaining a minimum shaft embedment length of 25 ft.

For Texas Cone Penetrometer (TCP) blow count data that falls between two of the listed values in the tables, it is permissible to use linear interpolation between the two nearest blow count values to determine foundation embedment length.

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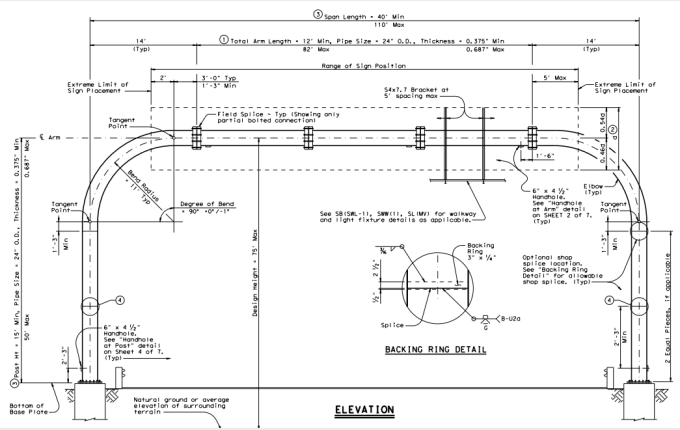
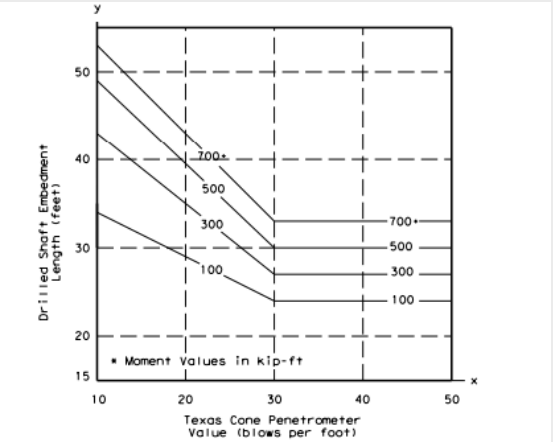
Monotube Sign Structure - Span





48" Diameter Drilled Shaft Load Curves (kip-ft)

Note: The Drilled Shaft Load Curves were developed in terms of applied moment, shear, and torsion. Moment combined with shear controlled the length of the shafts for the blow count range considered. While moment is used to represent the design curves in the Drilled Shaft Load Curve plot, shear was also taken into account.

The 700* curve is valid for designing foundations for load cases with a moment greater than or equal to 700 k-ft.

Use the foundation design curves only for the design loading listed on this standard. A custom foundation design is required for soil profiles with blow counts less than 10 bl/ft.

Interpolate moment values that are between two curves.

TOP OF DRILLED SHAFT DESIGN LOADS 90 MPH WIND SPEED					
Span Length	Post Height	Axial (kips)	Moment (k-ft)	Torsion (k-ft)	Shear (kips)
40'	15'	7	119	33	11
	20'	8	134	27	9
	30'	10	189	24	8
	40'	14	251	22	7
	50'	20	316	23	8
50'	15'	8	150	51	14
	20'	9	169	44	11
	30'	12	237	41	9
	40'	18	314	44	9
	50'	13	389	25	9

Determine foundation embedment length based on the blow counts in the upper 20 ft of soil.

Terminate shafts encountering rock with a minimum rock penetration of 8 ft, while maintaining a minimum shaft embedment length of 20 ft.

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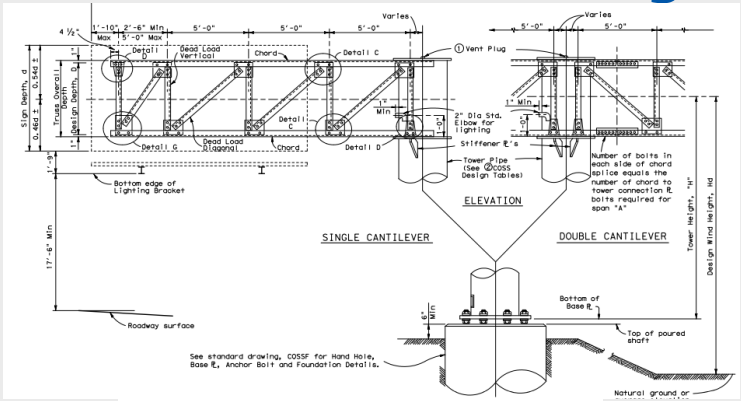
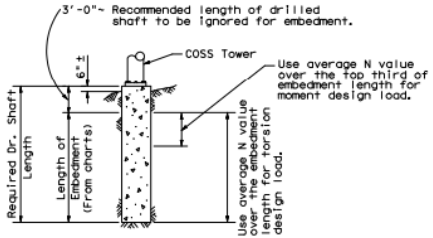
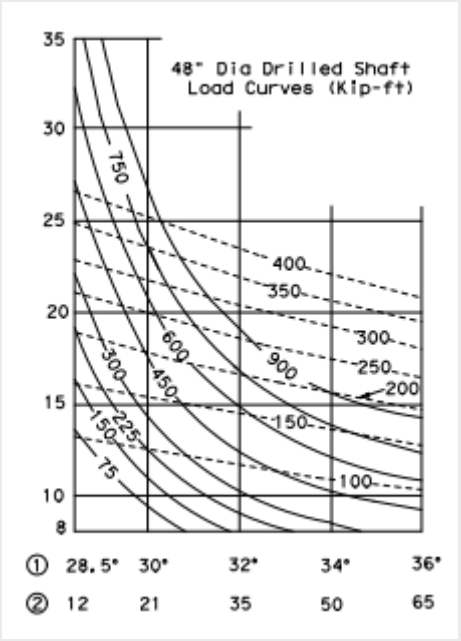
Cantilever Overhead Sign Support

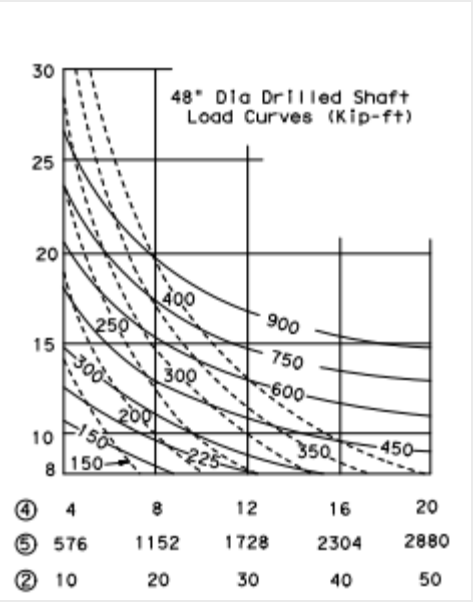




① Ø = Angle of internal friction of soil (degrees)
② N = Texas cone penetrometer value (blows per ft)
④ C(psi) = Cohesive shear strength of soil (psi)
⑤ C(psf) = Cohesive shear strength of soil (psf)



③ SUBMERGED SAND SOIL (COHESIONLESS)
Moment ——————
Torsion ----------



CLAY SOIL (COHESIVE)
Moment ——————
Torsion ----------

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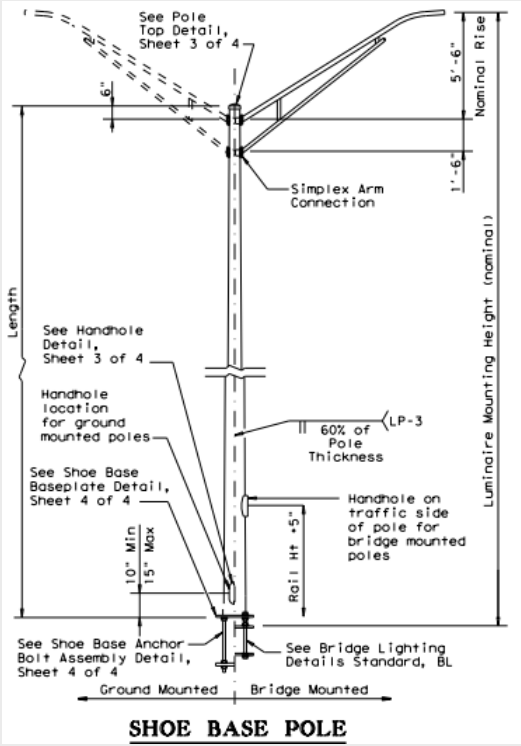
Roadway Illumination Pole



SHOE BASE POLE

TABLE 2

RECOMMENDED FOUNDATION LENGTHS
(See note 1)

MOUNTING HEIGHT	TEXAS CONE PENETROMETER N Blows/ft		
	10	15	40
≤20 ft.	6'	6'	6'
>20 ft. to 30 ft.	8'	6'	6'
>30 ft. to 40 ft.	8'	8'	6'
>40 ft. to 50 ft.	10'	8'	6'

TABLE 3

PAY QUANTITY OF RIPRAP PER FOUNDATION
(Install only when shown on the plans)

Foundation Diameter	RIPRAP DIAMETER	RIPRAP (CONC) (CL B)
30 in.	78 in.	0.35 CY

1. "Recommended Foundation Lengths" table is for information purposes only. Foundation lengths shall be as shown on the plans, or as directed by the Engineer. Foundations will be paid for under Item 416, "Drilled Shaft Foundations," unless otherwise shown on the plans.

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High Mast Illumination Pole

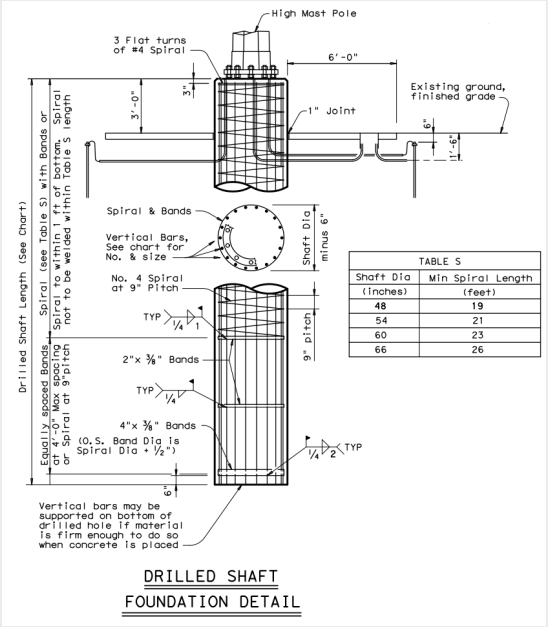


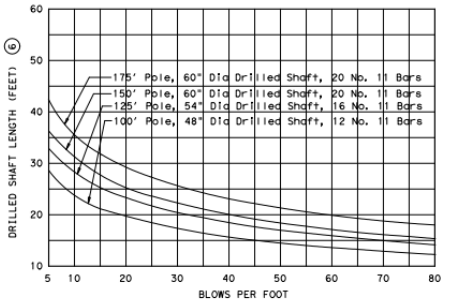
TABLE S

Shaft Dia (inches)	Min Spiral Length (feet)
48	19
54	21
60	23
66	26

DRILLED SHAFT FOUNDATION DETAIL

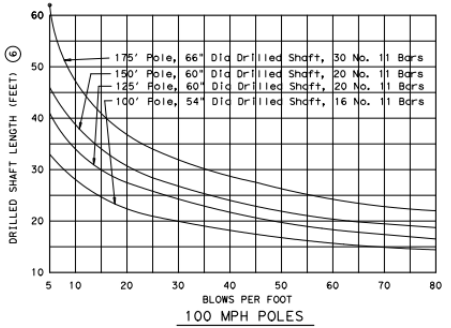
Drilled shaft lengths as determined from the foundation design chart or other acceptable methods are to be as shown elsewhere on the plans.

⑥ Includes normal 3 Ft exposure. Shafts with more than 3 Ft exposure must have additional length.



80 MPH POLES

Do not extrapolate below 5 Blows/Ft. A special design will be required for soil less than 5 Blows/Ft.



100 MPH POLES

Do not extrapolate below 5 Blows/Ft. A special design will be required for soil less than 5 Blows/Ft.

TEXAS CONE PENETROMETER TEST TABLES

Types of Ancillary Traffic Structures

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Traffic Signal Pole	TS – FD – 12	N_{TCP}	Moment and Shear
Intelligent Transportation Systems Pole	ITS(4) – 15	N_{TCP}	Not Specified

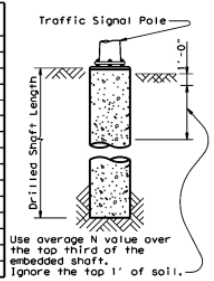
Traffic Signal Pole

FOUNDATION DESIGN TABLE

FDN TYPE	DRILLED SHAFT DIA	REINFORCING STEEL		EMBEDDED DRILLED SHAFT LENGTH-ft ④, ⑤, ⑥			ANCHOR BOLT DESIGN ①				FOUNDATION DESIGN LOAD ②		TYPICAL APPLICATION
		VERT BARS	SPIRAL & PITCH	TEXAS CONE PENETROMETER N Blows/ft 10	15	40	ANCHOR BOLT DIA	Fy (KSI)	BOLT CIR DIA	ANCHOR TYPE	MOMENT K-ft	SHEAR Kips	
24-A	24"	4- #5	#2 at 12"	5.7	5.3	4.5	¾"	36	12 ¾"	1	10	1	Pedestal pole, pedestal mounted controller.
30-A	30"	8- #9	#3 at 6"	11.3	10.3	8.0	1 ½"	55	17"	2	87	3	Mast arm assembly. (see Selection Table)
36-A	36"	10- #9	#3 at 6"	13.2	12.0	9.4	1 ¾"	55	19"	2	131	5	Mast arm assembly. (see Selection Table) 30' strain pole with or without luminaire.
36-B	36"	12- #9	#3 at 6"	15.2	13.6	10.4	2"	55	21"	2	190	7	Mast arm assembly. (see Selection Table) Strain pole taller than 30' & strain pole with mast arm
42-A	42"	14- #9	#3 at 6"	17.4	15.6	11.9	2 ¼"	55	23"	2	271	9	Mast arm assembly. (see Selection Table)

FOUNDATION SELECTION TABLE FOR STANDARD MAST ARM PLUS ILSN SUPPORT ASSEMBLIES (ft)

		FDN 30-A	FDN 36-A	FDN 36-B	FDN 42-A
80 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH	32'	48'		
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS	24' X 24'			
		28' X 28'			
		32' X 28'	32' X 32'		
			36' X 36'		
			40' X 36'		
			44' X 28'	44' X 36'	
100 MPH DESIGN WIND SPEED	MAX SINGLE ARM LENGTH		36'	44'	
	MAXIMUM DOUBLE ARM LENGTH COMBINATIONS		24' X 24'		
			28' X 28'		
			32' X 24'	32' X 32'	
				36' X 36'	
				40' x24'	40' X 36'
					44' x 36'



NOTES:

① Anchor bolt design develops the foundation capacity given under Foundation Design Loads.

② Foundation Design Loads are the allowable moments and shears at the base of the structure.

③ Foundations may be listed separately or grouped according to similarity of location and type. Quantities are for the Contractor's information only.

④ Field Penetrometer readings at a depth of approximately 3 to 5 feet may be used to adjust shaft lengths.

⑤ If rock is encountered, the Drilled Shaft shall extend a minimum of two diameters into solid rock.

⑥ Decimal lengths in Design Table are to allow interpolation for other penetrometer values. Round to nearest foot for entry into Summary Table.

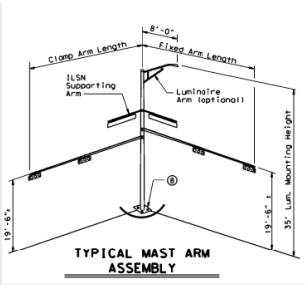
ANCHOR BOLT & TEMPLATE SIZES

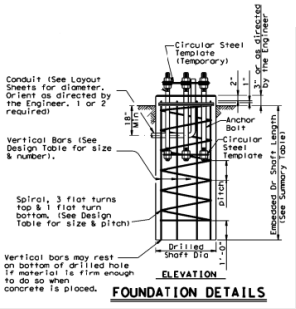
BOLT DIA IN.	⑦ BOLT LENGTH	TOP THREAD	BOTTOM THREAD	BOLT CIRCLE	R_E	R_T
¾"	1'-6"	3"	—	12 ¾"	7 ⅛"	5 ⅝"
1 ½"	3'-4"	6"	4"	17"	10"	7"
1 ¾"	3'-10"	7"	4 ½"	19"	11 ¼"	7 ¾"
2"	4'-3"	8"	5"	21"	12 ½"	8 ½"
2 ¼"	4'-9"	9"	5 ½"	23"	13 ¾"	9 ¼"

⑦ Min dimensions given, longer bolts are acceptable.

FOUNDATION SUMMARY TABLE ③

LOCATION IDENTIFICATION	AVG. N BLOW /ft.	FDN TYPE	NO. EA	DRILLED SHAFT LENGTH ⑥ (FEET) 24-A	30-A	36-A	36-B	42-A
TOTAL DRILLED SHAFT LENGTHS								





Types of Ancillary Traffic Structures

Structure	Standard	Soil Strength Parameters	Design Loading Conditions
Large Road Signs	SMD (8W2) – 08	N_{TCP}, C, ϕ	Not Specified
Overhead Sign Bridge	OSB – FD OSB – FD – SC	N_{TCP}, C, ϕ	Uplift Loading and Moment
Monotube Sign Structure (Cantilever)	MC(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
Monotube Sign Structure (Span)	MS(7) – 22	N_{TCP}	Axial, Moment, Torsion, and Shear
Cantilever Overhead Sign Support	COSS – FD	N_{TCP}, C, ϕ	Moment and Torsion
Roadway Illumination Pole	RID(2) – 20	N_{TCP}	Not Specified
High Mast Illumination Pole	HMIF(2) – 98	N_{TCP}	Not Specified
Traffic Signal Pole	TS – FD – 12	N_{TCP}	Moment and Shear
Intelligent Transportation Systems Pole	ITS(4) – 15	N_{TCP}	Not Specified

Intelligent Transportation Systems Pole

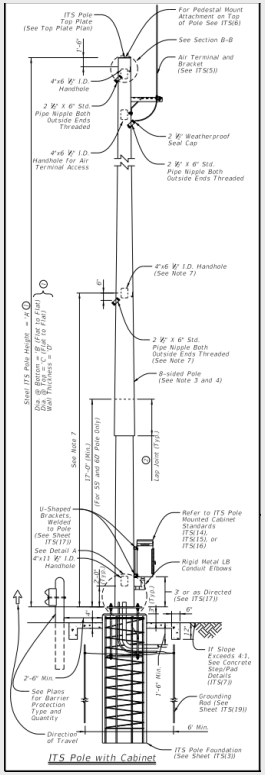


TABLE 2: ITS POLE – 110 MPH (W/ 2 SOLAR PANELS) (4)

POLE TYPE (1)	POLE HEIGHT (FT)	POLE SHAFT (1)(10)			BASE PLATE (1)					TOP PLATE (2)	ANCHOR BOLT (3)						FOUNDATION (3)			
		BOTTOM OUTSIDE DIA. (IN)	TOP OUTSIDE DIA. (IN)	WALL THICKNESS (IN)	INSIDE DIA. (IN)	OUTSIDE DIA. (IN)	BOLT CIRCLE DIA. (IN)	BOLT HOLE DIA. (IN)	THICKNESS (IN)	OUTSIDE DIA. (IN)	DIA. (IN)	NO. OF BOLTS	LENGTH OF BOLT MIN. (IN)	TEMPLATE INSIDE DIA. (IN)	TEMPLATE OUTSIDE DIA. (IN)	TEMPLATE WIDTH (IN)	DRILL SHAFT DEPTH – TEXAS CONE PENETROMETER (N – BLOWS/FT.) (SEE NOTE 5)			DRILLED SHAFT DIA. (IN)
																	N = 10	N = 15	N = 40	
		'A'	'B'	'C'	'D'	'E'	'F'	'G'	'H'	'I'	'J'	'K'	'L'	'M'	'N'	'O'	'P'	'Q'			'R'
8 SIDED	20	10	8	1/2	10-1/16	21	16	1-1/4	1-1/2	9	1	4	29	14	18	2	14	12	10	36
	30	13	9	1/2	13-1/16	24	19	1-9/16	1-3/4	10	1-1/4	6	35	16-1/2	21-1/2	2-1/2	18	15	11	36
	40	15	9	1/2	15-1/16	25	21	1-9/16	1-3/4	10	1-1/4	6	35	18-1/2	23-1/2	2-1/2	20	17	12	42
	45	16	10	1/2	17-1/16	27	22	1-9/16	1-3/4	11	1-1/4	8	35	19-1/2	24-1/2	2-1/2	21	18	13	42
	50	17	10	1/2	18-1/16	28	23	1-9/16	1-3/4	11	1-1/4	8	35	20-1/2	25-1/2	2-1/2	22	19	14	42
	55 (7)	19	11	5/8	19-1/16	30	25	1-9/16	2	12	1-1/4	8	35	22-1/2	27-1/2	2-1/2	24	20	14	42
	60 (7)	20	11	5/8	20-1/16	31	26	1-13/16	2	12	1-1/2	6	40	23	29	3	25	21	15	48

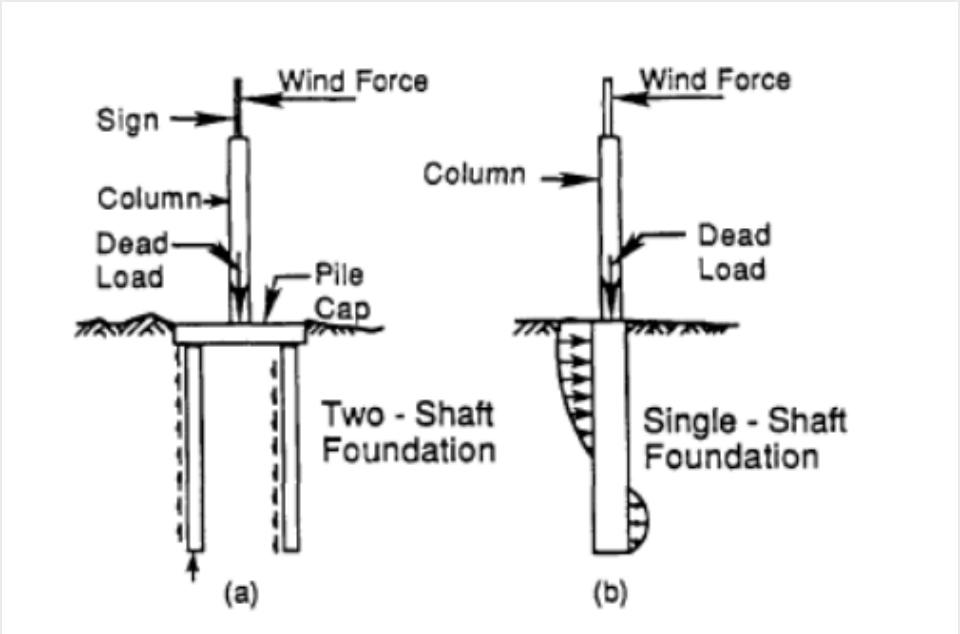
TABLE 3: ITS POLE – 130 MPH (W/ 1 SOLAR PANEL) (5)

POLE TYPE (1)	POLE HEIGHT (FT)	POLE SHAFT (1)(10)			BASE PLATE (1)					TOP PLATE (2)	ANCHOR BOLT (3)						FOUNDATION (3)			
		BOTTOM OUTSIDE DIA. (IN)	TOP OUTSIDE DIA. (IN)	WALL THICKNESS (IN)	INSIDE DIA. (IN)	OUTSIDE DIA. (IN)	BOLT CIRCLE DIA. (IN)	BOLT HOLE DIA. (IN)	THICKNESS (IN)	OUTSIDE DIA. (IN)	DIA. (IN)	NO. OF BOLTS	LENGTH OF BOLT MIN. (IN)	TEMPLATE INSIDE DIA. (IN)	TEMPLATE OUTSIDE DIA. (IN)	TEMPLATE WIDTH (IN)	DRILL SHAFT DEPTH – TEXAS CONE PENETROMETER (N – BLOWS/FT.) (SEE NOTE 5)			DRILLED SHAFT DIA. (IN)
																	N = 10	N = 15	N = 40	
		'A'	'B'	'C'	'D'	'E'	'F'	'G'	'H'	'I'	'J'	'K'	'L'	'M'	'N'	'O'	'P'	'Q'			'R'
8 SIDED	20	10	8	1/2	10-1/16	21	16	1-9/16	1-3/4	9	1-1/4	4	35	13-1/2	18-1/2	2-1/2	16	14	10	36
	30	13	9	1/2	15-1/16	24	19	1-9/16	1-3/4	10	1-1/4	6	35	16-1/2	21-1/2	2-1/2	18	16	11	36
	40	15	9	1/2	15-1/16	26	21	1-9/16	1-3/4	10	1-1/4	6	35	18-1/2	23-1/2	2-1/2	21	18	13	42
	45	16	10	1/2	16-1/16	27	22	1-9/16	1-3/4	11	1-1/4	8	35	19-1/2	24-1/2	2-1/2	23	19	14	42
	50	17	10	1/2	17-1/16	28	23	1-9/16	2	11	1-1/2	8	40	20	26	3	24	20	14	42
	55 (7)	19	11	5/8	19-1/16	30	25	1-13/16	2	12	1-1/2	8	40	22	28	3	27	22	15	42
	60 (7)	20	11	5/8	20-1/16	31	26	1-13/16	2	12	1-1/2	8	40	23	29	3	28	23	16	48

5. Recommended embedment lengths are for information purposes only. Foundation embedment depth is based off Texas Cone Penetrometer Value N = 10 blows/ft. for soft soils and up to 40 blows/ft. for hard soils. Foundation lengths shall be as shown on the plans, or as directed by the Engineer. Foundations will be paid for under Item 416, "Drilled Shaft Foundations" unless otherwise shown on the plans.

Design of Laterally Loaded Structures

- Design philosophy different than bridges
  - Approach differs from axial capacity design
    - Brom's method
    - P-Y analysis
  - Transient load controlled
    - Often designed assuming loads are static
  - Often wider boring spacing



LRFD Update

- All standards currently use N_{TCP}, C, or Φ to determine foundation length
- Long-term, standards will be updated to LRFD
  - TCP → SPT
- Short-term, use *Geotechnical Manual – LRFD (April 2024)*
  - Figure 2-2: SPT vs Angle of Internal Friction for Cohesionless Soils
    - Recommended to use "*Lower Bound*" of Φ
  - Appendix 2: N_{TCP} vs N_{SPT} correlation

$$In\ Clay: N_{TCP} = 1.5 \times N_{SPT}$$

$$In\ Sand: N_{TCP} = 2.0 \times N_{SPT}$$

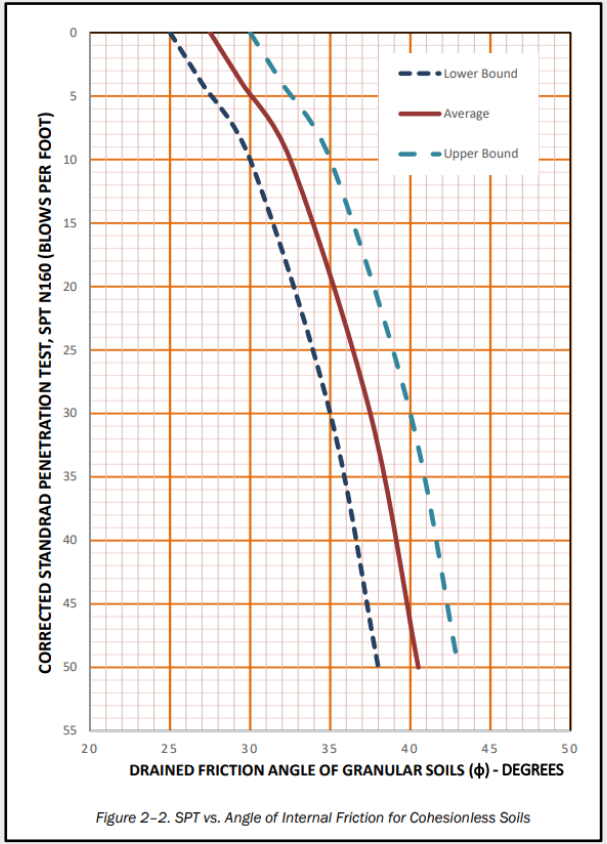


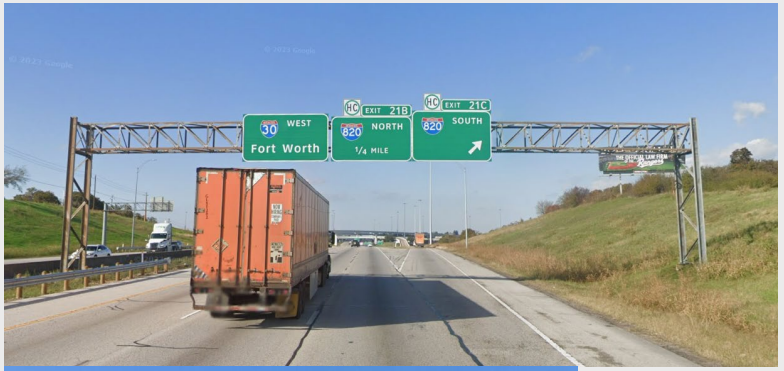
Figure 2-2. SPT vs. Angle of Internal Friction for Cohesionless Soils

Soil Property Selection Best Practices

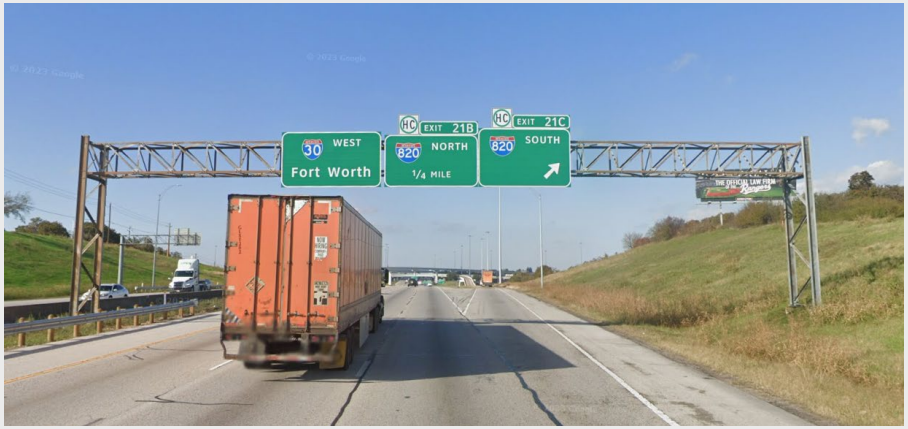
- Boring proximity
  - New boring with SPT and laboratory testing
  - Existing TCP boring
- Soil type
- Soil uniformity with depth
- Future improvements/changes of conditions
- Shrinking/swelling soils

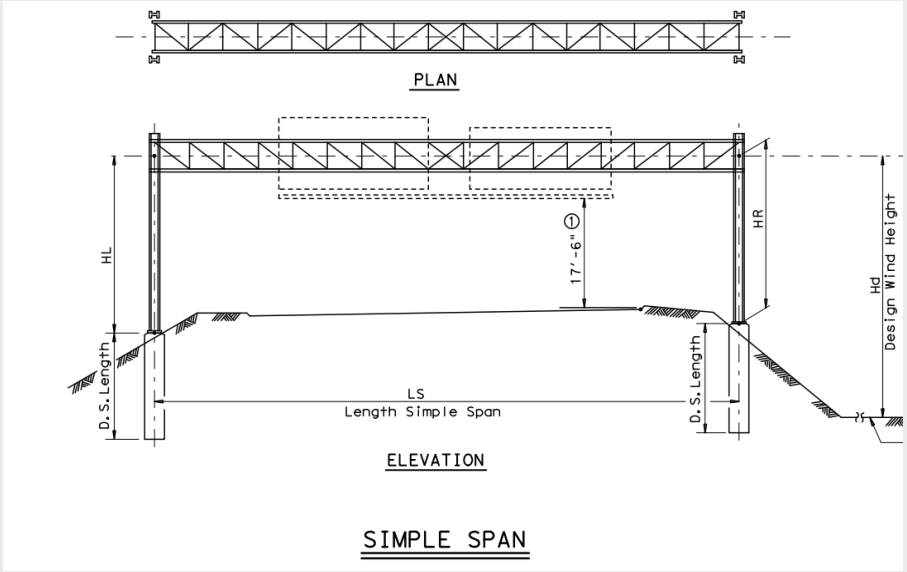
Examples

- Overhead Sign Bridges (OSB)
  - Axial (Uplift) Load
- Cantilever Overhead Sign Structure (COSS)
  - Lateral and Torsional Load



Overhead Sign Bridges (OSB)





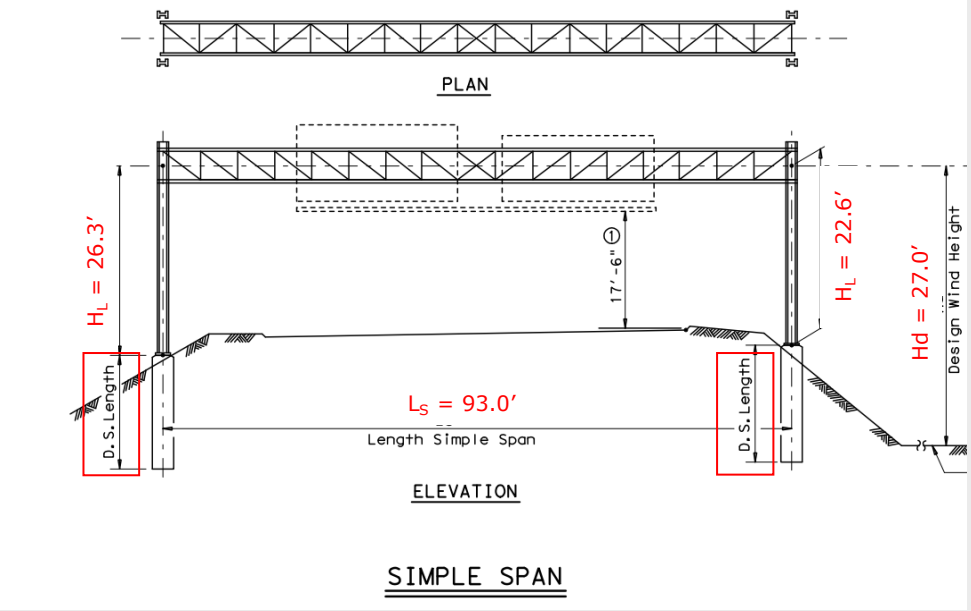
Design Loading Conditions: Uplift Loading and Moment

Foundation Diameter: 24” – 54”

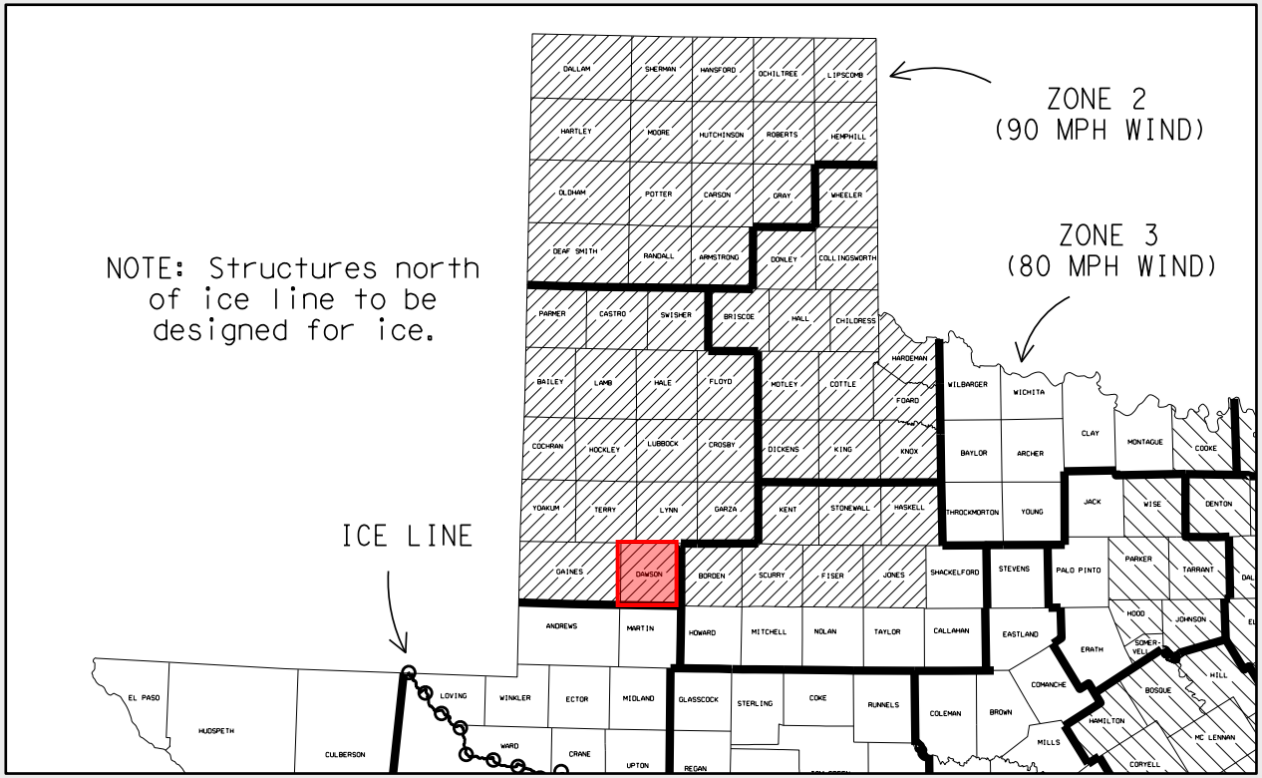
Foundation Embedment: 4’ – 55’

Overhead Sign Bridges (OSB)

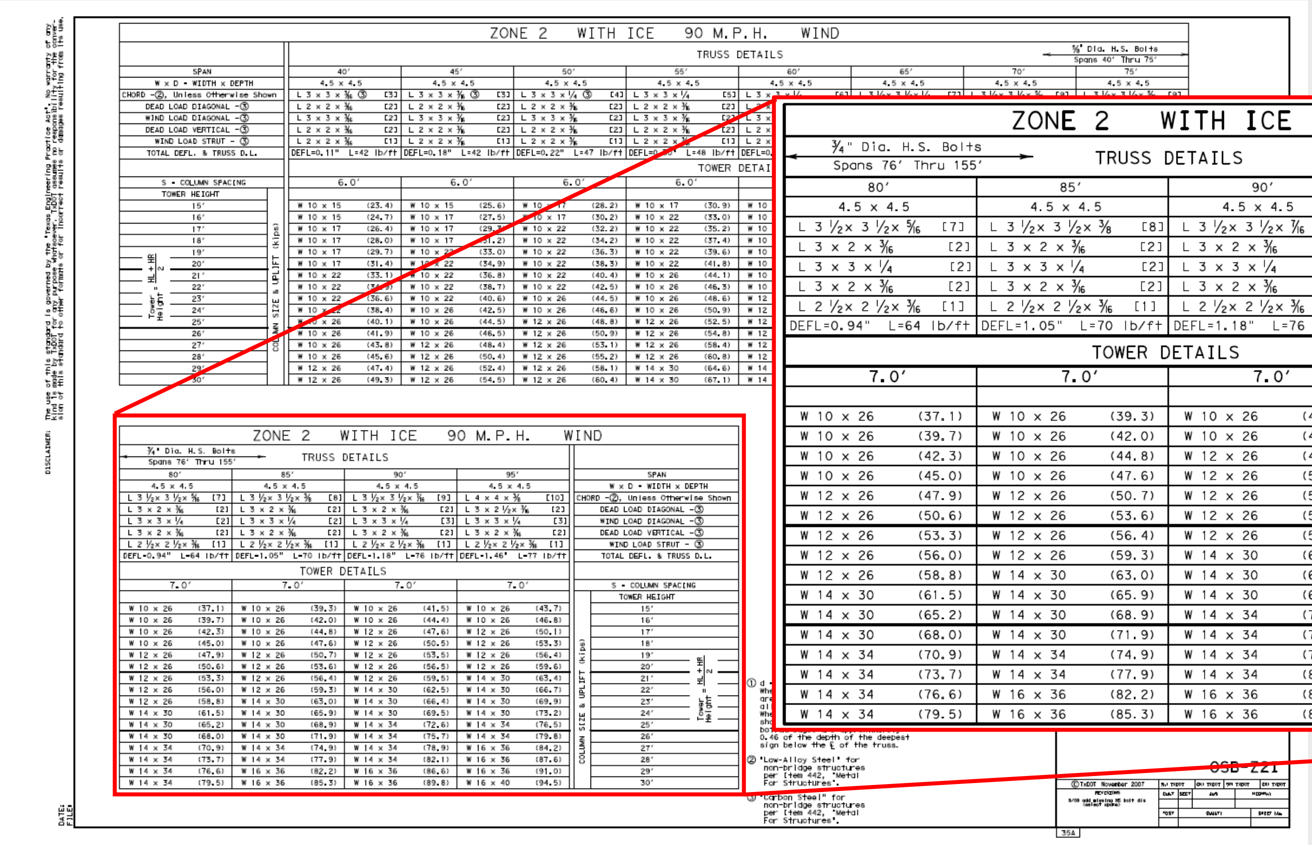
- Given:
  - Span, L_S = 93.0’
  - Left Tower Height, H_L = 26.3’
  - Right Tower Height, H_R = 22.6’
  - Design Wind Height, H_d = 27.0’
  - Avg. SPT Penetrometer Value, N = 20
  - Dawson County



Overhead Sign Bridges (OSB)



- Zone 2
- 90 mph
- Design Height, Hd = 27.0’
  ↓
  Standard: OSB-Z2I



ZONE 2 WITH ICE 90 M.P.H. WIND

¾" Dia. H.S. Bolts, Spans 76' Thru 155'

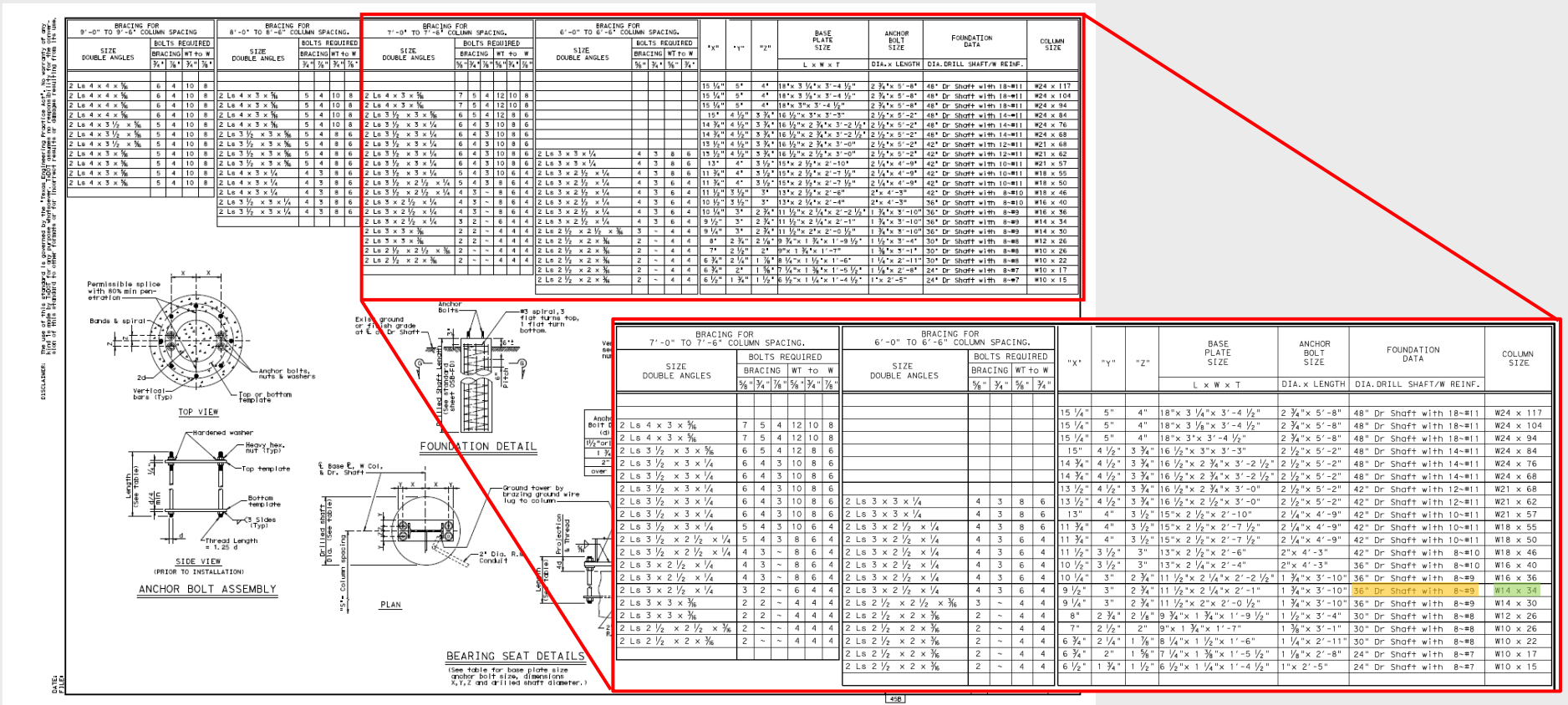
TRUSS DETAILS

80'	85'	90'	95'	SPAN
4.5 x 4.5	4.5 x 4.5	4.5 x 4.5	4.5 x 4.5	W x D = WIDTH x DEPTH
L 3 ½ x 3 ½ x 5/16 [7]	L 3 ½ x 3 ½ x 3/8 [8]	L 3 ½ x 3 ½ x 7/16 [9]	L 4 x 4 x 3/8 [10]	CHORD -②, Unless Otherwise Shown
L 3 x 2 x 3/16 [2]	L 3 x 2 x 3/16 [2]	L 3 x 2 x 3/16 [2]	L 3 x 2 ½ x 3/16 [2]	DEAD LOAD DIAGONAL -③
L 3 x 3 x ¼ [2]	L 3 x 3 x ¼ [2]	L 3 x 3 x ¼ [3]	L 3 x 3 x ¼ [3]	WIND LOAD DIAGONAL -③
L 3 x 2 x 3/16 [2]	L 3 x 2 x 3/16 [2]	L 3 x 2 x 3/16 [2]	L 3 x 2 x 3/16 [2]	DEAD LOAD VERTICAL -③
L 2 ½ x 2 ½ x 3/16 [1]	L 2 ½ x 2 ½ x 3/16 [1]	L 2 ½ x 2 ½ x 3/16 [1]	L 2 ½ x 2 ½ x 3/16 [1]	WIND LOAD STRUT - ③
DEFL=0.94" L=64 lb/ft	DEFL=1.05" L=70 lb/ft	DEFL=1.18" L=76 lb/ft	DEFL=1.46" L=77 lb/ft	TOTAL DEFL. & TRUSS D.L.

TOWER DETAILS

COLUMN SIZE & UPLIFT (kips); Tower Height = $\frac{HL + HR}{2}$

7.0'	7.0'	7.0'	7.0'	S = COLUMN SPACING / TOWER HEIGHT
W 10 x 26 (37.1)	W 10 x 26 (39.3)	W 10 x 26 (41.5)	W 10 x 26 (43.7)	15'
W 10 x 26 (39.7)	W 10 x 26 (42.0)	W 10 x 26 (44.4)	W 10 x 26 (46.8)	16'
W 10 x 26 (42.3)	W 10 x 26 (44.8)	W 12 x 26 (47.6)	W 12 x 26 (50.1)	17'
W 10 x 26 (45.0)	W 10 x 26 (47.6)	W 12 x 26 (50.5)	W 12 x 26 (53.3)	18'
W 12 x 26 (47.9)	W 12 x 26 (50.7)	W 12 x 26 (53.5)	W 12 x 26 (56.4)	19'
W 12 x 26 (50.6)	W 12 x 26 (53.6)	W 12 x 26 (56.5)	W 12 x 26 (59.6)	20'
W 12 x 26 (53.3)	W 12 x 26 (56.4)	W 12 x 26 (59.5)	W 14 x 30 (63.4)	21'
W 12 x 26 (56.0)	W 12 x 26 (59.3)	W 14 x 30 (62.5)	W 14 x 30 (66.7)	22'
W 12 x 26 (58.8)	W 14 x 30 (63.0)	W 14 x 30 (66.4)	W 14 x 30 (69.9)	23'
W 14 x 30 (61.5)	W 14 x 30 (65.9)	W 14 x 30 (69.5)	W 14 x 30 (73.2)	24'
W 14 x 30 (65.2)	W 14 x 30 (68.9)	W 14 x 34 (72.6)	W 14 x 34 (76.5)	25'
W 14 x 30 (68.0)	W 14 x 30 (71.9)	W 14 x 34 (75.7)	W 14 x 34 (79.8)	26'
W 14 x 34 (70.9)	W 14 x 34 (74.9)	W 14 x 34 (78.9)	W 16 x 36 (84.2)	27'
W 14 x 34 (73.7)	W 14 x 34 (77.9)	W 14 x 34 (82.1)	W 16 x 36 (87.6)	28'
W 14 x 34 (76.6)	W 16 x 36 (82.2)	W 16 x 36 (86.6)	W 16 x 36 (91.0)	29'
W 14 x 34 (79.5)	W 16 x 36 (85.3)	W 16 x 36 (89.8)	W 16 x 40 (94.5)	30'



BRACING FOR 9'-0" TO 9'-6" COLUMN SPACING

SIZE DOUBLE ANGLES	BOLTS REQUIRED BRACING ¾"	BRACING ⅞"	WT to W ¾"	WT to W ⅞"
2 Ls 4 x 4 x 5/16	6	4	10	8
2 Ls 4 x 4 x 3/8	6	4	10	8
2 Ls 4 x 4 x 7/16	6	4	10	8
2 Ls 4 x 4 x 1/2	6	4	10	8
2 Ls 4 x 3 1/2 x 5/16	5	4	10	8
2 Ls 4 x 3 1/2 x 3/8	5	4	10	8
2 Ls 4 x 3 1/2 x 7/16	5	4	8	6
2 Ls 4 x 3 1/2 x 1/2	5	4	8	6
2 Ls 4 x 3 x 5/16	5	4	10	8
2 Ls 4 x 3 x 3/8	5	4	10	8
2 Ls 4 x 3 x 1/4	4	3	8	6
2 Ls 4 x 3 x 5/16	5	4	10	8

BRACING FOR 8'-0" TO 8'-6" COLUMN SPACING.

SIZE DOUBLE ANGLES	BOLTS REQUIRED BRACING ¾"	BRACING ⅞"	WT to W ¾"	WT to W ⅞"
2 Ls 4 x 3 x 5/16	5	4	10	8
2 Ls 4 x 3 x 3/8	5	4	10	8
2 Ls 4 x 3 x 7/16	5	4	10	8
2 Ls 3 1/2 x 3 x 5/16	5	4	8	6
2 Ls 3 1/2 x 3 x 3/8	5	4	8	6
2 Ls 3 1/2 x 3 x 7/16	5	4	8	6
2 Ls 3 1/2 x 3 x 1/2	5	4	8	6
2 Ls 3 1/2 x 2 1/2 x 1/4	4	3	8	6
2 Ls 3 1/2 x 3 x 1/4	4	3	8	6

BRACING FOR 7'-0" TO 7'-6" COLUMN SPACING.

SIZE DOUBLE ANGLES	BOLTS REQUIRED BRACING 5/16	3/8	7/16	1/2	WT to W 5/16	3/8	7/16	1/2
2 Ls 4 x 3 x 5/16	7	5	4	12	10	8		
2 Ls 4 x 3 x 3/8	7	5	4	12	10	8		
2 Ls 3 1/2 x 3 x 5/16	6	5	4	12	8	6		
2 Ls 3 1/2 x 3 x 3/8	6	5	4	12	8	6		
2 Ls 3 1/2 x 3 x 7/16	6	4	3	10	8	6		
2 Ls 3 1/2 x 3 x 1/2	6	4	3	10	8	6		
2 Ls 3 1/2 x 2 1/2 x 1/4	5	4	3	8	6	4		
2 Ls 3 1/2 x 2 1/2 x 5/16	5	4	3	8	6	4		
2 Ls 3 1/2 x 2 1/2 x 3/8	5	4	3	10	6	4		
2 Ls 3 1/2 x 2 1/2 x 7/16	6	4	3	10	8	6		
2 Ls 3 1/2 x 2 1/2 x 1/2	6	4	3	10	8	6		
2 Ls 3 x 3 x 5/16	4	3	~	8	6	4		
2 Ls 3 x 3 x 3/8	4	3	~	8	6	4		
2 Ls 3 x 2 1/2 x 1/4	4	3	~	8	6	4		
2 Ls 3 x 2 1/2 x 5/16	4	3	~	8	6	4		
2 Ls 3 x 2 1/2 x 3/8	3	2	~	6	4	4		
2 Ls 3 x 3 x 3/8	2	2	~	4	4	4		
2 Ls 3 x 3 x 7/16	2	2	~	4	4	4		
2 Ls 2 1/2 x 2 1/2 x 5/16	2	~	~	4	4	4		
2 Ls 2 1/2 x 2 x 3/8	2	~	~	4	4	4		

BRACING FOR 6'-0" TO 6'-6" COLUMN SPACING.

SIZE DOUBLE ANGLES	BOLTS REQUIRED BRACING 3/8	BRACING 7/16	WT to W 3/8	WT to W 7/16	WT to W 1/2
2 Ls 3 x 3 x 1/4	4	3	8	6	
2 Ls 3 x 3 x 1/4	4	3	8	6	
2 Ls 3 x 2 1/2 x 1/4	4	3	6	4	
2 Ls 3 x 2 1/2 x 1/4	4	3	6	4	
2 Ls 3 x 2 1/2 x 1/4	4	3	6	4	
2 Ls 3 x 2 1/2 x 1/4	4	3	6	4	
2 Ls 3 x 2 1/2 x 1/4	4	3	6	4	
2 Ls 2 1/2 x 2 1/2 x 3/16	3	~	4	4	
2 Ls 2 1/2 x 2 x 3/16	2	~	4	4	
2 Ls 2 1/2 x 2 x 3/16	2	~	4	4	
2 Ls 2 1/2 x 2 x 3/16	2	~	4	4	
2 Ls 2 1/2 x 2 x 3/16	2	~	4	4	
2 Ls 2 1/2 x 2 x 3/16	2	~	4	4	

"X"	"Y"	"Z"	BASE PLATE SIZE L x W x T	ANCHOR BOLT SIZE DIA. x LENGTH	FOUNDATION DATA DIA. DRILL SHAFT/W REINF.	COLUMN SIZE
15 1/4"	5"	4"	18" x 3 1/4" x 3'-4 1/2"	2 3/4" x 5'-8"	48" Dr Shaft with 18-#11	W24 x 117
15 1/4"	5"	4"	18" x 3 1/8" x 3'-4 1/2"	2 3/4" x 5'-8"	48" Dr Shaft with 18-#11	W24 x 104
15 1/4"	5"	4"	18" x 3" x 3'-4 1/2"	2 3/4" x 5'-8"	48" Dr Shaft with 18-#11	W24 x 94
15"	4 1/2"	3 3/4"	16 1/2" x 3" x 3'-3"	2 1/2" x 5'-2"	48" Dr Shaft with 14-#11	W24 x 84
14 3/4"	4 1/2"	3 3/4"	16 1/2" x 2 3/4" x 3'-2 1/2"	2 1/2" x 5'-2"	48" Dr Shaft with 14-#11	W24 x 76
14 3/4"	4 1/2"	3 3/4"	16 1/2" x 2 3/4" x 3'-2 1/2"	2 1/2" x 5'-2"	48" Dr Shaft with 14-#11	W24 x 68
13 1/2"	4 1/2"	3 3/4"	16 1/2" x 2 3/4" x 3'-0"	2 1/2" x 5'-2"	42" Dr Shaft with 12-#11	W21 x 68
13 1/2"	4"	3 1/2"	15" x 2 1/2" x 2'-10"	2 1/4" x 4'-9"	42" Dr Shaft with 10-#11	W21 x 57
11 3/4"	4"	3 1/2"	15" x 2 1/2" x 2'-7 1/2"	2 1/4" x 4'-9"	42" Dr Shaft with 10-#11	W18 x 50
11 1/2"	3 1/2"	3"	13" x 2 1/4" x 2'-6"	2" x 4'-3"	42" Dr Shaft with 8-#10	W18 x 46
10 1/2"	3 1/2"	3"	13" x 2 1/4" x 2'-4"	2" x 4'-3"	36" Dr Shaft with 8-#10	W16 x 40
10 1/4"	3"	2 3/4"	11 1/2" x 2 1/4" x 2'-2 1/2"	1 3/4" x 3'-10"	36" Dr Shaft with 8-#9	W16 x 36
9 1/2"	3"	2 3/4"	11 1/2" x 2 1/4" x 2'-1"	1 3/4" x 3'-10"	36" Dr Shaft with 8-#9	W14 x 34
9 1/4"	3"	2 3/4"	11 1/2" x 2" x 2'-0 1/2"	1 3/4" x 3'-10"	36" Dr Shaft with 8-#9	W14 x 30
8"	2 3/4"	2 1/8"	9 3/4" x 1 3/4" x 1'-9 1/2"	1 1/2" x 3'-4"	30" Dr Shaft with 8-#8	W12 x 26
7"	2 1/2"	2"	9" x 1 3/4" x 1'-7"	1 3/8" x 3'-1"	30" Dr Shaft with 8-#8	W10 x 26
6 3/4"	2"	1 5/8"	7 1/4" x 1 3/8" x 1'-5 1/2"	1 1/8" x 2'-8"	24" Dr Shaft with 8-#7	W10 x 17
6 1/2"	1 3/4"	1 1/2"	6 1/2" x 1 1/4" x 1'-4 1/2"	1" x 2'-5"	24" Dr Shaft with 8-#7	W10 x 15

Appendix 2

Ancillary Structure Foundations

When using roadway and traffic standards developed for foundations from TCP information (COSS, High Mast Illumination Poles), use the following correlations (from *Touma and Reese, 1972*) from SPT values acquired in the drilled boring logs:

In Clay: $N_{TCP} = 1.5 * N_{SPT}$

In Sand: $N_{TCP} = 2.0 * N_{SPT}$

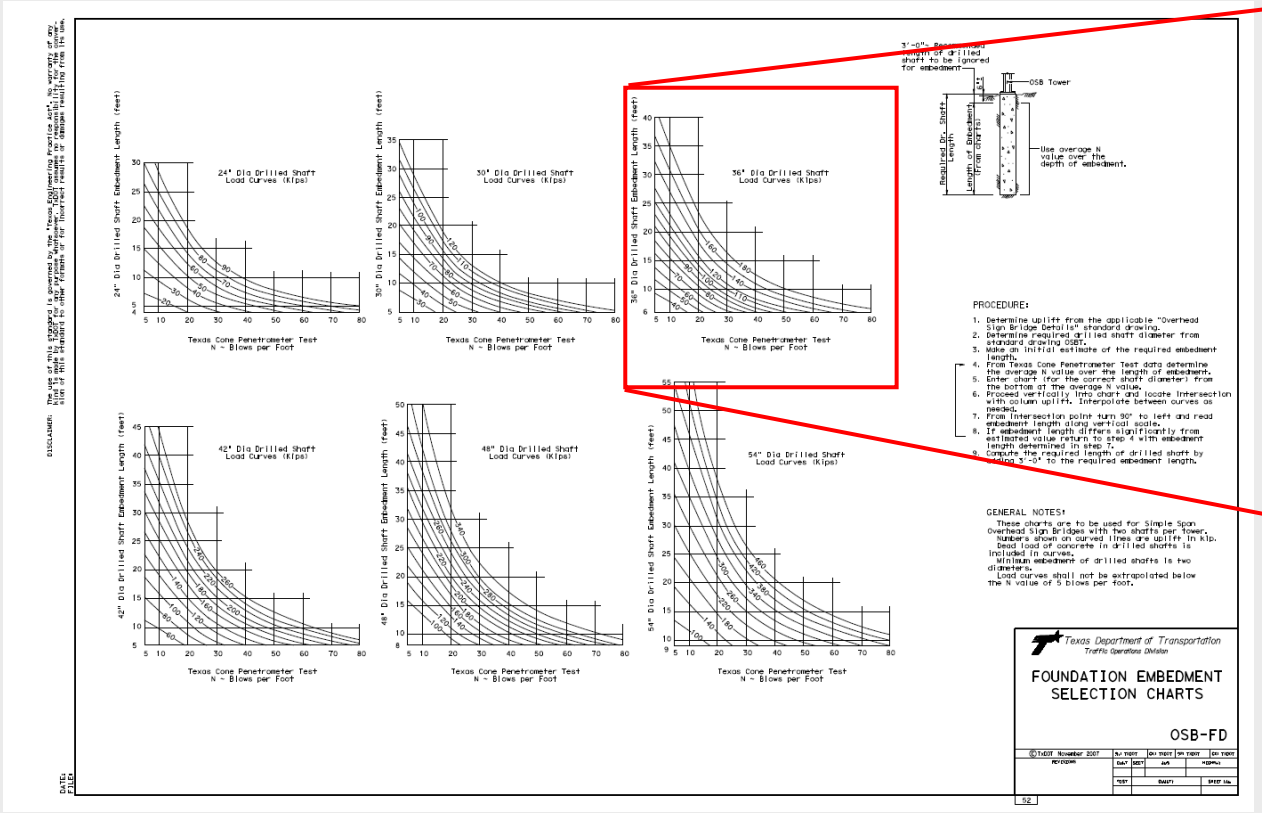
Where, N_{TCP} = equivalent TCP blow counts when using STP information

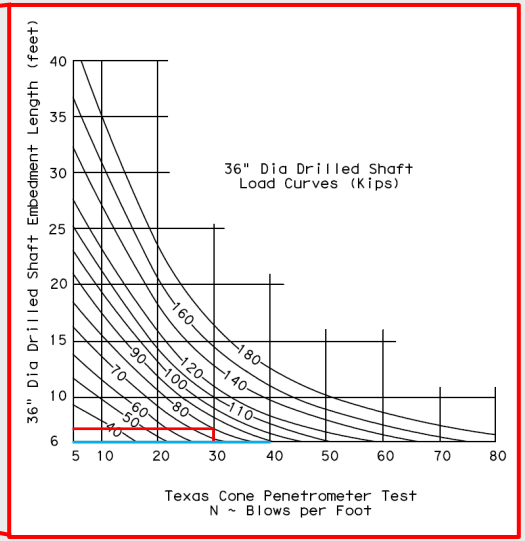
N_{SPT} = uncorrected blow counts from STP in-situ testing

These correlations apply to the standard foundation embedment selection charts regarding TCP information currently refenced in the standards.

$N_{SPT} = 20$ bl

In Clay: $N_{TCP} = 30$ bl
In Sand: $N_{TCP} = 40$ bl



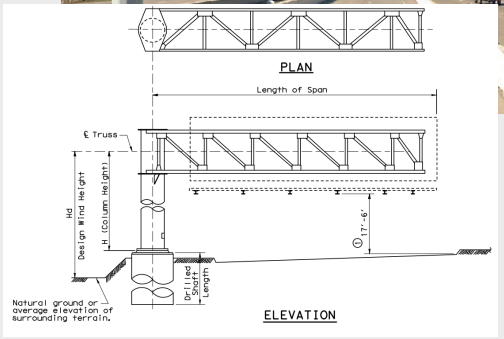


$Uplift_L$ = 80 k
$Uplift_R$ = 70 k

Clay (30 bl)
L_L = 7′ + 3′ = 10′
L_R = 6′ + 3′ = 9′

Sand (40 bl)
L_L = 6′ + 3′ = 9′
L_R = 6′ + 3′ = 9′

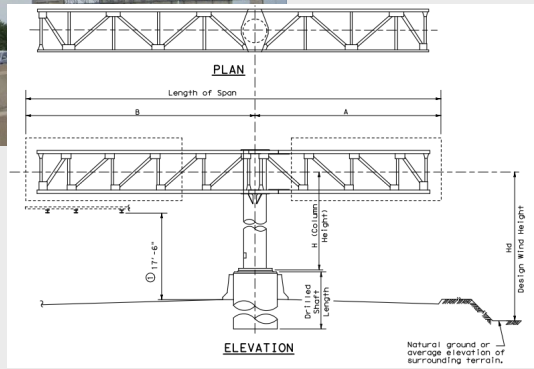
Cantilever Overhead Sign Structures (COSS)



Design Loading Conditions: Moment and Torsion

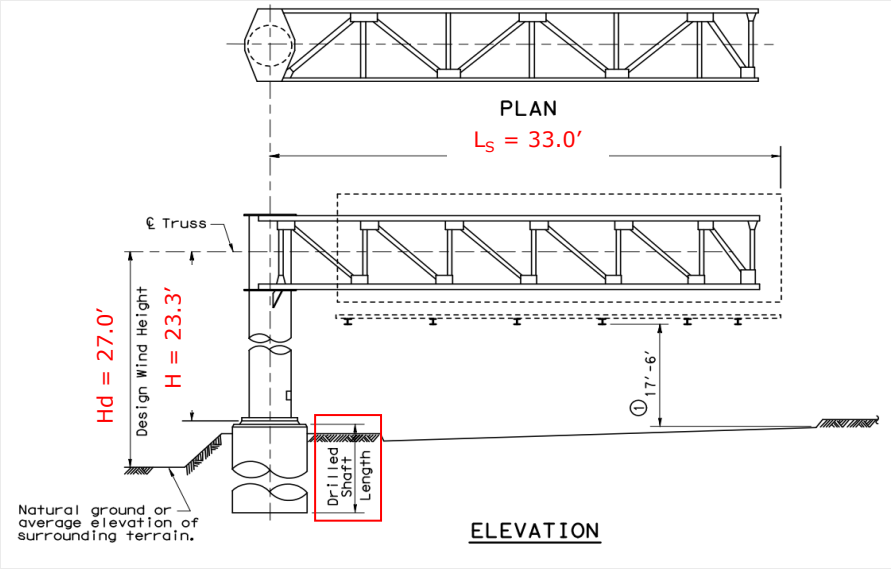
Foundation Diameter: 36” – 54”

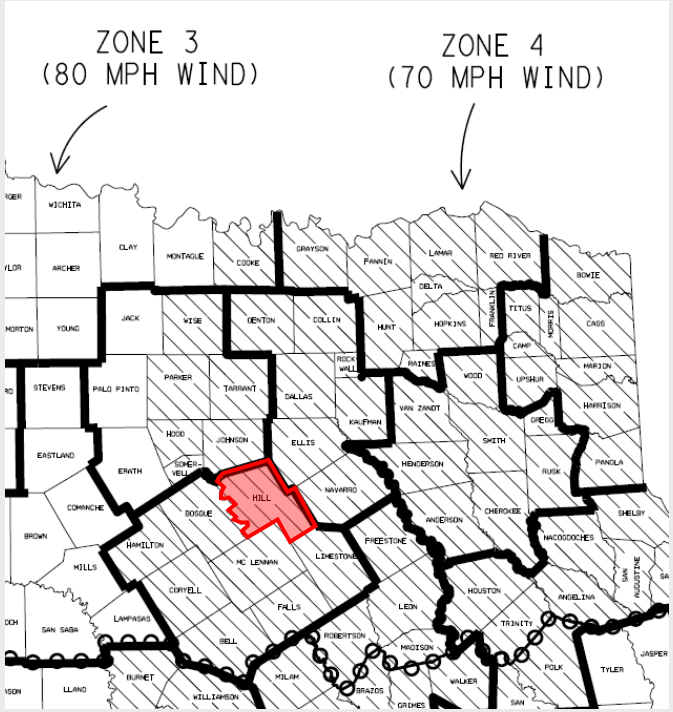
Foundation Embedment: 6’ – 40’



Cantilever Overhead Sign Structures (COSS)

- Given:
  - Cantilever Span = 33.0’
  - Column Height, H = 23.3’
  - Design Wind Height, H_d = 27.0’
  - Avg. SPT Penetrometer Value, N = 15
  - Hill County

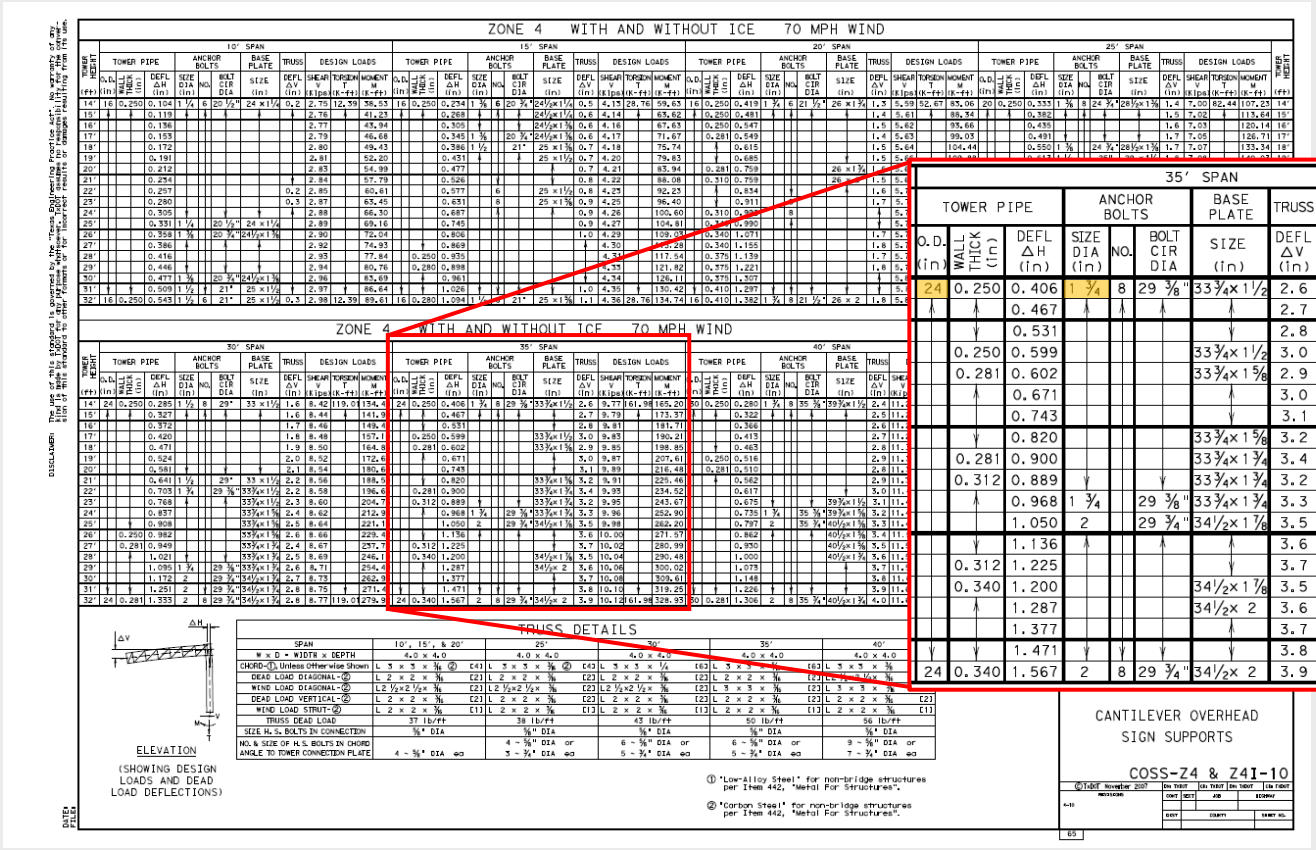




- Zone 4
- 70 mph
- Design Height, Hd = 27.0’

↓

Standard: COSS-Z4 & Z4I-10



ZONE 4 WITH AND WITHOUT ICE 70 MPH WIND

10' SPAN / 15' SPAN / 20' SPAN / 25' SPAN

TOWER HEIGHT	TOWER PIPE O.D. (in)	TOWER PIPE WALL THICK (in)	TOWER PIPE DEFL ΔH (in)	ANCHOR BOLTS SIZE DIA (in)	ANCHOR BOLTS NO.	ANCHOR BOLTS BOLT CIR DIA	BASE PLATE SIZE (in)	TRUSS DEFL ΔV (in)	DESIGN LOADS SHEAR V (Kips)	DESIGN LOADS TORSION T (K-ft)	DESIGN LOADS MOMENT M (K-ft)
14'	16	0.250	0.104	1 ⅛	6	20 ½"	24 x 1¼	0.2	2.75	12.39	38.53
15'			0.119						2.76		41.23
16'			0.136						2.77		43.94
17'			0.153						2.79		46.68
18'			0.172						2.80		49.43
19'			0.191						2.81		52.20
20'			0.212						2.83		54.99
21'			0.254						2.84		57.79
22'			0.257					0.2	2.85		60.61
23'			0.280					0.3	2.87		63.45
24'			0.305						2.88		66.30
25'			0.331	1 ¼		20 ½"	24 x 1¼		2.89		69.16
26'			0.358	1 ⅜		20 ¾"	24½ x 1⅜		2.90		72.04
27'			0.386						2.92		74.93
28'			0.416						2.93		77.84
29'			0.447						2.94		80.76
30'			0.477	1 ⅜		20 ¾"	24½ x 1⅜		2.96		83.69
31'			0.509	1 ½		21"	25 x 1½		2.97		86.64
32'	16	0.250	0.543	1 ½	6	21"	25 x 1½	0.3	2.98	12.39	89.61

TOWER HEIGHT	TOWER PIPE O.D. (in)	TOWER PIPE WALL THICK (in)	TOWER PIPE DEFL ΔH (in)	ANCHOR BOLTS SIZE DIA (in)	ANCHOR BOLTS NO.	ANCHOR BOLTS BOLT CIR DIA	BASE PLATE SIZE (in)	TRUSS DEFL ΔV (in)	DESIGN LOADS SHEAR V (Kips)	DESIGN LOADS TORSION T (K-ft)	DESIGN LOADS MOMENT M (K-ft)
14'	16	0.250	0.234	1 ⅜	6	20 ¾"	24½ x 1⅞	0.5	4.13	28.76	59.63
15'			0.268				24½ x 1⅞	0.6	4.14		63.62
16'			0.305				24½ x 1⅞	0.6	4.16		67.63
17'			0.345	1 ⅜		20 ¾"	24½ x 1⅞	0.6	4.17		71.67
18'			0.386	1 ½		21"	25 x 1⅜	0.7	4.18		75.74
19'			0.431				25 x 1½	0.7	4.20		79.83
20'			0.477					0.7	4.21		83.94
21'			0.526					0.8	4.22		88.08
22'			0.577		6		25 x 1½	0.8	4.25		92.23
23'			0.631		8		25 x 1⅝	0.9	4.25		96.40
24'			0.687					0.9	4.26		100.60
25'			0.745					0.9	4.27		104.81
26'			0.806					1.0	4.29		109.03
27'			0.869					1.0	4.30		113.28
28'			0.935					1.0	4.33		117.54
29'			0.998					1.0	4.34		121.82
30'			0.961					1.0	4.34		126.11
31'			1.026					1.0	4.35		130.42
32'	16	0.280	1.094	1 ½	8	21"	25 x 1⅝	1.1	4.36	28.76	134.74

TOWER HEIGHT	TOWER PIPE O.D. (in)	TOWER PIPE WALL THICK (in)	TOWER PIPE DEFL ΔH (in)	ANCHOR BOLTS SIZE DIA (in)	ANCHOR BOLTS NO.	ANCHOR BOLTS BOLT CIR DIA	BASE PLATE SIZE (in)	TRUSS DEFL ΔV (in)	DESIGN LOADS SHEAR V (Kips)	DESIGN LOADS TORSION T (K-ft)	DESIGN LOADS MOMENT M (K-ft)
14'	24	0.250	0.285	1 ½	8	29"	33 x 1½	1.8	8.42	119.01	134.4
15'			0.327					1.6	8.44		141.9
16'			0.372					1.7	8.46		149.4
17'			0.420					1.8	8.48		157.1
18'			0.471					1.9	8.50		164.8
19'			0.524					2.0	8.52		172.6
20'			0.581					2.1	8.54		180.6
21'			0.641	1 ½		29"	33 x 1½	2.2	8.56		188.5
22'			0.703	1 ¾		29 ⅜"	33¾ x 1½	2.2	8.58		196.6
23'			0.768				33¾ x 1¾	2.3	8.60		204.7
24'			0.837				33¾ x 1¾	2.4	8.62		212.9
25'			0.908				33¾ x 1¾	2.5	8.64		221.1
26'		0.250	0.982				33¾ x 1¾	2.6	8.66		229.4
27'		0.281	0.949				33¾ x 1¾	2.4	8.67		237.7
28'			1.021				33¾ x 1¾	2.5	8.69		246.1
29'			1.095	1 ¾		29 ⅜"	33¾ x 1¾	2.6	8.71		254.4
30'			1.172	2		29 ¾"	34½ x 1¾	2.7	8.73		262.9
31'			1.251	2		29 ¾"	34½ x 1¾	2.8	8.75		271.4
32'	24	0.281	1.333	2	8	29 ¾"	34½ x 1¾	2.8	8.77	119.01	279.9

TOWER HEIGHT	TOWER PIPE O.D. (in)	TOWER PIPE WALL THICK (in)	TOWER PIPE DEFL ΔH (in)	ANCHOR BOLTS SIZE DIA (in)	ANCHOR BOLTS NO.	ANCHOR BOLTS BOLT CIR DIA	BASE PLATE SIZE (in)	TRUSS DEFL ΔV (in)	DESIGN LOADS SHEAR V (Kips)	DESIGN LOADS TORSION T (K-ft)	DESIGN LOADS MOMENT M (K-ft)
14'	24	0.250	0.406	1 ¾	8	29 ⅜"	33¾ x 1½	2.6	9.77	161.98	165.20
15'			0.467					2.7	9.79		173.37
16'			0.531					2.8	9.81		181.71
17'			0.599				33¾ x 1½	2.9	9.83		190.21
18'			0.602				33¾ x 1⅝	2.9	9.85		198.85
19'			0.671					3.0	9.87		207.61
20'			0.743					3.1	9.89		216.48
21'			0.820				33¾ x 1⅝	3.2	9.91		225.46
22'			0.900				33¾ x 1¾	3.3	9.93		234.52
23'			0.968	1 ¾		29 ⅜"	33¾ x 1¾	3.4	9.95		243.67
24'			1.050	2		29 ¾"	34½ x 1⅞	3.5	9.98		252.90
25'			1.136					3.6	10.00		262.20
26'		0.312	1.225					3.7	10.02		271.57
27'			1.200					3.5	10.04		280.99
28'		0.340	1.287				34½ x 2	3.6	10.06		290.48
29'			1.377					3.7	10.08		300.02
30'			1.471					3.8	10.10		309.61
31'			1.567	2		29 ¾"	34½ x 2	3.9	10.12	161.98	319.25
32'	24	0.340	1.567	2	8	29 ¾"	34½ x 2	3.9	10.12	161.98	328.93

35' SPAN

TOWER PIPE O.D. (in)	TOWER PIPE WALL THICK (in)	TOWER PIPE DEFL ΔH (in)	ANCHOR BOLTS SIZE DIA (in)	ANCHOR BOLTS NO.	ANCHOR BOLTS BOLT CIR DIA	BASE PLATE SIZE (in)	TRUSS DEFL ΔV (in)	DESIGN LOADS SHEAR V (Kips)	DESIGN LOADS TORSION T (K-ft)	DESIGN LOADS MOMENT M (K-ft)	TOWER HEIGHT (ft)
24	0.250	0.406	1 ¾	8	29 ⅜"	33¾ x 1½	2.6	9.77	161.98	165.20	14'
		0.467					2.7	9.79		173.37	15'
		0.531					2.8	9.81		181.71	16'
	0.250	0.599				33¾ x 1½	3.0	9.83		190.21	17'
	0.281	0.602				33¾ x 1⅝	2.9	9.85		198.85	18'
		0.671					3.0	9.87		207.61	19'
		0.743					3.1	9.89		216.48	20'
		0.820				33¾ x 1⅝	3.2	9.91		225.46	21'
	0.281	0.900				33¾ x 1¾	3.4	9.93		234.52	22'
	0.312	0.889				33¾ x 1¾	3.2	9.95		243.67	23'
		0.968	1 ¾		29 ⅜"	33¾ x 1¾	3.3	9.96		252.90	24'
		1.050	2		29 ¾"	34½ x 1⅞	3.5	9.98		262.20	25'
		1.136					3.6	10.00		271.57	26'
	0.312	1.225					3.7	10.02		280.99	27'
	0.340	1.200				34½ x 1⅞	3.5	10.04		290.48	28'
		1.287				34½ x 2	3.6	10.06		300.02	29'
		1.377					3.7	10.08		309.61	30'
		1.471					3.8	10.10		319.25	31'
24	0.340	1.567	2	8	29 ¾"	34½ x 2	3.9	10.12	161.98	328.93	32'

TRUSS DETAILS

SPAN	10', 15', & 20'	25'	30'	35'	40'
W x D = WIDTH x DEPTH	4.0 x 4.0	4.0 x 4.0	4.0 x 4.0	4.0 x 4.0	4.0 x 4.0
CHORD-①, Unless Otherwise Shown	L 3 x 3 x 5/16 ② [4]	L 3 x 3 x 5/16 ② [4]	L 3 x 3 x 1/4 [6]	L 3 x 3 x 5/16 [6]	L 3 x 3 x 5/16 [6]
DEAD LOAD DIAGONAL-②	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]
WIND LOAD DIAGONAL-②	L2 1½x2 1½x 3/16 [2]	L2 1½x2 1½x 3/16 [2]	L2 1½x2 1½x 3/16 [2]	L 3 x 3 x 3/16 [2]	L 3 x 3 x 3/16 [2]
DEAD LOAD VERTICAL-②	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]	L 2 x 2 x 3/16 [2]
WIND LOAD STRUT-②	L 2 x 2 x 3/16 [1]	L 2 x 2 x 3/16 [1]	L 2 x 2 x 3/16 [1]	L 2 x 2 x 3/16 [1]	L 2 x 2 x 3/16 [1]
TRUSS DEAD LOAD	37 lb/ft	38 lb/ft	43 lb/ft	50 lb/ft	56 lb/ft
SIZE H. S. BOLTS IN CONNECTION	3/4" DIA	3/4" DIA	3/4" DIA	3/4" DIA	3/4" DIA
NO. & SIZE OF H. S. BOLTS IN CHORD	4 - 3/4" DIA ea	4 - 3/4" DIA or 3 - 3/4" DIA ea	6 - 3/4" DIA or 5 - 3/4" DIA ea	6 - 3/4" DIA or 5 - 3/4" DIA ea	9 - 3/4" DIA or 7 - 3/4" DIA ea

① "Low-Alloy Steel" for non-bridge structures per Item 442, "Metal For Structures".

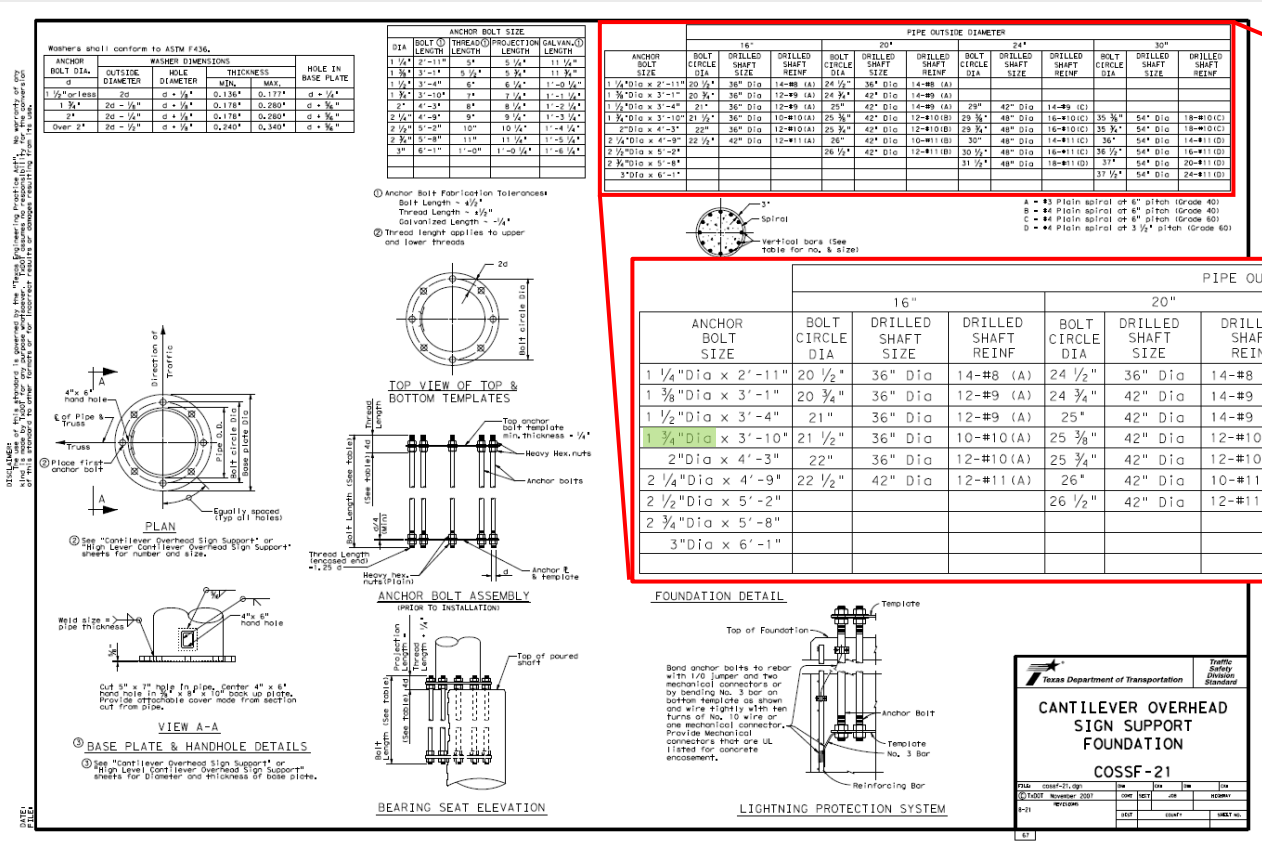
② "Carbon Steel" for non-bridge structures per Item 442, "Metal For Structures".

ELEVATION

(SHOWING DESIGN LOADS AND DEAD LOAD DEFLECTIONS)

CANTILEVER OVERHEAD SIGN SUPPORTS

COSS-Z4 & Z4I-10



Washers shall conform to ASTM F436.

ANCHOR BOLT DIA. d	WASHER DIMENSIONS OUTSIDE DIAMETER	HOLE DIAMETER	THICKNESS MIN.	THICKNESS MAX.	HOLE IN BASE PLATE
1 ½"orless	2d	d + ⅛"	0.136"	0.177"	d + ⅛"
1 ¾"	2d - ½"	d + ⅛"	0.178"	0.280"	d + ⅜"
2"	2d - ½"	d + ⅛"	0.178"	0.280"	d + ⅜"
Over 2"	2d - ½"	d + ⅛"	0.240"	0.340"	d + ⅜"

DIA	ANCHOR BOLT SIZE BOLT ① LENGTH	THREAD ② LENGTH	PROJECTION LENGTH	GALVAN. ① LENGTH
1 ¼"	2'-11"	5"	5 ¼"	11 ¼"
1 ⅜"	3'-1"	5 ½"	5 ⅜"	11 ⅜"
1 ½"	3'-4"	6"	6 ¼"	1'-0 ¼"
1 ⅝"	3'-10"	7"	7 ¼"	1'-1 ¼"
2"	4'-3"	8"	8 ¼"	1'-2 ¼"
2 ¼"	4'-9"	9"	9 ¼"	1'-3 ¼"
2 ½"	5'-2"	10"	10 ¼"	1'-4 ¼"
2 ¾"	5'-8"	11"	11 ¼"	1'-5 ¼"
3"	6'-1"	1'-0"	1'-0 ¼"	1'-6 ¼"

① Anchor Bolt Fabrication Tolerances:
Bolt Length - 4½"
Thread Length + ½"
Galvanized Length - -¼"

② Thread lenght applies to upper and lower threads

ANCHOR BOLT SIZE	PIPE OUTSIDE DIAMETER 16" BOLT CIRCLE DIA	16" DRILLED SHAFT SIZE	16" DRILLED SHAFT REINF	20" BOLT CIRCLE DIA	20" DRILLED SHAFT SIZE	20" DRILLED SHAFT REINF	24" BOLT CIRCLE DIA	24" DRILLED SHAFT SIZE	24" DRILLED SHAFT REINF	30" BOLT CIRCLE DIA	30" DRILLED SHAFT SIZE	30" DRILLED SHAFT REINF
1 ¼"Dia x 2'-11"	20 ½"	36" Dia	14-#8 (A)	24 ½"	36" Dia	14-#8 (A)						
1 ⅜"Dia x 3'-1"	20 ¾"	36" Dia	12-#9 (A)	24 ¾"	42" Dia	14-#9 (A)						
1 ½"Dia x 3'-4"	21"	36" Dia	12-#9 (A)	25"	42" Dia	14-#9 (A)	29"	42" Dia	14-#9 (C)			
1 ¾"Dia x 3'-10"	21 ½"	36" Dia	10-#10(A)	25 ⅜"	42" Dia	12-#10(B)	29 ⅜"	48" Dia	16-#10(C)	35 ⅜"	54" Dia	18-#10(C)
2"Dia x 4'-3"	22"	36" Dia	12-#10(A)	25 ¾"	42" Dia	12-#10(B)	29 ¾"	48" Dia	16-#10(C)	35 ¾"	54" Dia	18-#10(C)
2 ¼"Dia x 4'-9"	22 ½"	42" Dia	12-#11(A)	26"	42" Dia	10-#11(B)	30"	48" Dia	14-#11(C)	36"	54" Dia	14-#11(D)
2 ½"Dia x 5'-2"				26 ½"	42" Dia	12-#11(B)	30 ½"	48" Dia	16-#11(C)	36 ½"	54" Dia	16-#11(D)
2 ¾"Dia x 5'-8"							31 ½"	48" Dia	18-#11(D)	37"	54" Dia	20-#11(D)
3"Dia x 6'-1"										37 ½"	54" Dia	24-#11(D)

3" Spiral
Vertical bars (See Table for no. & size)

A = #3 Plain spiral at 6" pitch (Grade 40)
B = #4 Plain spiral at 6" pitch (Grade 40)
C = #4 Plain spiral at 6" pitch (Grade 60)
D = #4 Plain spiral at 3 ½" pitch (Grade 60)

TOP VIEW OF TOP & BOTTOM TEMPLATES

PLAN

② See "Cantilever Overhead Sign Support" or "High Level Cantilever Overhead Sign Support" sheets for number and size.

Cut 5" x 7" hole in pipe, Center 4" x 6" hand hole in ¾" x 8" x 10" back up plate. Provide attachable cover made from section cut from pipe.

VIEW A-A

③ BASE PLATE & HANDHOLE DETAILS

③ See "Cantilever Overhead Sign Support" or "High Level Cantilever Overhead Sign Support" sheets for diameter and thickness of base plate.

ANCHOR BOLT ASSEMBLY (PRIOR TO INSTALLATION)

BEARING SEAT ELEVATION

FOUNDATION DETAIL

Bond anchor bolts to rebar with 1/0 jumper and two mechanical connectors or by bending No. 3 bar on bottom template as shown and wire tightly with ten turns of No. 10 wire or one mechanical connector. Provide Mechanical connectors that are UL listed for concrete encasement.

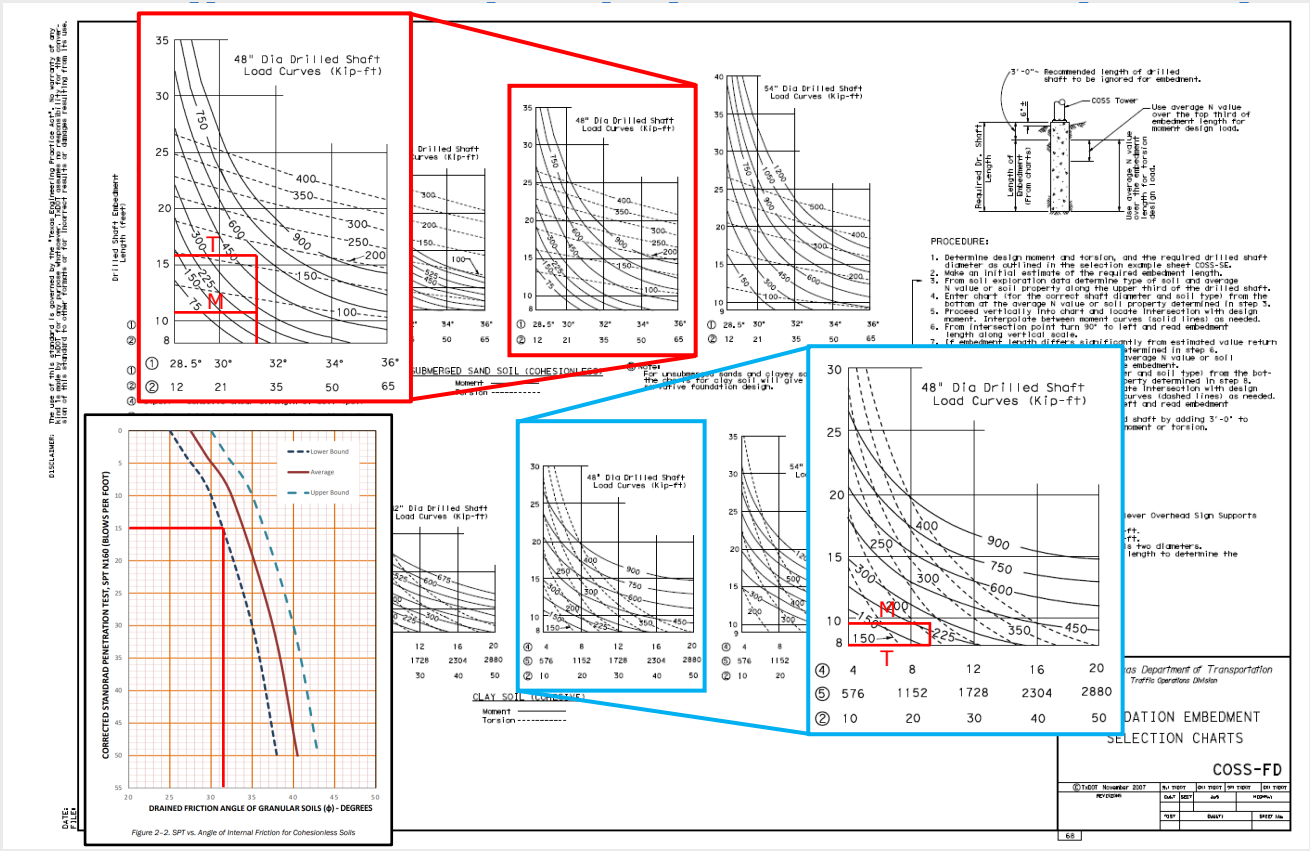
LIGHTNING PROTECTION SYSTEM

Texas Department of Transportation — Traffic Safety Division Standard

CANTILEVER OVERHEAD SIGN SUPPORT FOUNDATION

COSSF-21

ANCHOR BOLT SIZE	PIPE OUTSIDE DIAMETER 16" BOLT CIRCLE DIA	16" DRILLED SHAFT SIZE	16" DRILLED SHAFT REINF	20" BOLT CIRCLE DIA	20" DRILLED SHAFT SIZE	20" DRILLED SHAFT REINF	24" BOLT CIRCLE DIA	24" DRILLED SHAFT SIZE	24" DRILLED SHAFT REINF	30" BOLT CIRCLE DIA	30" DRILLED SHAFT SIZE	30" DRILLED SHAFT REINF
1 ¼"Dia x 2'-11"	20 ½"	36" Dia	14-#8 (A)	24 ½"	36" Dia	14-#8 (A)						
1 ⅜"Dia x 3'-1"	20 ¾"	36" Dia	12-#9 (A)	24 ¾"	42" Dia	14-#9 (A)						
1 ½"Dia x 3'-4"	21"	36" Dia	12-#9 (A)	25"	42" Dia	14-#9 (A)	29"	42" Dia	14-#9 (C)			
1 ¾"Dia x 3'-10"	21 ½"	36" Dia	10-#10(A)	25 ⅜"	42" Dia	12-#10(B)	29 ⅜"	48" Dia	16-#10(C)	35 ⅜"	54" Dia	18-#10(C)
2"Dia x 4'-3"	22"	36" Dia	12-#10(A)	25 ¾"	42" Dia	12-#10(B)	29 ¾"	48" Dia	16-#10(C)	35 ¾"	54" Dia	18-#10(C)
2 ¼"Dia x 4'-9"	22 ½"	42" Dia	12-#11(A)	26"	42" Dia	10-#11(B)	30"	48" Dia	14-#11(C)	36"	54" Dia	14-#11(D)
2 ½"Dia x 5'-2"				26 ½"	42" Dia	12-#11(B)	30 ½"	48" Dia	16-#11(C)	36 ½"	54" Dia	16-#11(D)
2 ¾"Dia x 5'-8"							31 ½"	48" Dia	18-#11(D)	37"	54" Dia	20-#11(D)
3"Dia x 6'-1"										37 ½"	54" Dia	24-#11(D)



Torsion = 162 k-ft
Moment = 244 k-ft
N_{SPT} = 15 bl

Sand:

Method 1:

$N_{TCP} = 2 \times N_{SPT} = 30$ bl

L = 16′ + 3′ = 19′

Method 2:

N_{SPT} = 15 bl

↓

Figure 2-2 (Lower Bound)

↓

φ = 31°

L = 16′ + 3′ = 19′

Clay:

$N_{TCP} = 1.5 \times N_{SPT} = 22.5$ bl

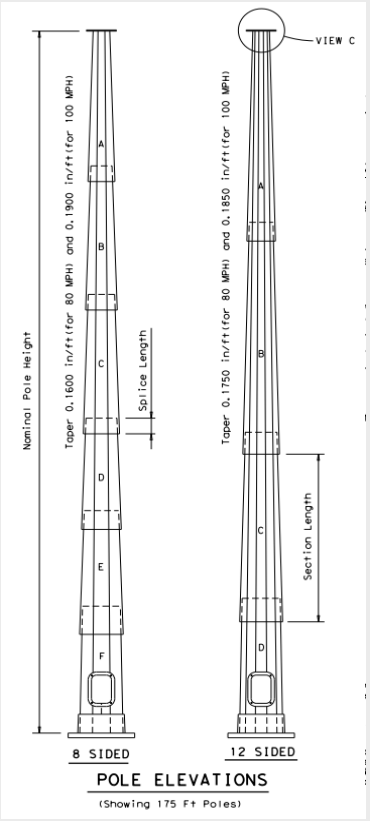
L = 10′ + 3′ = 13′

Future Plans

- Research FY25
  - Refine design approach compliant with current AASHTO requirements
  - Simplified soil parameters for LRFD based design approach
- Standard Updates
  - Design updates
  - Future standards to add N_{SPT} and/or C and Φ

Conclusions

- Every standard is different
  - Read the general notes on usage
- Geotechnical parameter selection requires discernment
  - Use all the information you have
- Keep an eye out for additional updates
- Feel free to reach out if you have questions



Questions?

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