

Monotube Sign Structure

{ Jared Schwennesen



Overhead Sign Structures



The First Monotubes



Crosstown Monotube



I-44 Monotube



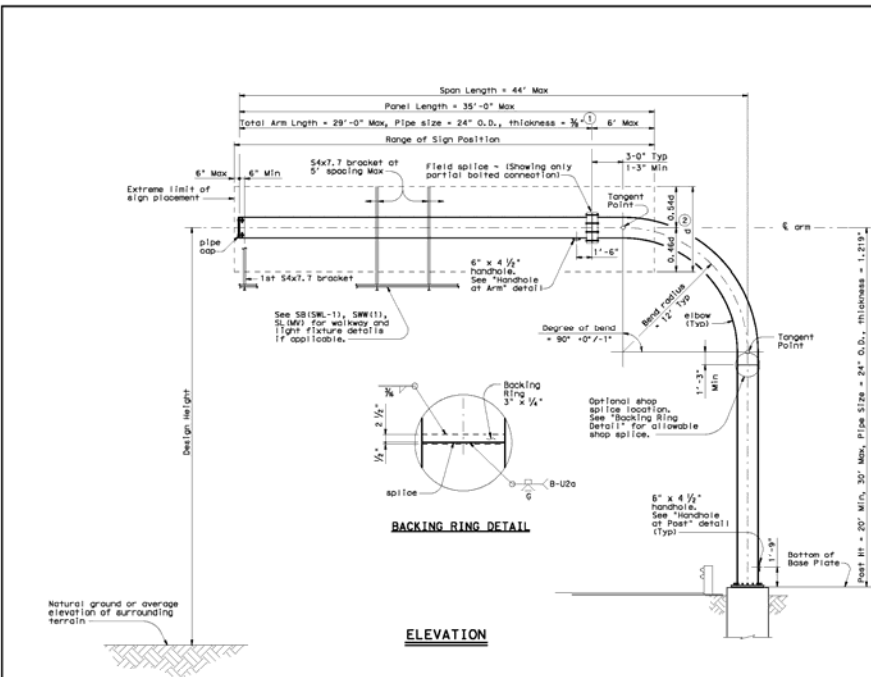
Port of Entry Monotube



Monotube Signal

ISOLATION: This drawing is prepared in accordance with the terms of the contract and is not to be used for any other purpose without the written consent of the Texas Department of Transportation. The use of this drawing for any other purpose is at the user's risk.

DATE: 08/07/07



- 1 Arm length must be adjusted to accommodate span length required as shown on the structural layout sheet.
- 2 When signs of different depths are used, the bottom edges of all signs may be placed in line. Where this is done, all signs should be so positioned that the bottom edges are approximately 0.46 of the depth of the deepest sign below the 6' of most arm.

GENERAL NOTES:

Designed according to current 2006 AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals and Interim Specifications.

Design wind speed equals 130 mph (3-second wind speed). Design height is up to 50 ft.

Each structure is designed to support signs of equivalent area to a 10 ft deep sign panel over 80 percent of the span length. Sign panel overlap onto elbow may not exceed 6 ft from field splice. Design includes 3 lbs per square ft for sign panel, 20 lbs per ft for light or lane control signal (LCS) and 50 lbs per ft for walkway, all placed as specified for the design sign panel. Sign panels may include a dynamic message sign (DMS) weighing up to 4,000 lbs.

Steel for pipe post and arm must conform to ASTM A53 Grade B, Type E or 5 or A106 Grade B. All other structural steel must conform to ASTM A36, A372 Grade 50 or A588.

All connection bolts and U-bolts must conform to ASTM A325 with A563 heavy hex nuts, and F436 washers. Anchor bolts must conform to ASTM F1554 Grade 55 or A193 B7, with ASTM A194 Grade 2H or A563 heavy hex nuts, and F436 washers. Install connection bolts in accordance with Item 447, "Structural Bolting". Lubricate and tighten anchor bolts in accordance with Item 449, "Anchor Bolts". Bend elbow in accordance with TPA-185-98 "Recommended Standards for Induction Bending of Pipe and Tube".

Form elbows for tubular frame by hot bending methods which will not crack or buckle the interior radius of pipe bend, and will not change the physical characteristics of the material. For each seam-welded pipe, locate a longitudinal seam weld at the neutral axis during the bending process.

The locations of drilled holes to accommodate 1 1/2 inch threaded couplings and C&B connectors for cord and cable fitting on arms must be approved by the Engineer.

Fabrication and welding must be in accordance with the Item 441, "Steel Structures", the AWS Structural Welding Code D1.1, and the details shown on the plans. Unless otherwise noted, all steel parts must be galvanized in accordance with Item 445, "Galvanizing" other fabrication. During galvanizing process, drain acid towards base plate and to avoid acid entrapment under backing ring.

Construct foundations in accordance with Item 416, "Drilled Shaft Foundations". Use Class C concrete. Use Grade 60 reinforcing steel.

Shop assemble post and arm in accordance with Item 441. During shop assembly, first bring the field splice to a snug tight condition with the required bolts in all holes through each ply in the connection. Then verify corner and span length prior to disassembly. Contractor must demonstrate to the Engineer that the preassembled span length of the frame in the no load condition is within 2 inches (+/-) of the design span length.

If the tubular frame is erected as one unit, the frame must be adequately suspended to avoid distortions. The structure must be supported by the crane during the anchor bolts tightening process.

SHEET 1 OF 4

Texas Department of Transportation
Traffic Operations Division

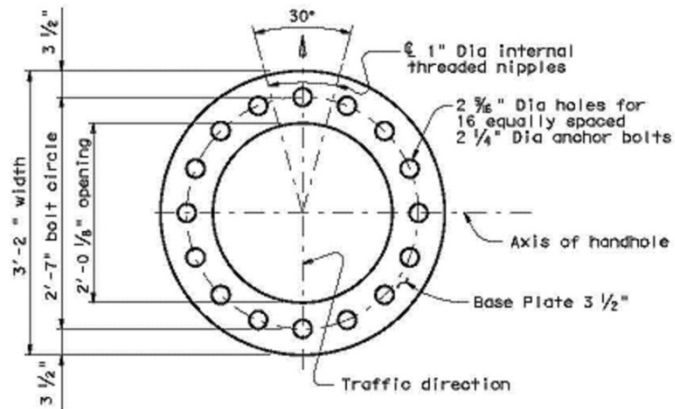
MONOTUBE SIGN STRUCTURE (CANTILEVER)

MC (1)-07

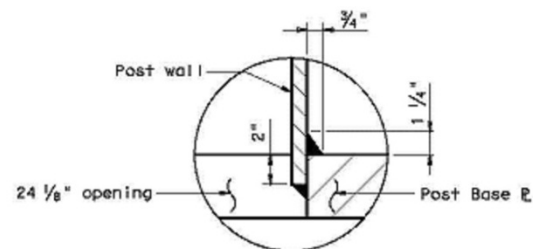
DATE	BY	CHK	APP	DATE
08/07/07	August 2007	See 10807	See 10807	See 10807
REVISION	Rev	Rev	Rev	Rev
101	See 101	See 101	See 101	See 101

3.00.1

Texas Standard



BASE PLATE DETAIL



POST WELD DETAIL
(at Base Plate)

Texas Standard

Colorado Standard

**TYPICAL VERTICAL POST CANTILEVER
PIPE SELECTION PROCEDURE FOR VERTICAL POST CANTILEVERS**

A. COVERAGE PERCENTAGE = $\frac{\text{SIGN PANEL LENGTH}}{\text{SPAN}}$ FOR THE SPAN LENGTH USE THE SPAN FROM ONE OF THE CHARTS (25', 30', 35', ETC.), NOT THE ACTUAL SPAN.

B. PICK THE PIPE OUTSIDE DIAMETER (OD) FROM THE 0-50% OR THE 51-80% CHART. THE COVERAGE PERCENTAGE CHOSEN SHOULD BE HIGH ENOUGH TO INCLUDE ANY SIGN PANELS WHICH MAY POTENTIALLY BE PLACED ON THIS SIGN IN THE FUTURE.

C. TO DETERMINE "OD" FOR THE SELECTION CHARTS ADD THE AREA OF THE EXT. PANEL, IF PRESENT, TO THE MAIN SIGN PANEL AREA DIVIDE BY THE MAIN PANEL LENGTH TO OBTAIN "OD".

D. IF NO PIPE IS SHOWN FOR A CERTAIN SPAN THIS INDICATES THAT THIS SPAN/SIGN PANEL/HEIGHT COMBINATION EXCEEDS THE LIMITS OF THIS STANDARD.

E. ON THE OVERHEAD SIGN X-SECTION SHEET INDICATE THE DIAMETER OF THE PIPE, THE HEIGHT "H" AND THE SPAN.

F. OBTAIN THE DESIGN WIND SPEED FROM THE OVERHEAD SIGN X-SECTION SHEETS IN THE ROADWAY PLANS.

-CANTILEVER SIGN PIPE SELECTION TABLES-

90 MPH WIND

H" (FT.)	10'		12'		14'	
	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30
20	14	14	16	16	16	18
25	16	18	18	18	18	20
30	18	20	20	20	24	24
35	20	24	24	24	24	24
40	24	24				
45						

100 MPH WIND

H" (FT.)	10'		12'		14'	
	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30
20	16	18	16	18	18	18
25	18	18	20	20	20	24
30	20	24	24	24	24	24
35	24	24				
40						
45						

80 MPH WIND

H" (FT.)	10'		12'		14'	
	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30	H ≤ 25	25 < H ≤ 30
20	12.75	14	14	14	14	15
25	14	16	16	18	16	18
30	16	18	18	18	18	20
35	18	20	20	20	24	24
40	20	24	24	24	24	24
45	24	24				

PROCEDURE TO DETERMINE THE DESIGN WIND SPEED

80 MPH IS THE STANDARD DESIGN WIND SPEED FOR THE STATE OF COLORADO. THE STANDARD DESIGN WIND SPEED OF 80 MPH IS TO BE USED AT ALL LOCATIONS EXCEPT THE FOLLOWING:

- USE THE 80 MPH WIND SPEED FOR LOCATIONS WITHIN 4 MILES OF EITHER SIDE OF THE BASE OF THE FOOTHILLS ALONG THE FRONT RANGE OF THE EASTERN SLOPE.
- USE THE 100 MPH WIND SPEED FOR LOCATIONS IN BOULDER COUNTY.

IF THERE ARE QUESTIONS CONCERNING THE PROPER DESIGN WIND SPEED CONTACT THE STAFF BRIDGE BRANCH.

Computer File Information

Creation Date: 07-04-12 Initialed: JRM
 Last Modification Date: 07-04-12 Initialed: JRM
 Full Path: www.coloradoDOT.info/business/designsupport
 Drawing File Name: S-614-50_10d12.dwg
 CAD Ver.: MicroStation V8i Scale: Not to Scale Units: English

Sheet Revisions

Date:	Comments

Colorado Department of Transportation

4201 East Arkansas Avenue
 Denver, Colorado 80222
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Safety & Traffic Engineering Branch KCM/RLO

**STATIC SIGN
MONOTUBE STRUCTURES**

Issued By: Safety and Traffic Engineering Branch on July 4, 2012

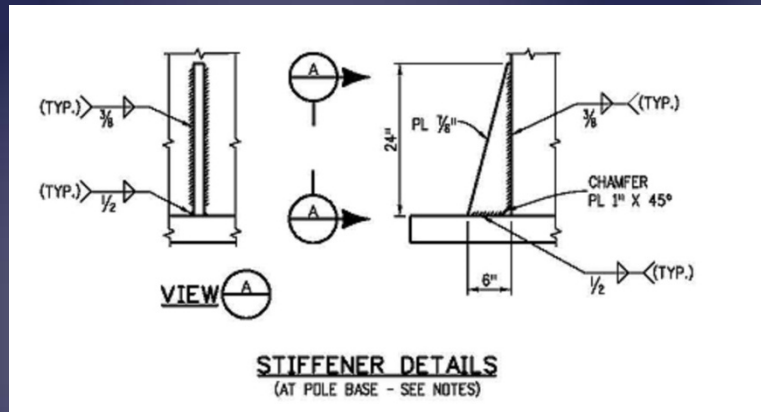
STANDARD PLAN NO.

S-614-50

Sheet No. 10 of 12

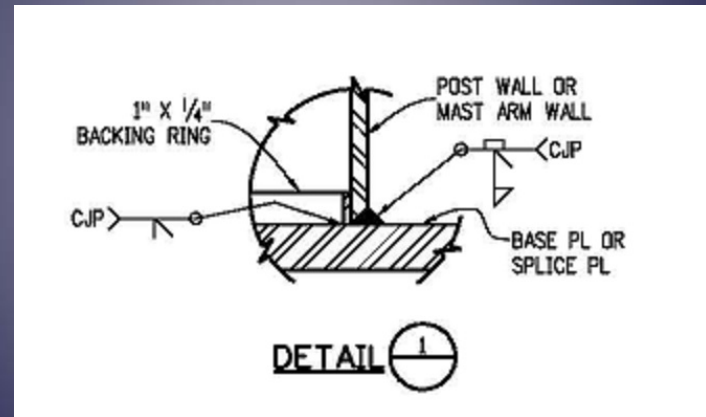
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Stiffeners

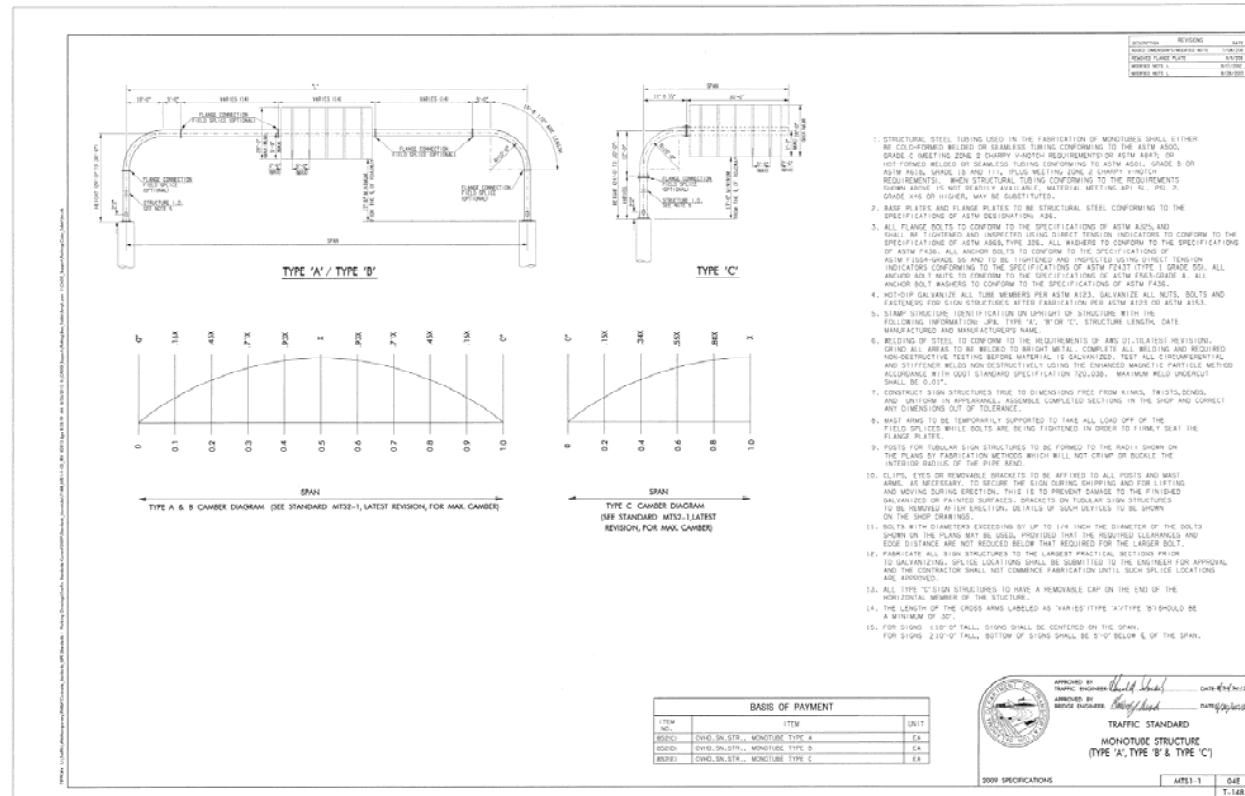


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Full Penn Weld



Colorado Standard



Oklahoma Standard

TYPE 'A' (0.00 SQ FT TO 600.00 SQ FT)									
SPAN	SIGN AREA	UPRIGHT		ARM		MAX CAMBER (%)			
(FT)	(SQ FT)	HEIGHT (FT)	DIAMETER (IN)	THICK. (IN)	DIAMETER (IN)	THICK. (IN)	IN	OUT	END
70.00	600.00	30.00	0.5000	20.00	0.2500	0.6000			
70.00	600.00	24.00	0.3750	20.00	0.2500	0.4000			
75.00	600.00	30.00	0.5000	20.00	0.2500	0.8000			
75.00	600.00	24.00	0.3750	20.00	0.2500	0.7000			
80.00	600.00	30.00	0.5000	20.00	0.2500	1.0000			
80.00	600.00	24.00	0.3750	20.00	0.2500	0.9000			
85.00	600.00	30.00	0.5000	20.00	0.2500	1.2000			
85.00	600.00	24.00	0.3750	20.00	0.2500	1.0000			
90.00	600.00	30.00	0.5000	20.00	0.2500	1.4000			
90.00	600.00	24.00	0.3750	20.00	0.2500	1.3000			
95.00	600.00	30.00	0.3750	24.00	0.2500	1.2000			
95.00	600.00	24.00	0.3750	24.00	0.2500	1.0000			
100.00	600.00	30.00	0.3750	24.00	0.2500	1.6000			
100.00	600.00	24.00	0.3750	24.00	0.2500	1.4000			
105.00	600.00	30.00	0.3750	24.00	0.2500	1.7000			
105.00	600.00	24.00	0.3750	24.00	0.2500	1.6000			
110.00	600.00	30.00	0.3750	24.00	0.2500	1.9000			
110.00	600.00	24.00	0.3750	24.00	0.2500	1.8000			
115.00	600.00	30.00	0.3750	24.00	0.2500	2.0000			
115.00	600.00	24.00	0.3750	24.00	0.2500	2.0000			
120.00	600.00	30.00	0.3750	24.00	0.3750	2.5000			
120.00	600.00	24.00	0.3750	24.00	0.2500	2.4000			
125.00	600.00	30.00	0.3750	24.00	0.3750	2.8000			
125.00	600.00	24.00	0.3750	24.00	0.3750	2.7000			
130.00	600.00	30.00	0.3750	24.00	0.3750	3.2000			
130.00	600.00	24.00	0.3750	24.00	0.3750	3.2000			
135.00	600.00	30.00	0.5000	24.00	0.3750	3.7000			
135.00	600.00	24.00	0.3750	24.00	0.3750	3.7000			
140.00	600.00	30.00	0.5000	24.00	0.3750	4.2000			
140.00	600.00	24.00	0.3750	24.00	0.3750	4.0000			
145.00	600.00	30.00	0.5000	24.00	0.3750	4.7000			
145.00	600.00	24.00	0.3750	24.00	0.3750	4.6000			
150.00	600.00	30.00	0.5000	24.00	0.5000	5.2000			
150.00	600.00	24.00	0.3750	24.00	0.3750	5.0000			

TYPE 'B' (600.00 SQ FT TO 800.00 SQ FT)									
SPAN	SIGN AREA	UPRIGHT		ARM		MAX CAMBER (%)			
(FT)	(SQ FT)	HEIGHT (FT)	DIAMETER (IN)	THICK. (IN)	DIAMETER (IN)	THICK. (IN)	IN	OUT	END
70.00	800.00	30.00	0.5000	24.00	0.2500	0.4000			
70.00	800.00	24.00	0.5000	20.00	0.2500	0.6000			
75.00	800.00	30.00	0.5000	24.00	0.2500	0.6000			
75.00	800.00	24.00	0.5000	20.00	0.2500	0.7000			
80.00	800.00	30.00	0.5000	24.00	0.2500	0.7000			
80.00	800.00	24.00	0.3750	24.00	0.2500	0.7000			
85.00	800.00	30.00	0.5000	24.00	0.2500	0.9000			
85.00	800.00	24.00	0.3750	24.00	0.2500	0.8000			
90.00	800.00	30.00	0.5000	24.00	0.2500	1.0000			
90.00	800.00	24.00	0.3750	24.00	0.2500	1.0000			
95.00	800.00	30.00	0.5000	24.00	0.2500	1.2000			
95.00	800.00	24.00	0.3750	24.00	0.2500	1.0000			
100.00	800.00	30.00	0.5000	24.00	0.3750	1.4000			
100.00	800.00	24.00	0.3750	24.00	0.3750	1.3000			
105.00	800.00	30.00	0.5000	24.00	0.3750	1.7000			
105.00	800.00	24.00	0.3750	24.00	0.3750	1.5000			
110.00	800.00	30.00	0.5000	24.00	0.3750	2.0000			
110.00	800.00	24.00	0.3750	24.00	0.3750	1.8000			
115.00	800.00	30.00	0.5000	24.00	0.3750	2.3000			
115.00	800.00	24.00	0.3750	24.00	0.3750	2.0000			
120.00	800.00	30.00	0.5000	24.00	0.3750	2.6000			
120.00	800.00	24.00	0.3750	24.00	0.3750	2.4000			
125.00	800.00	30.00	0.5000	24.00	0.3750	2.9000			
125.00	800.00	24.00	0.5000	24.00	0.3750	2.8000			
130.00	800.00	30.00	0.5000	24.00	0.5000	3.3000			
130.00	800.00	24.00	0.5000	24.00	0.3750	3.0000			
135.00	800.00	30.00	0.5000	24.00	0.5000	3.8000			
135.00	800.00	24.00	0.5000	24.00	0.5000	3.5000			
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140.00	800.00	24.00	0.5000	24.00	0.5000	4.0000			
145.00	800.00	30.00	0.5000	24.00	0.5000	4.8000			
145.00	800.00	24.00	0.5000	24.00	0.5000	4.5000			
150.00	800.00	30.00	0.5000	30.00	0.3750	5.5000			
150.00	800.00	24.00	0.3750	30.00	0.3750	5.3000			

DESCRIPTION

REVISION

DATE

DYNAMIC MESSAGE SIGNS (DMS) MAY ONLY BE USED ON TYPE 'B' OR 'C'.
MONOTUBE SIGNS: IF DYNAMIC MESSAGE SIGN IS ANTICIPATED, ADD 0.3000" TO MAX CAMBER FOR TYPE 'B' AND 0.3500" TO MAX CAMBER FOR TYPE 'C'.

TYPE 'C' (350.00 SQ FT)									
SPAN	SIGN AREA	UPRIGHT		ARM		MAX CAMBER (%)			
(FT)	(SQ FT)	HEIGHT (FT)	DIAMETER (IN)	THICK. (IN)	DIAMETER (IN)	THICK. (IN)	IN	OUT	END
70.00	350.00	30.00	0.5000	24.00	0.2500	0.4000			
70.00	350.00	24.00	0.3750	24.00	0.2500	0.6000			
75.00	350.00	30.00	0.5000	24.00	0.2500	0.6000			
75.00	350.00	24.00	0.3750	24.00	0.2500	0.7000			
80.00	350.00	30.00	0.5000	24.00	0.2500	0.7000			
80.00	350.00	24.00	0.3750	24.00	0.2500	0.7000			
85.00	350.00	30.00	0.5000	24.00	0.2500	0.9000			
85.00	350.00	24.00	0.3750	24.00	0.2500	0.8000			
90.00	350.00	30.00	0.5000	24.00	0.2500	1.0000			
90.00	350.00	24.00	0.3750	24.00	0.2500	1.0000			
95.00	350.00	30.00	0.5000	24.00	0.2500	1.2000			
95.00	350.00	24.00	0.3750	24.00	0.2500	1.0000			
100.00	350.00	30.00	0.5000	24.00	0.3750	1.4000			
100.00	350.00	24.00	0.3750	24.00	0.3750	1.3000			
105.00	350.00	30.00	0.5000	24.00	0.3750	1.7000			
105.00	350.00	24.00	0.3750	24.00	0.3750	1.5000			
110.00	350.00	30.00	0.5000	24.00	0.3750	2.0000			
110.00	350.00	24.00	0.3750	24.00	0.3750	1.8000			
115.00	350.00	30.00	0.5000	24.00	0.3750	2.3000			
115.00	350.00	24.00	0.3750	24.00	0.3750	2.0000			
120.00	350.00	30.00	0.5000	24.00	0.3750	2.6000			
120.00	350.00	24.00	0.3750	24.00	0.3750	2.4000			
125.00	350.00	30.00	0.5000	24.00	0.3750	2.9000			
125.00	350.00	24.00	0.5000	24.00	0.3750	2.8000			
130.00	350.00	30.00	0.5000	24.00	0.5000	3.3000			
130.00	350.00	24.00	0.5000	24.00	0.3750	3.0000			
135.00	350.00	30.00	0.5000	24.00	0.5000	3.8000			
135.00	350.00	24.00	0.5000	24.00	0.5000	3.5000			
140.00	350.00	30.00	0.5000	24.00	0.5000	4.3000			
140.00	350.00	24.00	0.5000	24.00	0.5000	4.0000			
145.00	350.00	30.00	0.5000	24.00	0.5000	4.8000			
145.00	350.00	24.00	0.5000	24.00	0.5000	4.5000			
150.00	350.00	30.00	0.5000	30.00	0.3750	5.5000			
150.00	350.00	24.00	0.3750	30.00	0.3750	5.3000			

APPROVED BY

TRAFFIC ENGINEER

DATE

DESIGNED BY

DESIGNER

DATE

TRAFFIC STANDARD

MONOTUBE STRUCTURE

(TYPE 'A', TYPE 'B' & TYPE 'C')

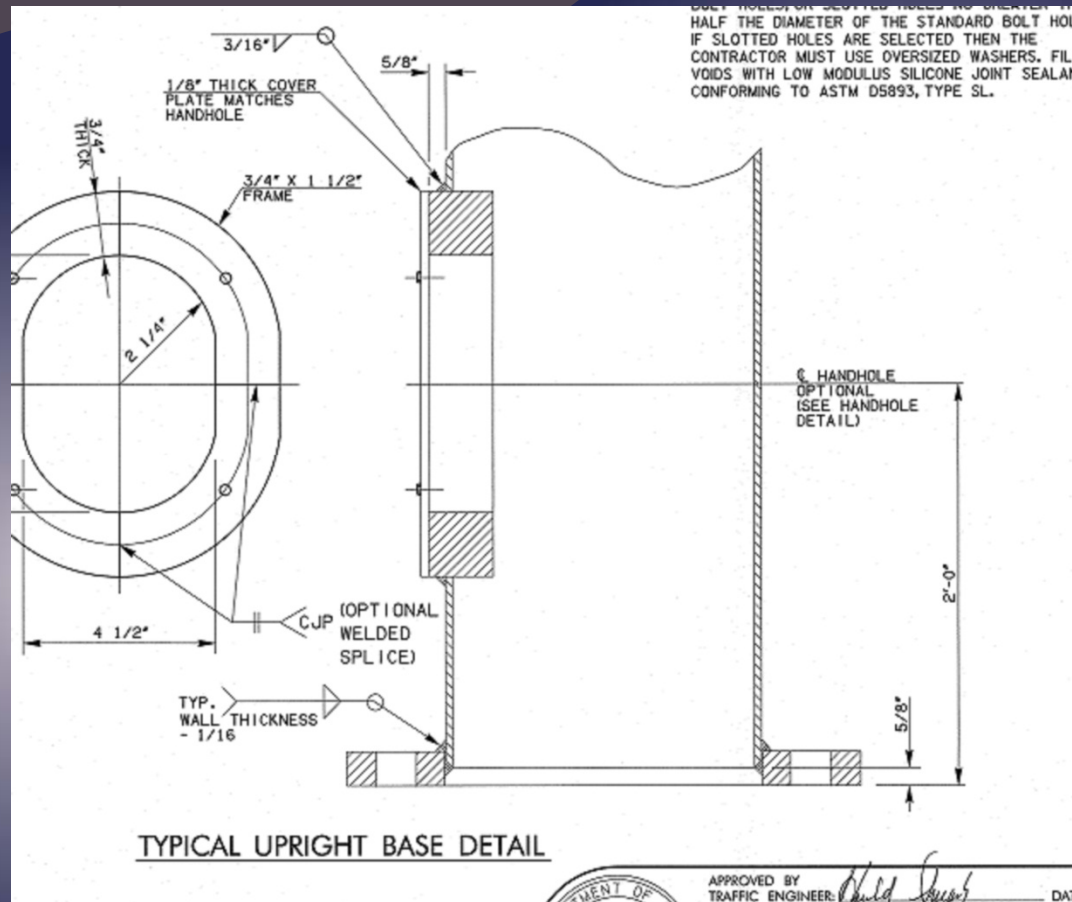
2009 SPECIFICATIONS

ARTICLE 1

005

1-149

Oklahoma Standard



Oklahoma Standard



Port of Entry Monotube



POE Monotube Cracks



POE Monotube Cracks



POE Monotube Cracks



Western Investigation



Western Monotube Crack



Western Monotube Crack



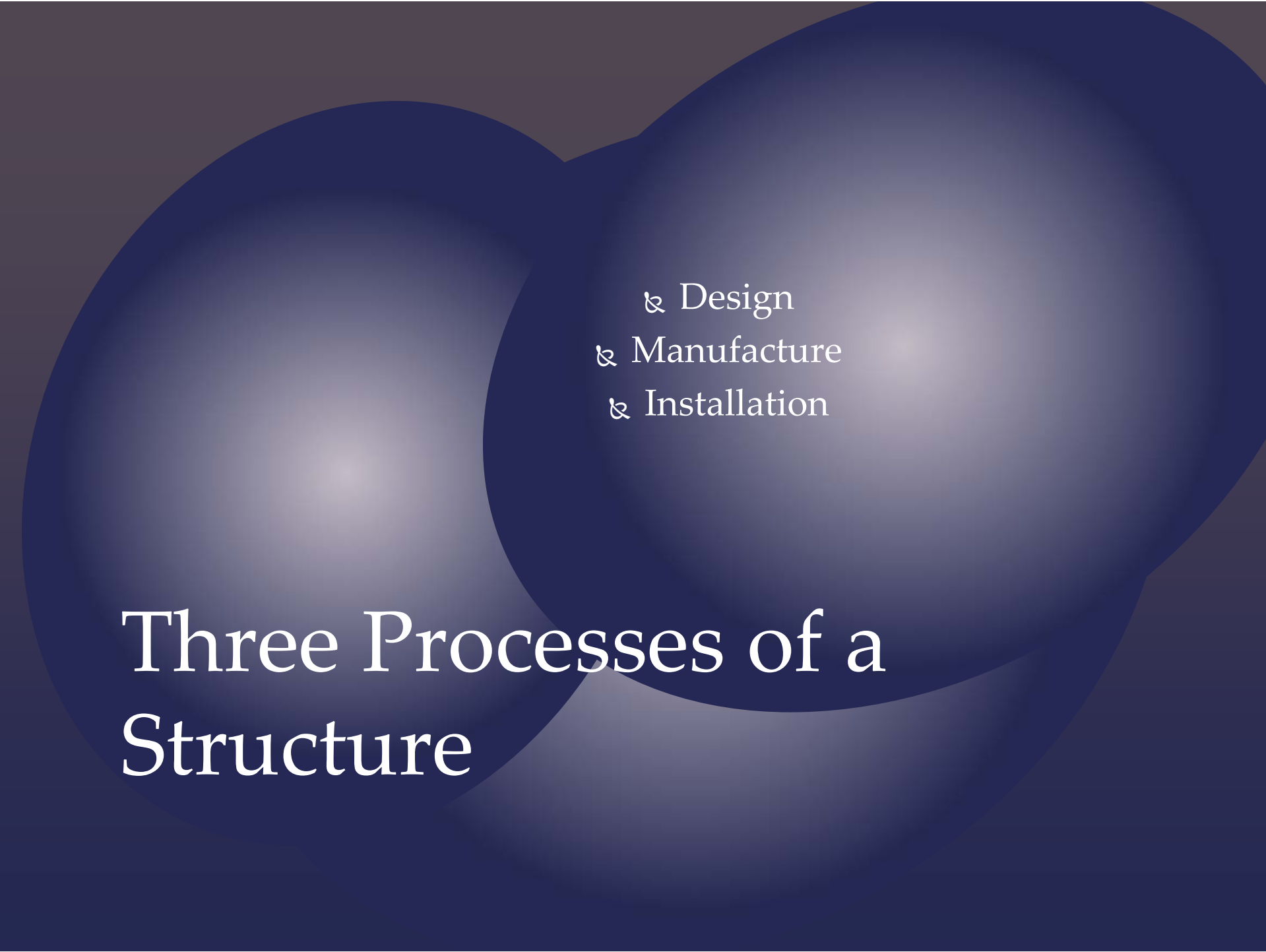
Western Monotube Crack



Western Monotube Crack

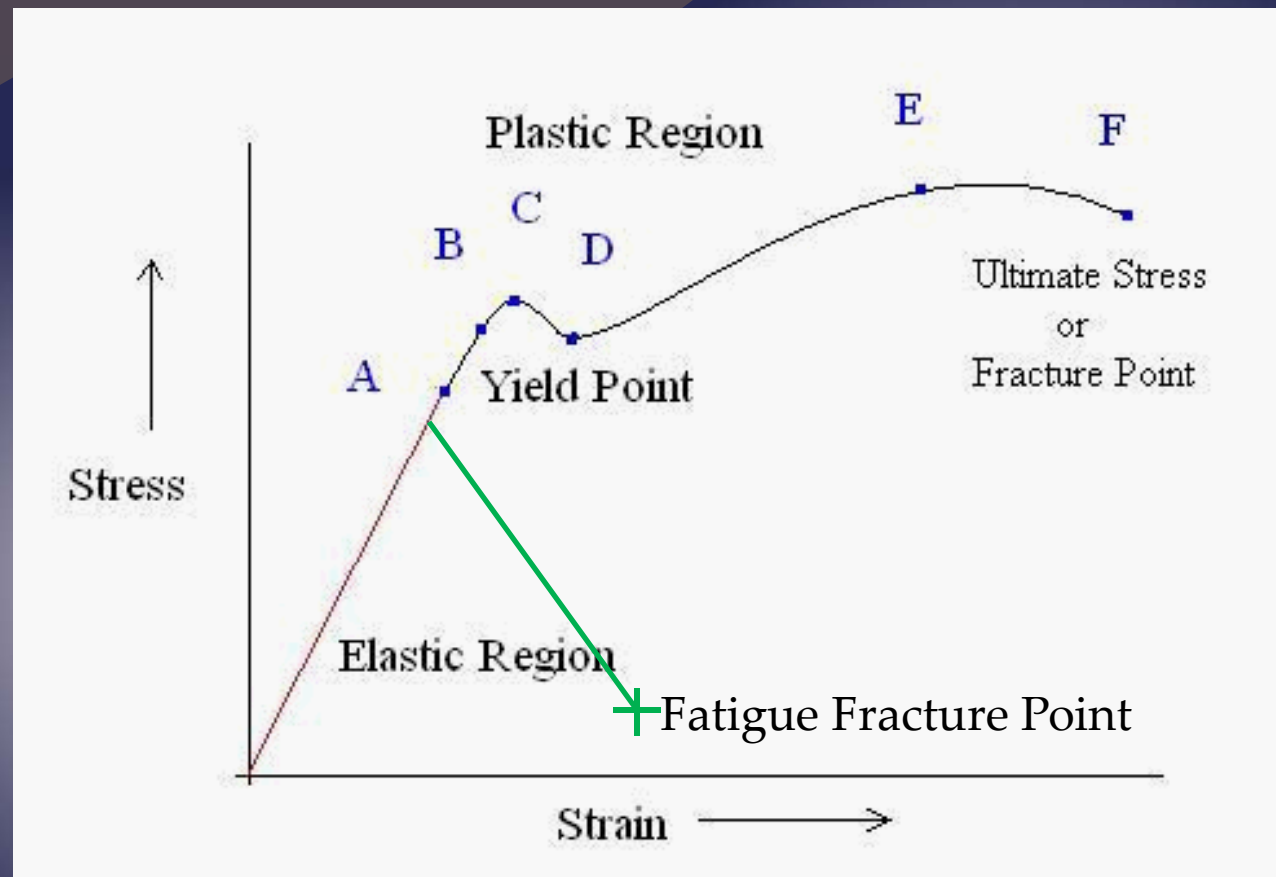


Western Monotube Crack



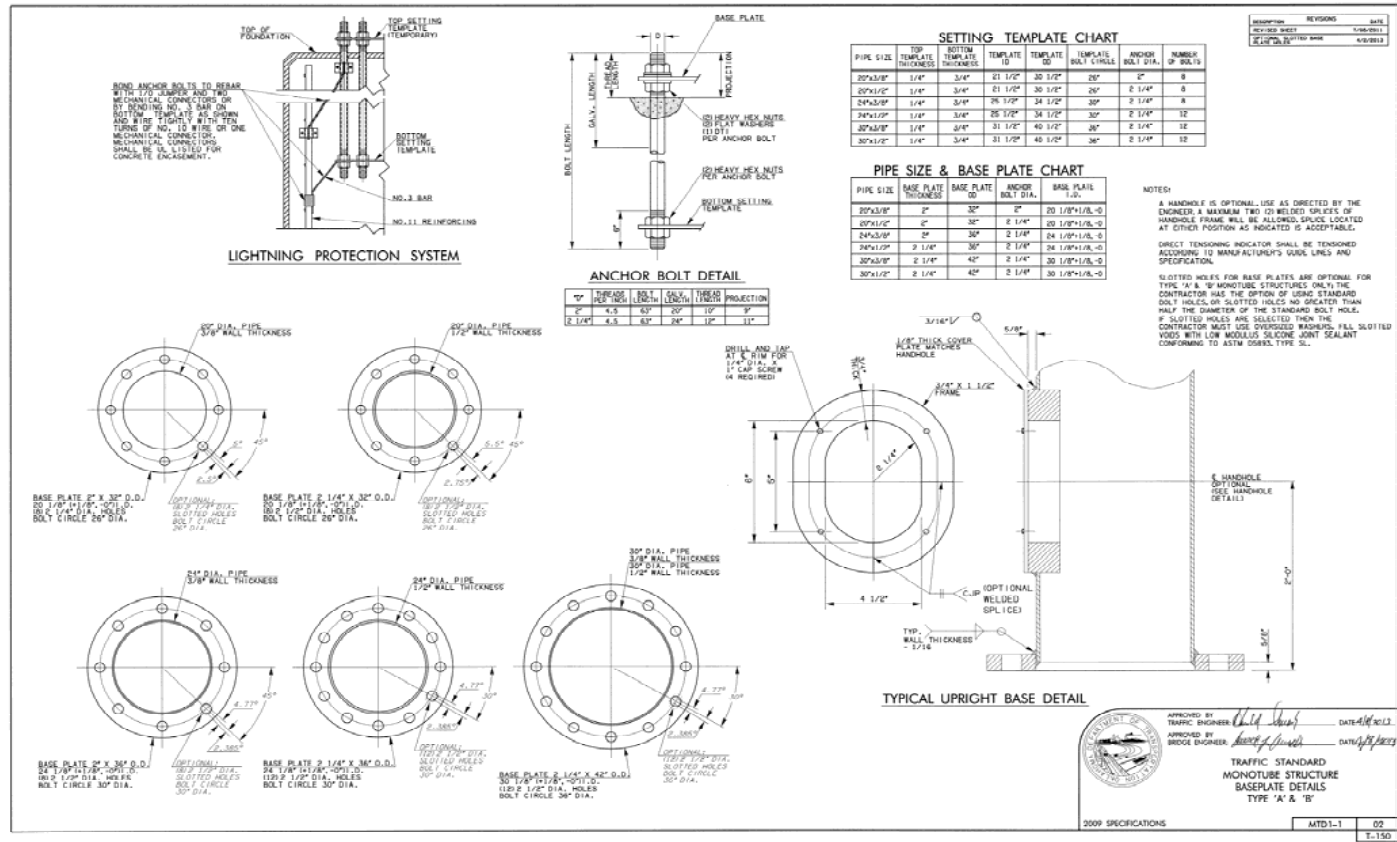
& Design
& Manufacture
& Installation

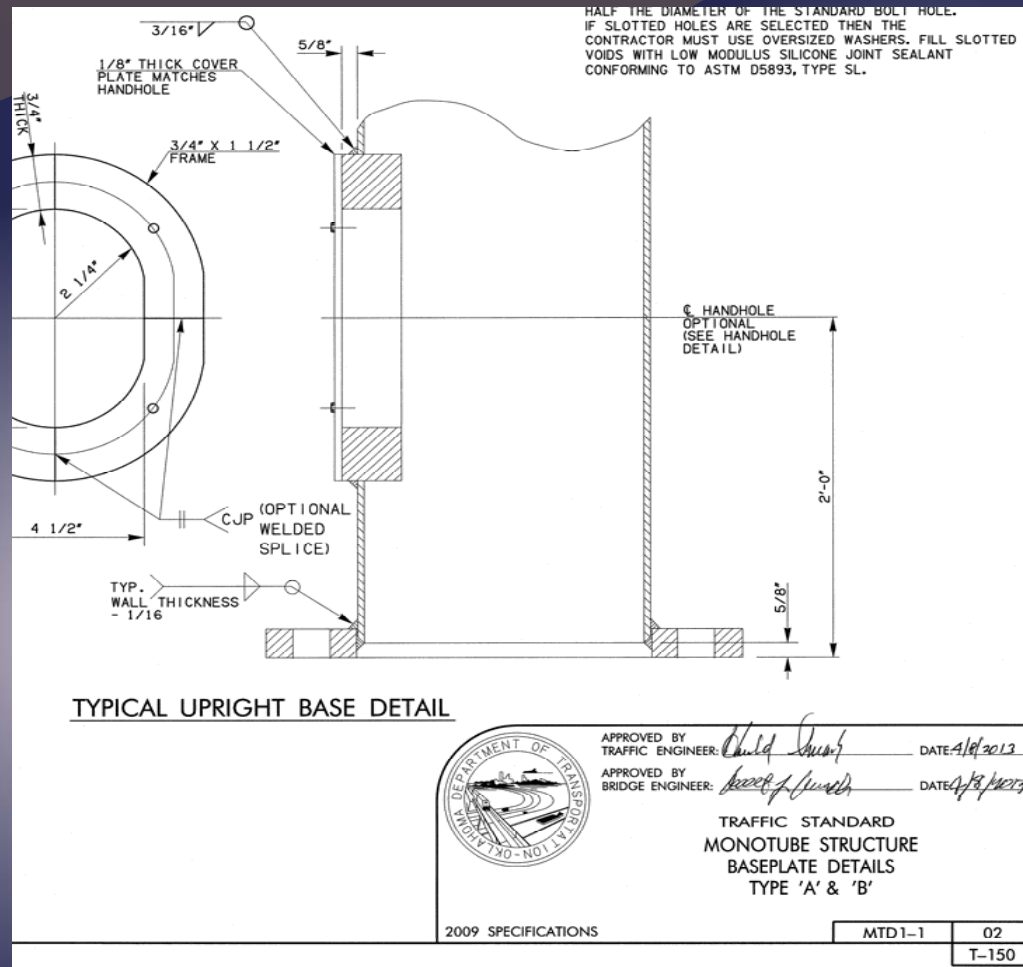
Three Processes of a Structure



Design - Fatigue

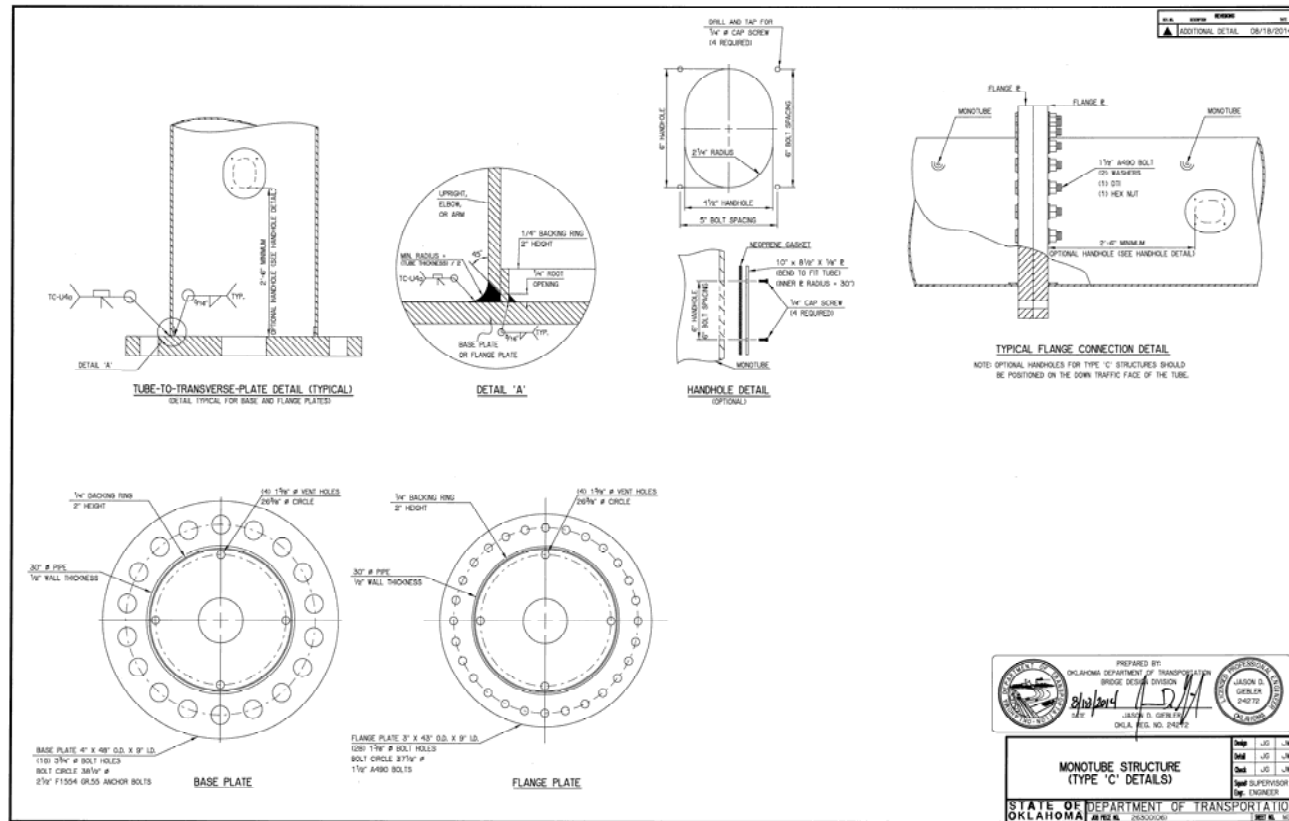
Design

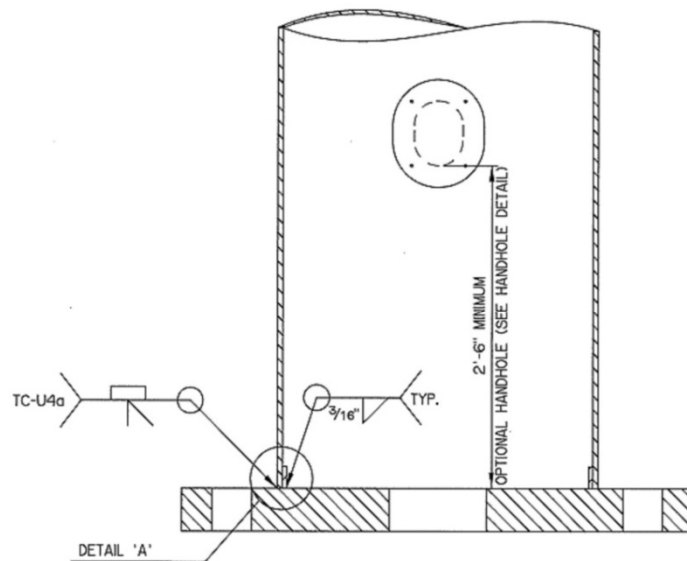




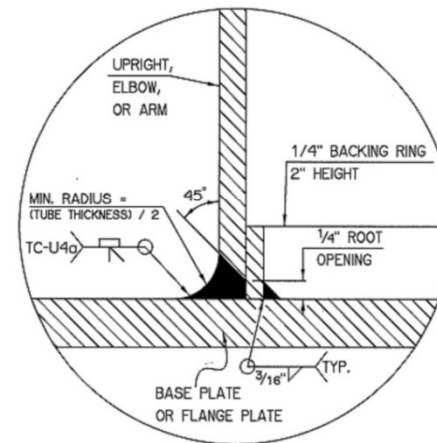
Design

Design





TUBE-TO-TRANSVERSE-PLATE DETAIL (TYPICAL)
(DETAIL TYPICAL FOR BASE AND FLANGE PLATES)



DETAIL 'A'

Design

- ⌘ Pre-qualification for manufactures
- ⌘ More restrictive specification
- ⌘ More Testing on structures prior to installation

Manufacture



Installation



Installation



Installation



Installation



Installation



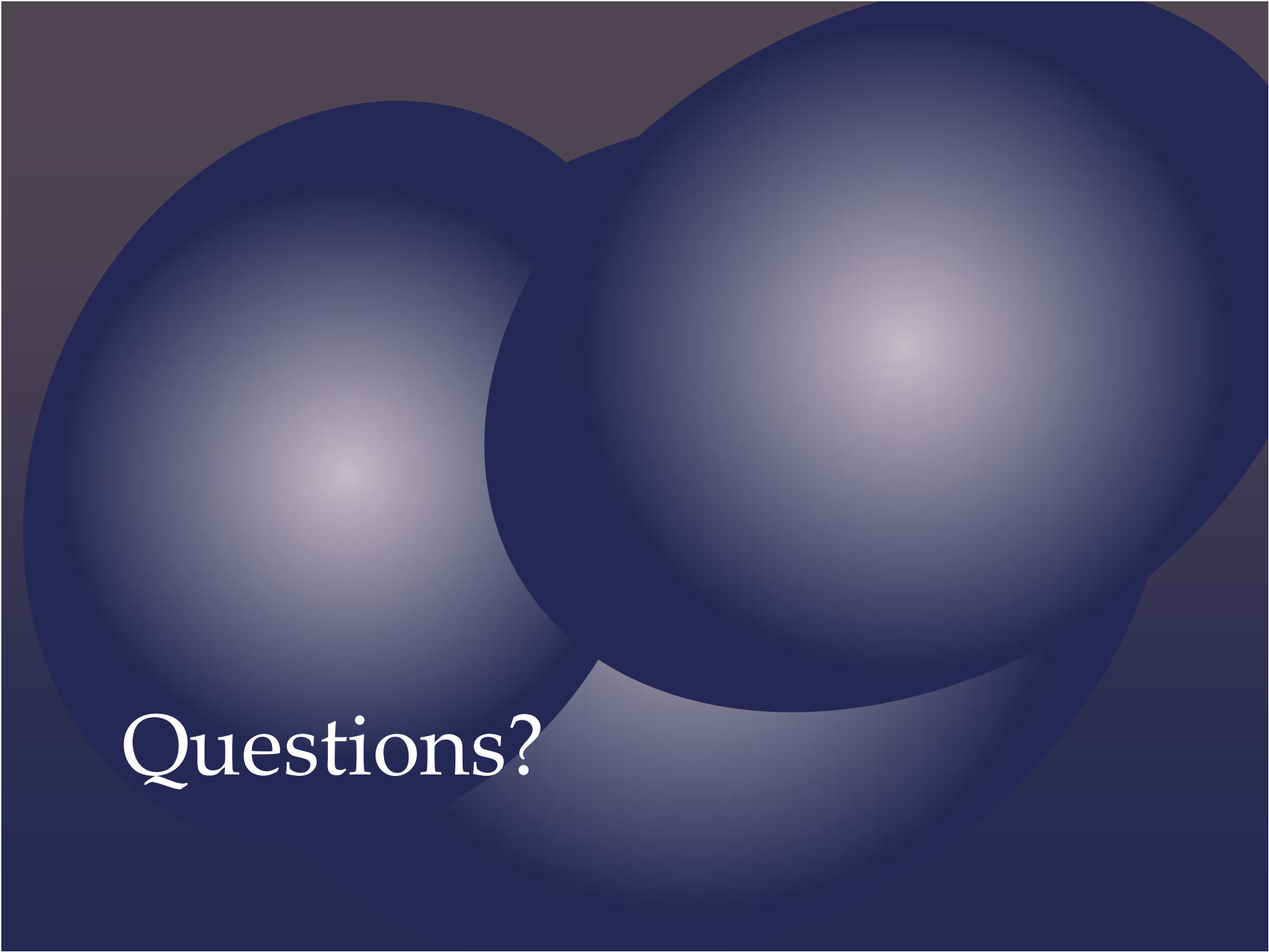
Installation



Installation



Installation

The background is a solid dark blue. Two large, overlapping circles of a slightly lighter shade of dark blue are positioned in the upper half of the frame. The circles overlap in the center, creating a darker blue intersection. The word "Questions?" is written in a white, serif font in the lower-left quadrant of the image.

Questions?