



Proper Use of Traffic Standards

Bridge Division



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a Communication

b Standard Sheets

c The “Hangover Effect”

d Balanced-T and DMS

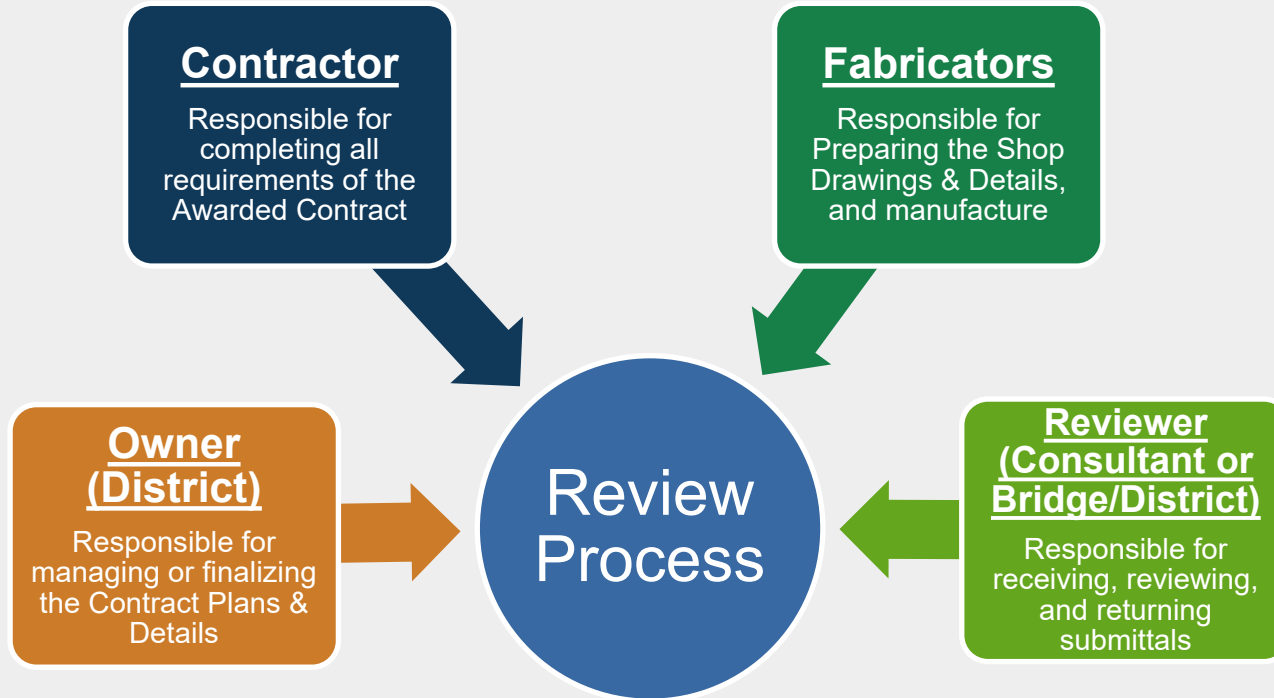
3 Roadway Illumination Poles

4 Traffic Signal Poles

The Review Process



The parties involved with the Review Process:



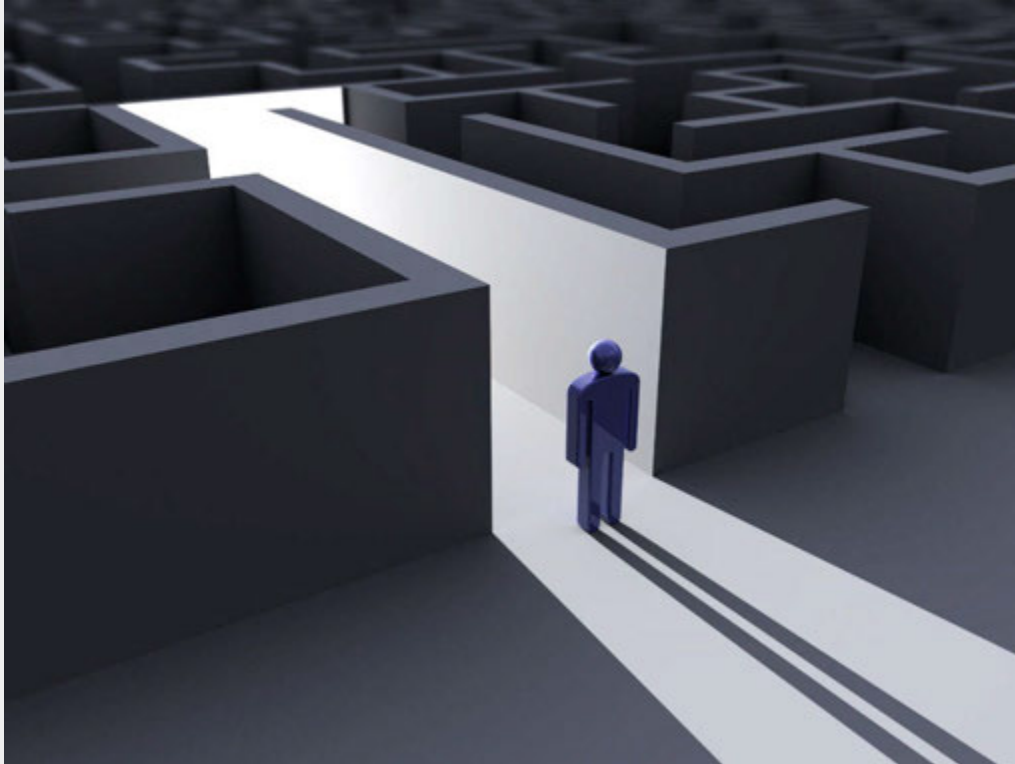
The Review Process



During the Review Process, the responsibility of Bridge's Shop Drawing Review is to **RECEIVE, REVIEW, and RETURN** submittals within a timely manner. Here is a list of the documents handled in the review process (in descending order):



However, completing the review process in a timely manner is not always possible.

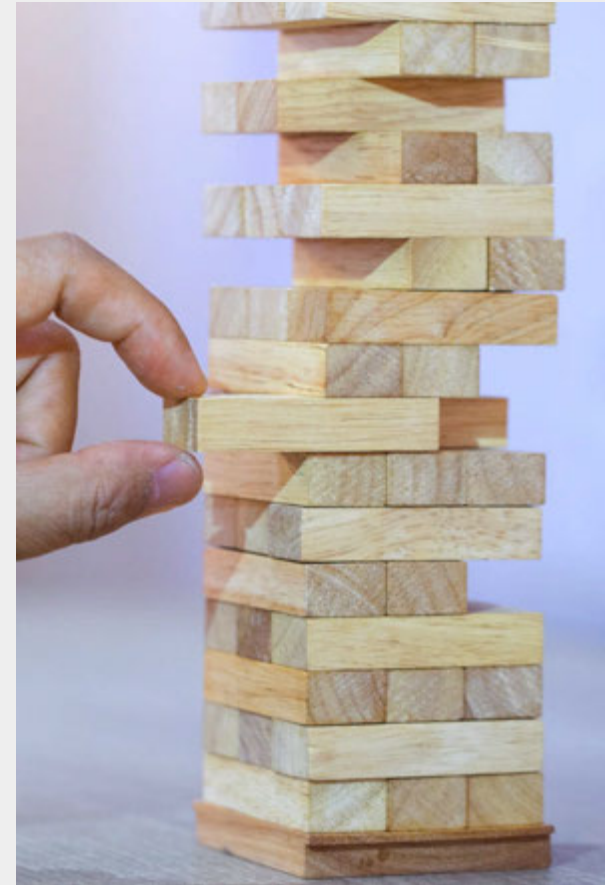


Here are some factors that commonly affect the review process:

- Communication
- The “Hangover Effect”
- Bal-T and DMS
- Substitutions for Special Designs



- All changes to the design of the structure proposed by the Fabricator require the Owner's approval and Contractor's acknowledgment.
 - These changes must be included in the Alternate Calculations and Shop Drawings
- If errors or discrepancies are discovered in the Contract documents by the Contractor or Fabricator, they must be brought to the Owner's attention. They can be communicated through the Request for Information (RFI) process.



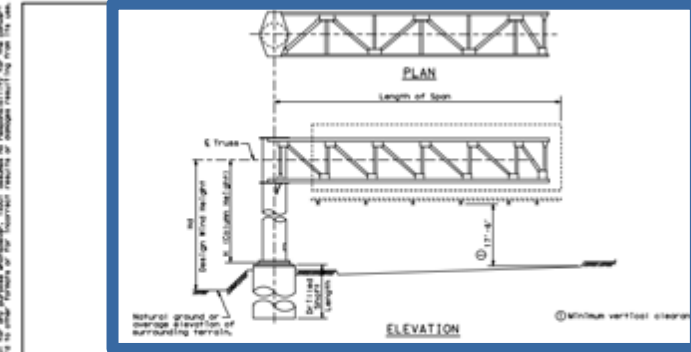


- Include:
 - Standard structure (e.g. COSS-Z1)
 - Structure Details (COSSD)
 - Wind Zone Map (WV & IZ-14)
 - Foundation Details (COSSF and COSS-FD)
 - Sign Brackets
 - SB(SWL-1)-14 and SMD2 for typical signs
 - DMS-(HZ)-21 or DMS(TM-1)-16 for Dynamic Message Signs (DMS)
 - Elevation View of structure

The "Hangover Effect"



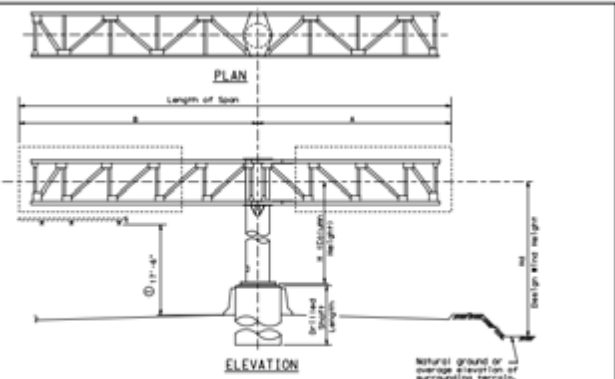
THIS DOCUMENT IS APPROVED BY THE TEXAS DEPARTMENT OF TRANSPORTATION, AS THE STANDARD FOR THE DESIGN OF OVERHEAD SIGN SUPPORTS. THE REQUIREMENTS OF THIS DOCUMENT ARE SUBJECT TO CHANGE WITHOUT NOTICE. THE TEXAS DEPARTMENT OF TRANSPORTATION IS NOT RESPONSIBLE FOR THE CONSEQUENCES OF ANY FAILURE TO FOLLOW THE REQUIREMENTS OF THIS DOCUMENT.



SELECTION EXAMPLE CANTILEVER SPAN

- Given: Cantilever Span = 33'; Column Height, $H = 25.3'$; Design Wind Height, $hd = 27'$; Avg. Reinforcement Value, $R = 15'$ (city type soil); Hill Country.
- Step 1:** Select applicable CDS5 standard. From Wind Velocity and Ice Load sheet (W & I)-161 determine that Hill Country is in Zone 4 (70 mph) and is above the ice line. Since Design Wind Height is less than 30', use standard CDS-24 & 241. If Design Wind Height is more than 30', use CDS-25 & 251. NOTE: In Zone 1 if Design Wind Height is greater than 30' use ACOS-21.
 - Step 2:** Determine tower details from CDS-24 & 241. Use column height to nearest tabulated value, i.e., 23'. Round span length up to the nearest tabulated value, i.e., 35'. Tower details are:
 Tower pipe 24" Dia with 60% wall thickness = 0.312"
 Base plate 35" x 35" x 1 1/2"
 Anchor bolts 4" Dia at 25" bolt circle
 Horizontal deflection of tower on E truss = 0.889". During installation, double nuts or base plate may be used to pull tower to compensate for horizontal deflection.
 Design Torsion = 142 kip-ft
 - Step 3:** Determine truss details from CDS-24 & 241. Read from small table at bottom of sheet for span = 35'. Truss design info, $R = 15'$; depth, $D = 4.0'$; $A = 0.7'$.
 Chord: L 3 x 3 x 3/8 (4) with 2 bolt connection at tower
 D.L. Diap. L 3 x 3 x 3/8 (4) with 2 bolt connection
 W.L. Diap. L 3 x 3 x 3/8 (4) with 2 bolt connection
 D.L. Vert. L 2 x 2 x 3/8 (4) with 1 bolt connection
 W.L. Strut L 2 x 2 x 3/8 (4) with 1 bolt connection
 Bolts are 5/8" Dia high strength with 5/8" Dia bolt alternate for chord connection at tower.
 D.L. of truss = 50 lb/ft
 Truss deflection of free end = 5.2". The fabricator shall compensate for this deflection by offsetting bolt holes between the upper and lower chords of the truss-to-tower connection.
 - Step 4:** Determine foundation details. Use standard CDSF. From CDSF with 24" Dia pipe and 1 1/2" Dia anchor bolts:
 Anchor bolts 4" Dia x 3'-10"
 Drilled shaft Dia 42"
 Vertical Reinforcing 12 - #10 bars
 Spiral C = 44 @ 8" pitch Grade 60
 Misc. hardware, base plate, anchor bolt, and foundation details are shown on CDSF.
 - Step 5:** Determine drilled shaft length from CDS-F5. Enter the appropriate graph for 42" Dia drilled shaft in city soil from the bottom with $R = 15'$. Pressed upward interlocking moment curves (solid lines) to locate 248 kip-ft. Project to the left side of the graph to determine the required embedment length, i.e., 12'. Repeat the procedure for torsion curves (dashed lines) to locate 142 kip-ft. The embedment length required to satisfy torsion is 14'. Add 3'-0" to the longer length to obtain a required drilled shaft length of 17'.

DATE: 11/11/11



SELECTION EXAMPLE DOUBLE CANTILEVER SPAN

- Given: Short span, $A = 9'$; Long Span, $B = 25'$; Total Cantilever Span = 34'; Column Height, $H = 24'$; Design Wind Height, $hd = 26'$; Avg. Reinforcement Value, $R = 20'$ (city type soil); Wheeler County.
- Step 1:** Select applicable CDS5 standard. From Wind Velocity and Ice Load sheet determine that Wheeler County is in Zone 2 (80 mph) and is above the ice line. Since Design Wind Height is less than 30', use standard CDS-221. If Design Wind Height is more than 30', use ACOS-21.
 - Step 2:** Determine tower details from CDS-221. Use column height = 24'. Round truss span length up to the next longer tabulated length span, i.e., 35'. If total span length is greater than 40', a special design would be required.
 Tower details are:
 Tower pipe 30" Dia with 60% wall thickness = 0.312"
 Base plate 40" x 40" x 2"
 Anchor bolts 8" Dia at 30" bolt circle
 Horizontal deflection of tower on E truss = 0.574-0.516 = 0.26". During installation, double nuts or base plate may be used to pull tower and compensate for horizontal deflection.
 Design moment = 463 kip-ft (use total span = 35')
 Design Torsion = 136 kip-ft (use long span = 25')
 - Step 3:** Determine truss details from CDS-221. Read from small table at bottom of sheet 2 of 2 for Span $A = 9'$ (use 10'):
 Chord: L 3 x 3 x 3/8 (4) with 2 bolt connection at splice
 D.L. Diap. L 3 x 3 x 3/8 (4) with 1 bolt connection
 W.L. Diap. L 3 x 3 x 3/8 (4) with 1 bolt connection
 D.L. Vert. L 2 x 2 x 3/8 (4) with 1 bolt connection
 W.L. Strut L 2 x 2 x 3/8 (4) with 1 bolt connection
 Bolts are 5/8" Dia high strength with 5/8" Dia bolt alternate for chord connection at tower.
 D.L. of truss = 43 lb/ft
 Truss defl. of free end = 5.2". For Span $A = 9'$ and for Span $B = 25'$, the fabricator shall compensate for deflection by offsetting bolt holes between upper and lower chords at splice and of truss-to-tower connection. Top chord shall be positioned between the tower and the pipe to achieve the required offset.
 - Step 4:** Determine foundation details. Use standard CDSF. From CDSF with 30" Dia pipe and 1 1/2" Dia anchor bolts:
 Anchor bolts 8" Dia x 4'-3"
 Drilled shaft Dia 54"
 Vertical Reinforcing 18 - #10 bars
 Spiral C = 44 @ 8" pitch Grade 60
 Misc. hardware, base plate, anchor bolt, and foundation details are shown on CDSF.
 - Step 5:** Determine drilled shaft length from CDS-F5. Enter the appropriate graph for 54" Dia drilled shaft in city soil from the bottom with $R = 20'$. Pressed upward interlocking moment curves (solid lines) to locate 463 kip-ft. Project to the left side of the graph to determine the required embedment length, i.e., 15'. Repeat the procedure for the torsion curves (dashed lines) to locate 136 kip-ft. The embedment length required to satisfy torsion is 9'. Add 3' to the longer length to obtain required drilled shaft length of 18'.

Texas Department of Transportation
 Traffic Operations Division

**CANTILEVER
 OVERHEAD SIGN SUPPORTS
 SELECTION EXAMPLES**

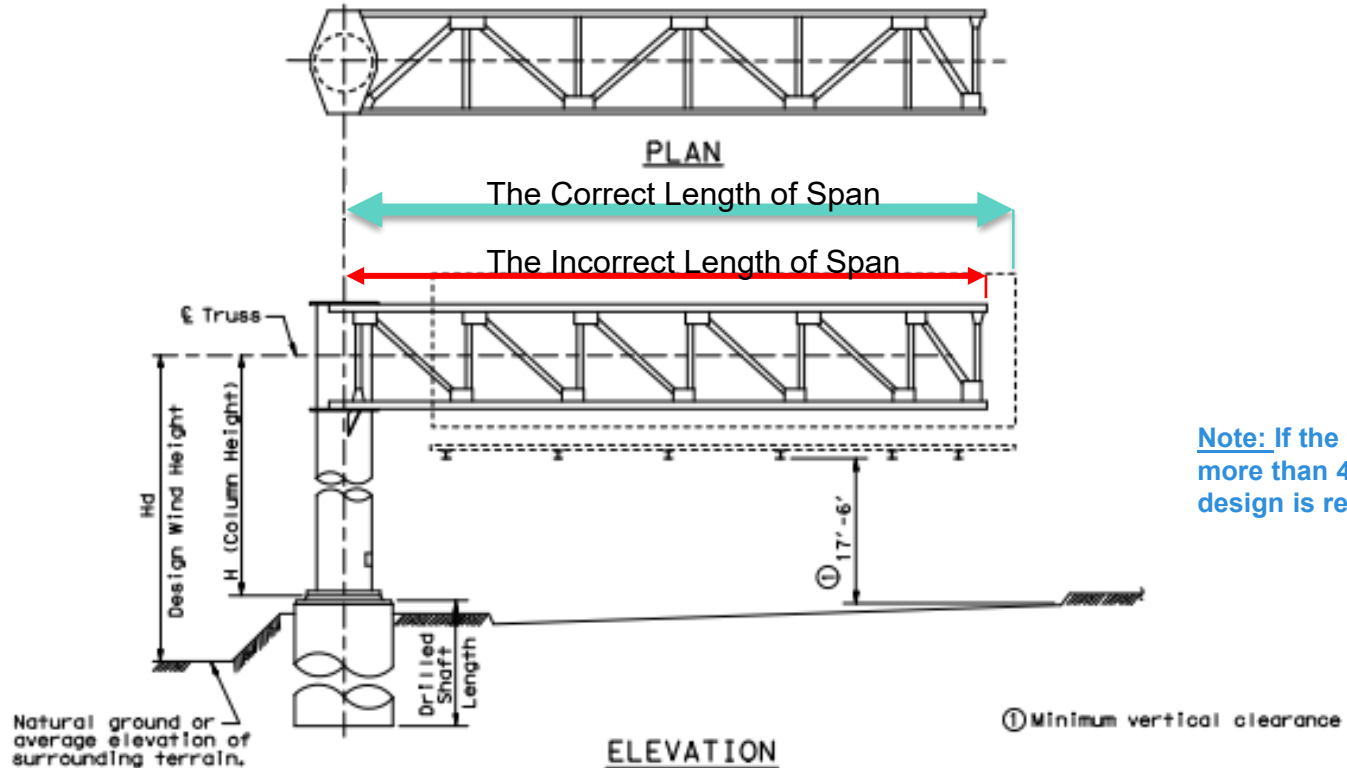
COSS-SE

1/2007	November 2007	1st Year	2nd Year	3rd Year	4th Year	5th Year
Revised		Year	Year	Year	Year	Year
		Year	Year	Year	Year	Year
		Year	Year	Year	Year	Year



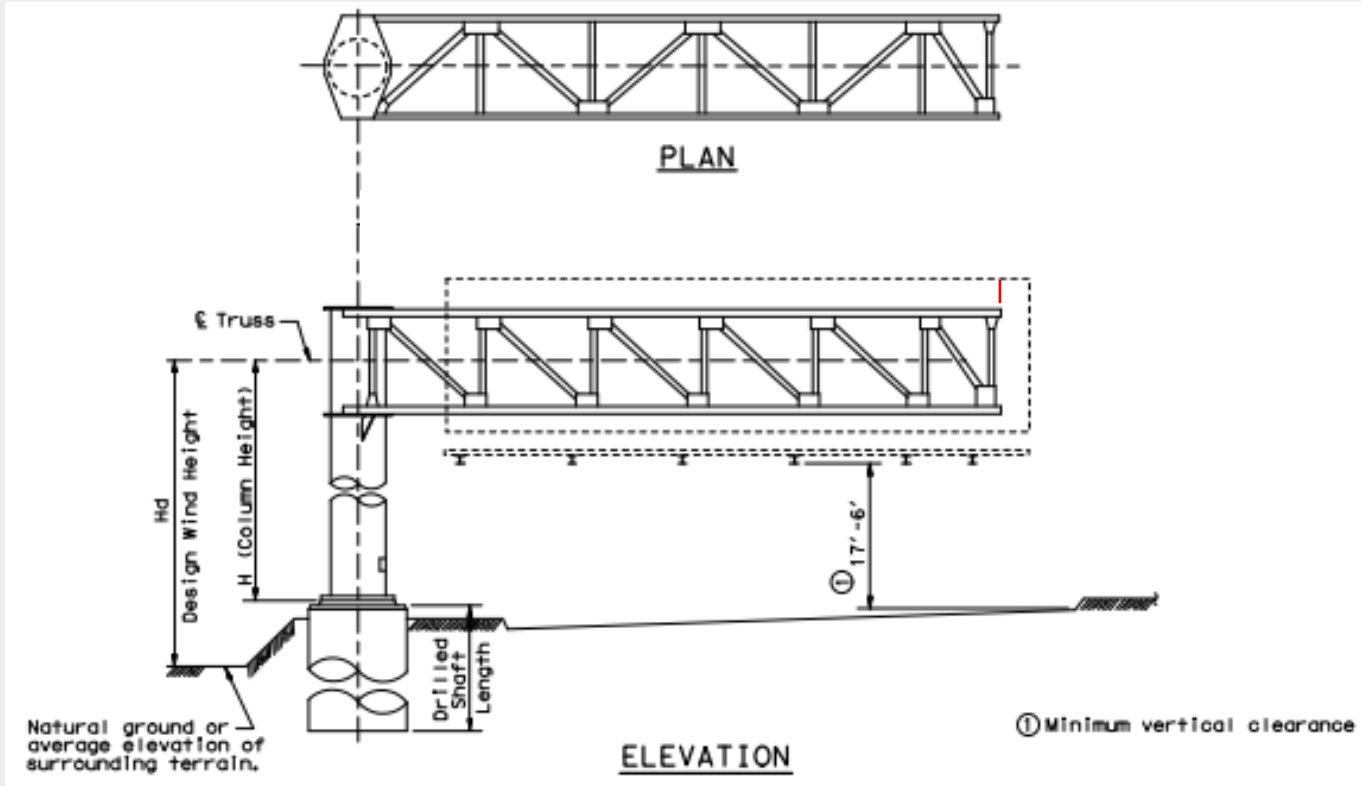
Length of Span

is from the CENTERLINE of the column/tower to the OUTSIDE edge of the sign (which normally overhangs the truss), up to a maximum of 40 feet



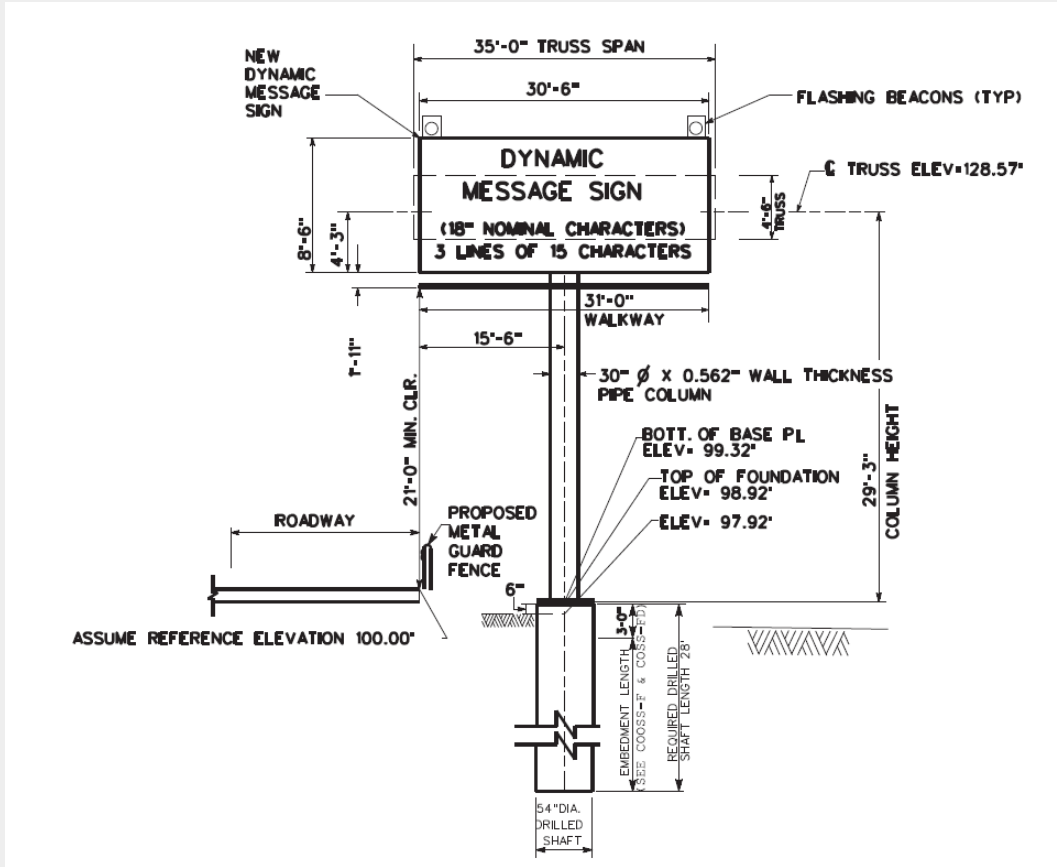
Note: If the total span equals more than 40 feet, a special design is required.

Design Wind Height vs. Column Height





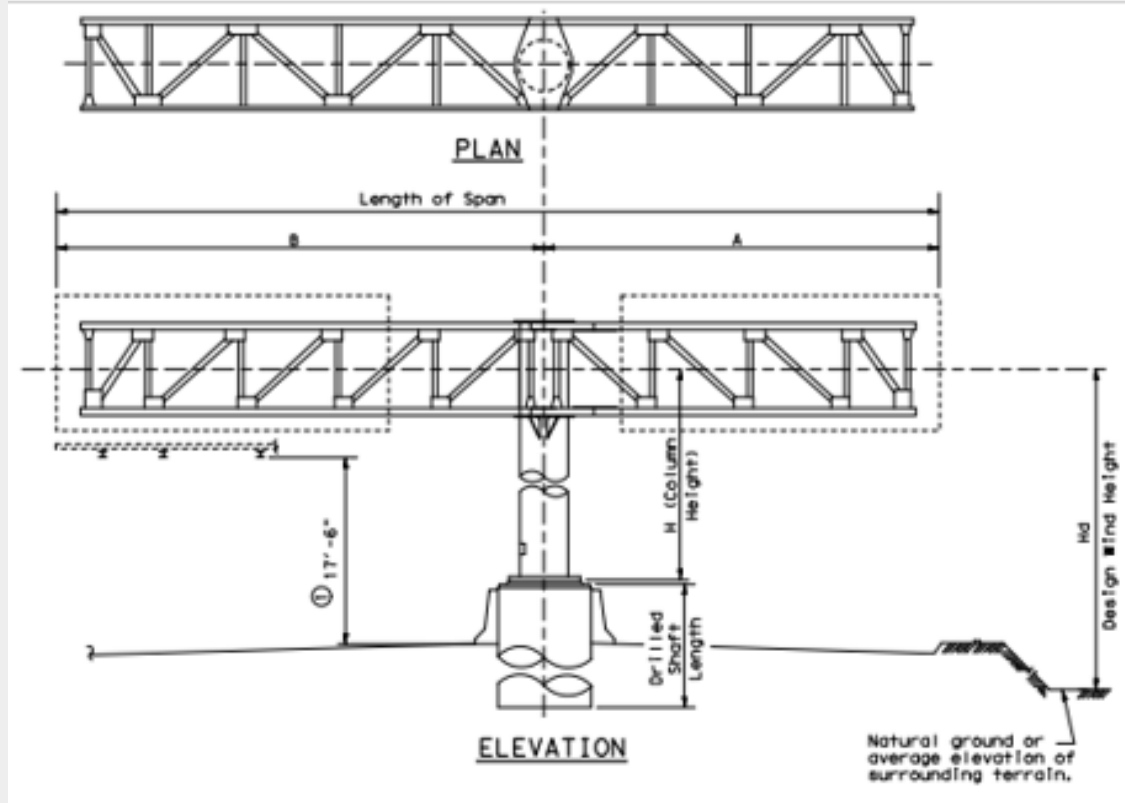
- Include:
 - Truss span length
 - Column height
 - Drilled shaft diameter
 - Embedment length
 - Structure station
 - Structure sign



Balanced-T and DMS

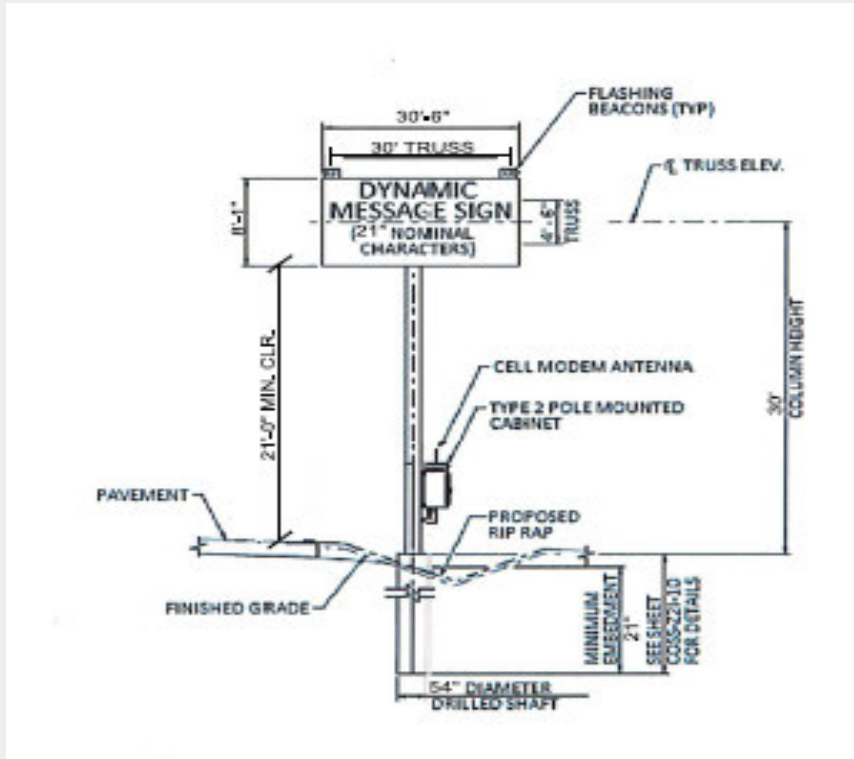


- Normally, when dealing with a Double Cantilever Span (or Balanced-T), the following steps are taken:
 - Select applicable COSS standard based on the location of the project and Design Wind Height. Note: If Design Wind Height is greater than 30', it is recommended to increase the Zone.
 - Determine tower details. Remember to round the total span length (Span A + Span B) up to the nearest tabulated value.
 - Determine truss details for Span A and **THEN** Span B.
 - Determine foundation details.
 - Determine drilled shaft length.

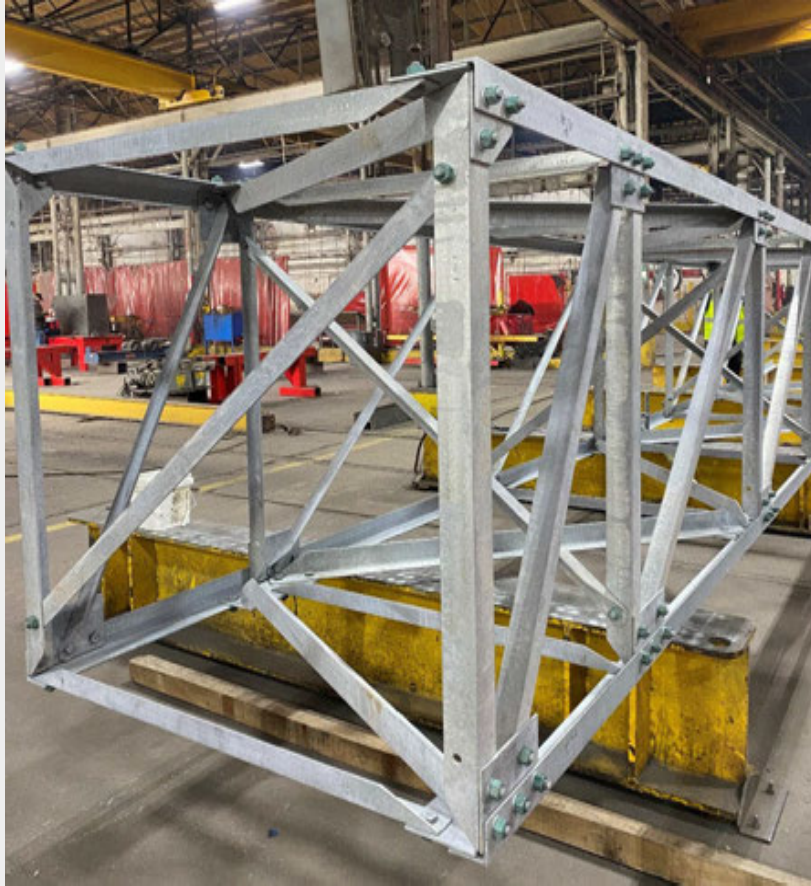




However, all COSS traffic standards are designed for conventional signs and does not account for a DMS.



1. Select applicable COSS standard based on the location of the project and Design Wind Height. Note: It is recommended to increase the Zone to account for increased loading from the DMS.
2. Determine tower details. Remember to round the total span length (Span A + Span B) up to the nearest tabulated value.
3. Determine truss details for Span A and Span B accounting for the full length of both cantilevers as one.
4. Determine foundation details.
5. Determine drilled shaft length.



- There are acceptable changes that Fabricators may make when developing shop drawings.
 - The width of a member may change by up to $\frac{1}{2}$ in and/or the thickness up to $\frac{1}{16}$ in.
 - This could be due to
 - Availability of member sizes
 - Tightening Clearances
 - Other reasons as they apply but the reason must be clear in the Drawing for the change
- These changes are acceptable when the Standard COSS & OSB designs are used
 - **When the SZ Standard has been used, the Engineer of Record must be notified and accept these changes.**



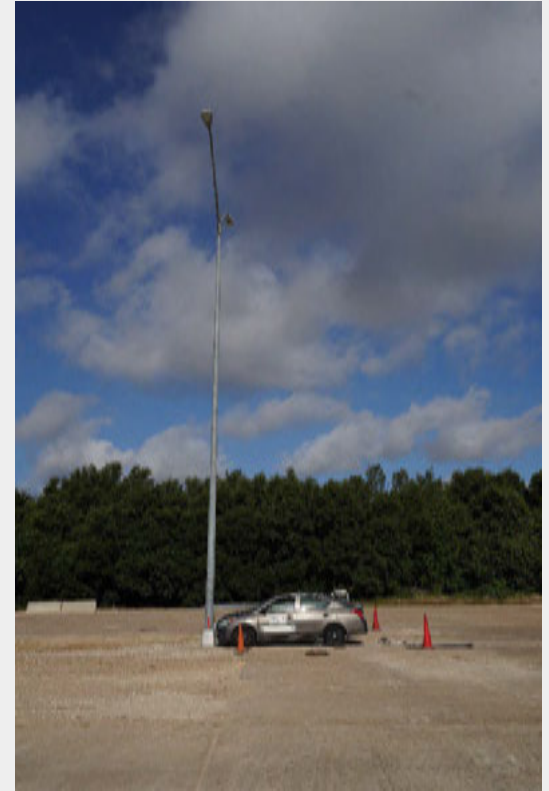
- DMS Structures are special designs
 - Typically a higher wind zone is used to account for increased loading
 - e.g. using zone 3 design for a DMS in zone 4
- Drilled shaft diameter based on pipe diameter and bolt circle
- Drilled shaft embedment length based on soil conditions

ZONE 4 WITH AND WITHOUT ICE 70 MPH WIND															
SIGN LOADS		35' SPAN												TOWER PIPE	
		TOWER PIPE			ANCHOR BOLTS			BASE PLATE	TRUSS	DESIGN LOADS					
TORSION T (K-ft)	MOMENT M (K-ft)	O. D. (in)	WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O. D. (in)	WALL THICK (in)	
119.01	134.48	24	0.250	0.406	1 3/4	8	29 3/8"	33 3/4 x 1 1/2	2.6	9.77	161.98	165.20	30	0.250	0
	141.90			0.467					2.7	9.79		173.37			0
	149.44			0.531					2.8	9.81		181.71			0

ZONE 3 WITH AND WITHOUT ICE 80 MPH WIND															
SIGN LOADS		35' SPAN												TOWER PIPE	
		TOWER PIPE			ANCHOR BOLTS			BASE PLATE	TRUSS	DESIGN LOADS					
TORSION T (K-ft)	MOMENT M (K-ft)	O. D. (in)	WALL THICK (in)	DEFL ΔH (in)	SIZE DIA (in)	NO.	BOLT CIR DIA	SIZE (in)	DEFL ΔV (in)	SHEAR V (Kips)	TORSION T (K-ft)	MOMENT M (K-ft)	O. D. (in)	WALL THICK (in)	
155.44	167.11	30	0.250	0.210	1 3/4	8	35 3/8"	39 3/4 x 1 1/2	1.5	12.87	211.58	202.48	30	0.280	0
	177.27			0.241					1.6	12.90		213.97			0
	187.54			0.275					1.6	12.93		225.63			0



- Standard steel pole designs
- Alternates can be aluminum or Steel



Standard Roadway Illumination Pole Limitations



- Poles in wind Zones greater than 110 MPH (Coastal Counties) should be Alternates



FOR HARRIS CO. ONLY
 Zone line is just North of US 90, around on the North, West and South sides of IH 610 and down the West side of SH 288.

FOR VICTORIA & JACKSON COUNTIES ONLY
 Zone line is just South of US 59.

140 MPH
 Zone line is just East of both CO 1847 & FM 511

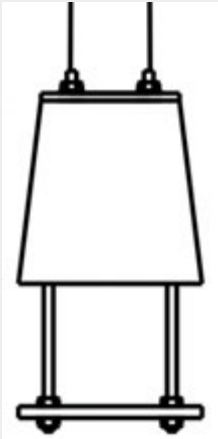
GENERAL NOTES:

1. Designs conform to AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 6th Edition (2013) and Interim Revisions thereto. **Design 3-Second Gust Wind Speed equals 110 mph** with a 1.14 gust factor. A wind importance factor of 0.80 is applied to adjust the wind speed to a 25 year recurrence interval. Design moments listed in tables assume base of pole is 25' above natural ground level.

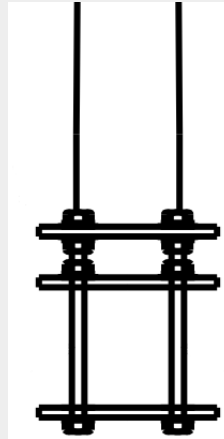
		Traffic Operations Division Standard	
WIND VELOCITY AND ICE ZONES (AASHTO 2001-2013 LTS DESIGN SPEC)			
WV & IZ(LTS2013) - 14			
FILE: lts2013.dgn	DN: TxDOT	CK: TxDOT	DR: TxDOT
© TxDOT August 2014	CONT SECT	JOB	HIGHWAY
REVISIONS	DIST	COUNTY	SHEET NO.



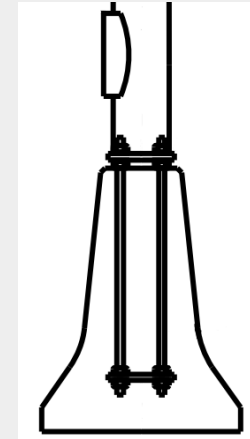
- Transformer Base- breakaway aluminum base for use where vehicle impact is a concern
- Shoe Base- Standard Base for mounting on the ground
- Concrete Traffic Barrier (CTB)- Ovalized base to fit on traffic barriers



*Transformer
Base*



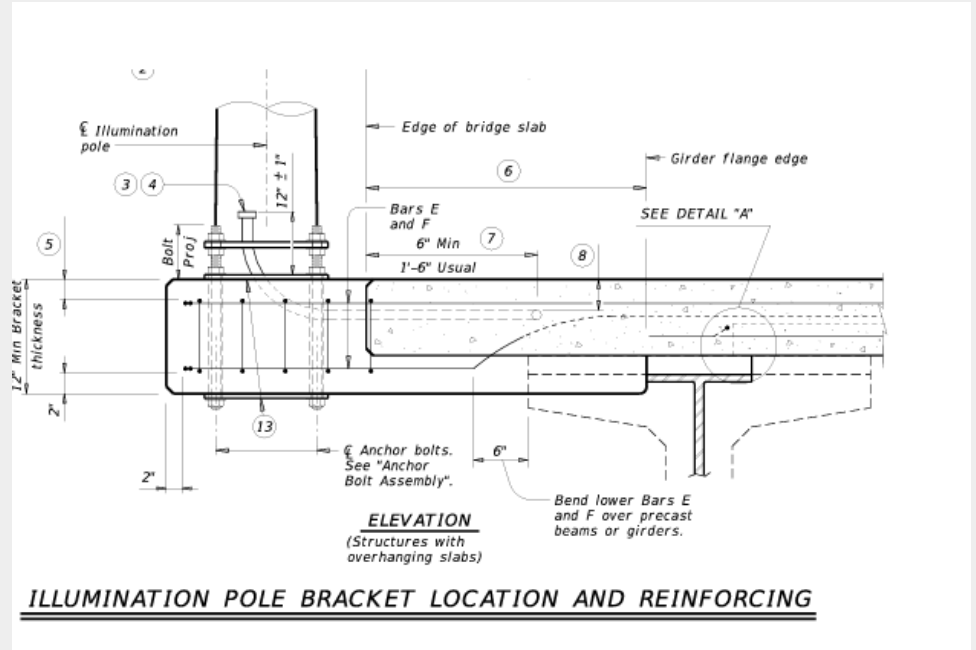
Shoe Base



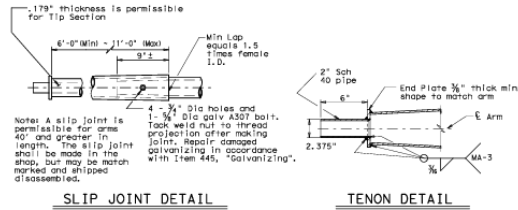
*Concrete Traffic
Barrier Base*



- Bridge Lighting Details (Bridge Standards)
 - MS-BL-19.dgn
 - Bracket for heights up to 100 ft



Traffic Signal Poles

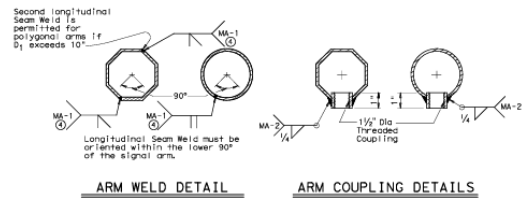


Note: A slip joint is permissible for arms 40' and greater in length. The slip joint shall be made in the shop, but may be match marked and shipped disassembled.

VIBRATION WARNING
 Mast arms of SMA and SMA structures and clamp-on Arms of LMA structures of approximately 40 ft or longer are subject to harmonic vertical vibrations in light wind conditions, due to the aerelastic characteristics of a few of the modes of possible combinations of the following signal numbers, weights and positions: existence/solidity of backplates; presence of additional attachments to the arm, such as signs and cameras; arm-wind orientation; and arm-pole stiffness.
 Such vibrations may cause fatigue damage to the structure and may lead to galloping in moderate wind conditions which may further damage the structure and alarm the public. Tests have indicated that when wind is blowing toward the back side of signal heads having unvented backplates attached the probability of unacceptable vibrations and/or galloping is rather high.
 If backplates are not required for improved visibility they should not be applied to the signal heads or, if they must be applied, they should be vented as a first and inexpensive measure to mitigate vibrations.
 The traffic signal mast arms shall be visually inspected in 5 to 20 mph wind conditions after installation of signal heads and any attachments, including any required backplates. If vertical movements with a total excursion (maximum upward excursion to maximum downward excursion) of more than approximately 8" are observed at the arm tip, a damping plate shall be fitted to the arm. See "Damping Plate Mounting Details" on standard sheet, MA-10-10.
 This visual inspection shall be repeated after each modification of the structure that could affect its aerelastic response. Excessive vibrations shall not be allowed to continue for more than two days.

Stainless steel bands (or cables) and cast brackets as in "Astro-Brook", "Soy Bracket" or "Tosy Bracket" with 1 1/2" Dia Threaded Coupling.

BRACKET ASSEMBLY



Longitudinal Seam Weld must be oriented within the lower 90° of the signal arm.
 60X Min. penetration
 100% penetration within
 6" of circumferential
 base welds.

GENERAL NOTES:
 Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signal and Interim Specifications thereon. Design Wind Speed equals 85 mph plus a 1.3 gust factor.

Poles are designed to support one 8'-0" luminaire arm, one 9'-0" internally lighted street name sign and one traffic signal arm with a length as tabulated. The specified luminaire load applied at the end of the luminaire arm equals 80 lbs vertical dead load plus the horizontal wind load on an effective projected area of 1.6 sq. ft. The specified internally lighted street name sign load applied 4.5 ft from the centerline of the pole equals 85 lbs vertical dead load plus horizontal wind load on an effective projected area of 11.5 sq. ft. The specified signal load applied at the end of the traffic signal arm equals 180 lbs vertical dead load plus the horizontal wind load on an effective projected area of 32.4 sq. ft. (actual area times drag coefficient).

See Standard Sheet "MA-0" for pole details, "MA-C" for traffic signal arm connection details, "MA-C (IL-500)" for internally lighted street name sign arm connection details, "LM-A" for luminaire arm and connection details, "RSC" for internally lighted street name sign details, and "TS-FD" for anchor bolt and foundation details. See "MA-C" for material specifications.

Fabrication shall be in accordance with Item 686, "Traffic Signal Pole Assemblies (Steel)" and with the details, dimensions, and weld procedures shown herein. Weld references call for preapproved weld procedures which the fabricator must obtain prior to fabrication. Materials, fabrication tolerances, and finishing practices shall meet the requirements of this sheet and Item 686, "Traffic Signal Pole Assemblies (Steel)".

Unless otherwise noted, all parts shall be galvanized in accordance with Item 465, "Galvanizing", after fabrication.

Deviation from the details and dimensions shown herein require submission of shop drawings in accordance with Item 441, "Steel Structures". Alternate designs are not acceptable.

Texas Department of Transportation
 Traffic Operations Division
**TRAFFIC SIGNAL
 SUPPORT STRUCTURES
 SINGLE MAST ARM ASSEMBLY**
 (80 MPH WIND ZONE)
SMA-80 (2) - 12

REV	DESCRIPTION	DATE	BY	CHK	APP
1	ISSUED	AUGUST 1995	...	...	...
2	...	...	...	...	...
3	...	...	...	...	...



- Some non-signal use has been observed (small signs)
- Validate Effective Projected Area (EPA) is acceptable
- $EPA = C_d * W * H$
 - $C_d = 1.2$ for signs
 - $C_d = 1.6$ for DMS

GENERAL NOTES:

Design conforms to 1994 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminares, and Traffic Signals and Interim Specifications thereto. Design Wind Speed equals 80 mph plus a 1.3 gust factor.

Poles are designed to support one 8'-0" luminaire arm, one 9'-0" internally lighted street name sign and one traffic signal arm with a length as tabulated. The specified luminaire load applied at the end of the luminaire arm equals 60 lbs vertical dead load plus the horizontal wind load on an effective projected area of 1.6 sq ft. The specified internally lighted street name sign load applied 4.5 ft from the centerline of the pole equals 85 lbs vertical dead load plus horizontal wind load on an effective projected area of 11.5 sq ft.

The specified signal load applied at the end of the traffic signal arm equals 180 lbs vertical dead load plus the horizontal wind load on an effective projected area of 32.4 sq ft (actual area times drag coefficient).



- After Installation, check for vibration in light wind (5 MPH - 20 MPH)

VIBRATION WARNING

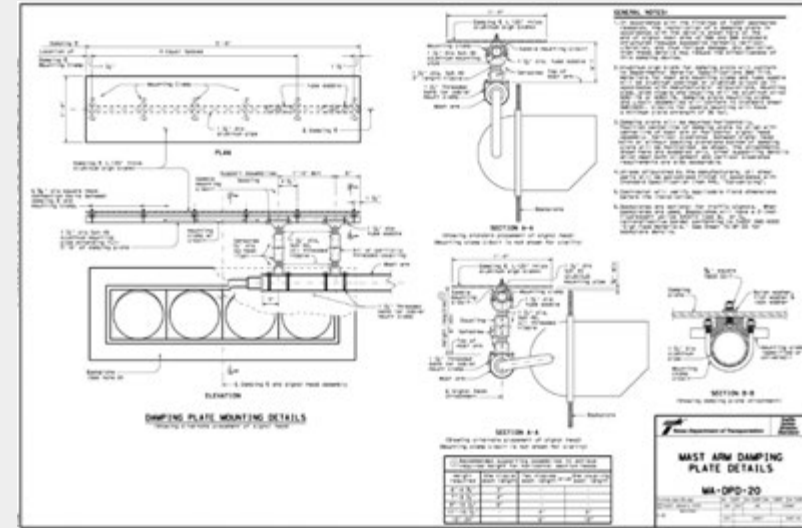
Mast Arms of SMA and DMA structures and clamp-on Arms of LMA structures of approximately 40 ft or longer are subject to harmonic vertical vibrations in light wind conditions due to the aeroelastic characteristics of a few of the myriads of possible combinations of the following: signal numbers, weights and positions; existence/solidity of backplates; presence of additional attachments to the arm, such as signs and cameras; arm-wind orientation; and arm-pole stiffness.

Such vibrations may cause fatigue damage to the structure and may lead to galloping in moderate wind conditions which may further damage the structure and alarm the public. Tests have indicated that when wind is blowing toward the back side of signal heads having un-vented backplates attached the probability of unacceptable harmonic vibration and/or galloping is rather high.

If backplates are not required for improved visibility they should not be applied to the signal heads or, if they must be applied, they should be vented as a first and inexpensive measure to mitigate vibrations.

The traffic signal mast arms shall be visually inspected in 5 to 20 mph wind conditions after installation of signal heads and any attachments, including any required backplates. If vertical movements with a total excursion (maximum upward excursion to maximum downward excursion) of more than approximately 8" are observed at the arm tip, a damping plate shall be fitted to the arm. See "Damping Plate Mounting Details" on standard sheet, MA-DPD-10.

This visual inspection shall be repeated after each modification of the structure that could affect its aeroelastic response. Excessive vibrations shall not be allowed to continue for more than two days.



Questions?



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