 GLENMARTIN GLENMARTIN 13620 Old Hwy 40 Boonville, MO 65233 Phone: (800) 486-1223 FAX: (660) 882-7200	Job Site Name: Parkland Sanitary Force Main	Page 1 of 14
	Project SO#:21570 Douglas County Wisconsin	Date 08:03:27 10/12/10
	Client TWIN CITIES INDUSTRIAL CONTROL	Designed by cjmartin

SITE NAME: Parkland Sanitary Force Main

SITE #:

SALES ORDER: 21570

SITE ADDRESS: Parkland

Purchaser: Twin City Industrial Control

Project Contact: Tom Loeser

Contact Address:

13005 16th Ave N, Suite 500

Plymouth MN

tom@tcicinc.com

763-557-6648

All documents and details prepared in accordance with applicable EIA/TIA-222G under the direct supervision of a registered professional engineer under the laws of the state of Wisconsin, Enclosed calculations are certified and meet all specified purchaser requirements.

DESIGN ENGINEER: Kyle McQuinn

CERTIFIED BY:




DATE : 10/12/2010

DATE REVIEWED:

REVIEWED

By Christopher J. Martin, P.E. at 11:38 am, Oct 12, 2010

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Tower Input Data

The main tower is a 3x free standing tower with an overall height of 100.00 ft above the ground line.

The base of the tower is set at an elevation of 0.00 ft above the ground line.

The face width of the tower is 2.50 ft at the top and 8.00 ft at the base.

This tower is designed using the TIA-222-G standard.

The following design criteria apply:

Basic wind speed of 110 mph.

Structure Class II.

Exposure Category C.

Topographic Category 1.

Crest Height 0.00 ft.

Nominal ice thickness of 0.5000 in.

Ice thickness is considered to increase with height.

Ice density of 56 pcf.

A wind speed of 50 mph is used in combination with ice.

Temperature drop of 50 °F.

Deflections calculated using a wind speed of 60 mph.

Locking washers provided for all brace bolted connections. Connection bolts meet A325X structural joint specification. All X-braces are center bolted..

All members hot dipped galvanized after fabrication per ASTM A123. Hardware (Bolts, Nuts, Etc.) galvanized per ASTM B695 Class 50 (Mechanical)..

All welded joints and connections welded in accordance per AWS D1:1:2008 and specified GlenMartin Weld Procedures (WP)..

Standard base riser located at each leg footing shall be provided in accordance with GlenMartin design requirements..

A non-linear (P-delta) analysis was used.

Pressures are calculated at each section.

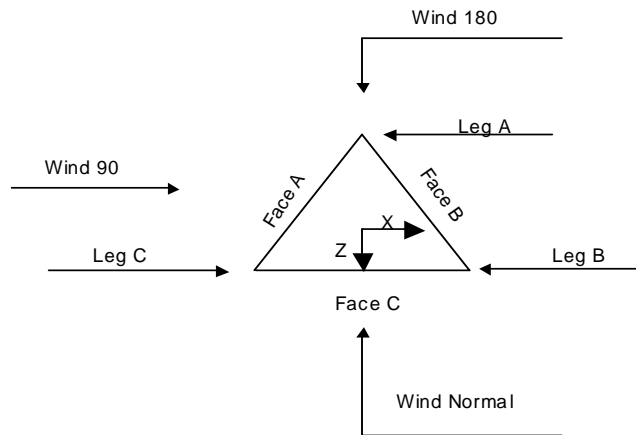
Stress ratio used in tower member design is 1.

Local bending stresses due to climbing loads, feedline supports, and appurtenance mounts are not considered.



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Triangular Tower

Tower Section Geometry

Tower Section	Tower Elevation	Assembly Database	Description	Section Width	Number of Sections	Section Length
	<i>ft</i>			<i>ft</i>		<i>ft</i>
T1	100.00-90.00			2.50	1	10.00
T2	90.00-80.00			2.50	1	10.00
T3	80.00-60.32			2.50	1	19.68
T4	60.32-40.64			3.75	1	19.68
T5	40.64-20.96			5.00	1	19.68
T6	20.96-1.28			6.75	1	19.68
T7	1.28-0.00			8.00	1	1.28

Tower Section Geometry (cont'd)

Tower Section	Tower Elevation	Diagonal Spacing	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset	Bottom Girt Offset
	<i>ft</i>	<i>ft</i>				<i>in</i>	<i>in</i>
T1	100.00-90.00	3.33	X Brace	No	No	0.0000	0.0000
T2	90.00-80.00	3.33	X Brace	No	No	0.0000	0.0000
T3	80.00-60.32	4.92	X Brace	No	No	0.0000	0.0000
T4	60.32-40.64	4.92	X Brace	No	No	0.0000	0.0000
T5	40.64-20.96	4.92	X Brace	No	No	0.0000	0.0000
T6	20.96-1.28	4.92	X Brace	No	Yes	0.0000	0.0000
T7	1.28-0.00	1.28	X Brace	No	Yes	0.0000	0.0000



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Tower Section Geometry (cont'd)

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 100.00-90.00	Pipe	P2.5x.203	A500-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T2 90.00-80.00	Pipe	P2.5x.203	A500-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T3 80.00-60.32	Pipe	P2.5x.203	A500-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T4 60.32-40.64	Pipe	P2.5x.203	A500-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T5 40.64-20.96	Pipe	P3x.216	A500-50 (50 ksi)	Single Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)
T6 20.96-1.28	Pipe	P3.5x.226	A500-50 (50 ksi)	Single Angle	L1 3/4x1 3/4x3/16	A36 (36 ksi)
T7 1.28-0.00	Pipe	P4x.337	A500-50 (50 ksi)	Single Angle		A36 (36 ksi)

Tower Section Geometry (cont'd)

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 100.00-90.00	Equal Angle	L1 1/2x1 1/2x3/16	A36 (36 ksi)	Single Angle		A36M-50 (50 ksi)

Tower Section Geometry (cont'd)

Tower Elevation ft	Gusset Area (per face) ft ²	Gusset Thickness in	Gusset Grade	Adjust. Factor A _f	Adjust. Factor A _r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontal in
T1 100.00-90.00	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T2 90.00-80.00	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T3 80.00-60.32	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T4 60.32-40.64	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T5 40.64-20.96	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T6 20.96-1.28	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000
T7 1.28-0.00	3.00	0.0000	A36 (36 ksi)	1	1	1	36.0000	36.0000



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Tower Section Geometry (cont'd)

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	Legs	K Factors ¹							
				X Brace Diags	K Brace Diags	Single Diags	Girts	Horiz.	Sec. Horiz.	Inner Brace	
				X Y	X Y	X Y	X Y	X Y	X Y	X Y	
T1 100.00-90.00	Yes	No	1	1	1	1	1	1	1	1	1
T2 90.00-80.00	Yes	No	1	1	1	1	1	1	1	1	1
T3 80.00-60.32	Yes	No	1	1	1	1	1	1	1	1	1
T4 60.32-40.64	Yes	No	1	1	1	1	1	1	1	1	1
T5 40.64-20.96	Yes	No	1	1	1	1	1	1	1	1	1
T6 20.96-1.28	Yes	No	1	1	1	1	1	1	1	1	1
T7 1.28-0.00	Yes	No	1	1	1	1	1	1	1	1	1

¹Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.

Tower Section Geometry (cont'd)

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T1 100.00-90.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T2 90.00-80.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T3 80.00-60.32	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T4 60.32-40.64	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T5 40.64-20.96	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T6 20.96-1.28	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75
T7 1.28-0.00	0.0000	1	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75	0.0000	0.75

Tower Section Geometry (cont'd)



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Tower Elevation	Connection Offsets							
	Diagonal				K-Bracing			
	Vert. Top	Horiz. Top	Vert. Bot.	Horiz. Bot.	Vert. Top	Horiz. Top	Vert. Bot.	Horiz. Bot.
ft	in	in	in	in	in	in	in	in
T1 100.00-90.00	2.7500	3.8250	2.7500	3.8250	0.0000	0.0000	0.0000	0.0000
T2 90.00-80.00	2.7500	4.0625	2.7500	4.0625	0.0000	0.0000	0.0000	0.0000
T3 80.00-60.32	2.7500	4.3125	2.7500	4.3125	0.0000	0.0000	0.0000	0.0000
T4 60.32-40.64	2.7500	4.6250	2.7500	4.6250	0.0000	0.0000	0.0000	0.0000
T5 40.64-20.96	3.3750	5.8750	3.3750	5.8750	0.0000	0.0000	0.0000	0.0000
T6 20.96-1.28	3.3750	5.8750	3.3750	5.8750	0.0000	0.0000	0.0000	0.0000
T7 1.28-0.00	3.3750	5.8750	3.3750	5.8750	0.0000	0.0000	0.0000	0.0000

Tower Section Geometry (cont'd)

Tower Elevation ft	Leg Connection Type	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
		Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.
T1 100.00-90.00	Flange	0.7500 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T2 90.00-80.00	Flange	0.7500 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T3 80.00-60.32	Flange	0.7500 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T4 60.32-40.64	Flange	0.7500 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T5 40.64-20.96	Flange	1.0000 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T6 20.96-1.28	Flange	1.0000 A325X	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0
T7 1.28-0.00	Flange	1.5000 A572-55	4	0.6250 A325X	1	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0	0.6250 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Component Type	Placement ft	Face Offset in	Lateral Offset (Frac FW)	#	# Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight plf
Feedline Ladder (Af)	A	No	Af (CaAa)	99.40 - 5.00	0.5000	0	1	1	3.0000	3.0000		8.40
Climbing Ladder	C	No	Af (CaAa)	99.40 - 5.00	0.5000	0	1	1	0.2500	0.5000		7.90
7/8	A	No	Ar (CaAa)	99.40 - 5.00	1.0000	0	4	4	1.1400 1.1100	1.1100		0.54
7/8	A	No	Ar (CaAa)	94.00 - 5.00	1.0000	0	2	2	1.1400 1.1100	1.1100		0.54
7/8	A	No	Ar (CaAa)	88.00 - 5.00	1.0000	0	3	3	1.1400 1.1100	1.1100		0.54



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Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft ²	A_F ft ²	C_{AA} In Face ft ²	C_{AA} Out Face ft ²	Weight lb
T1	100.00-90.00	A	0.000	0.000	9.379	0.000	103.58
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.783	0.000	74.26
T2	90.00-80.00	A	0.000	0.000	18.000	0.000	129.36
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.833	0.000	79.00
T3	80.00-60.32	A	0.000	0.000	38.184	0.000	260.96
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	1.640	0.000	155.47
T4	60.32-40.64	A	0.000	0.000	38.184	0.000	260.96
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	1.640	0.000	155.47
T5	40.64-20.96	A	0.000	0.000	38.184	0.000	260.96
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	1.640	0.000	155.47
T6	20.96-1.28	A	0.000	0.000	30.966	0.000	211.63
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	1.330	0.000	126.08
T7	1.28-0.00	A	0.000	0.000	0.000	0.000	0.00
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	0.000	0.000	0.00

Feed Line/Linear Appurtenances Section Areas - With Ice

Tower Section	Tower Elevation ft	Face or Leg	Ice Thickness in	A_R ft ²	A_F ft ²	C_{AA} In Face ft ²	C_{AA} Out Face ft ²	Weight lb
T1	100.00-90.00	A	1.112	0.000	0.000	21.407	0.000	291.66
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	2.873	0.000	111.67
T2	90.00-80.00	A	1.099	0.000	0.000	34.490	0.000	422.56
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	3.032	0.000	118.16
T3	80.00-60.32	A	1.078	0.000	0.000	71.281	0.000	856.97
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	5.884	0.000	230.42
T4	60.32-40.64	A	1.043	0.000	0.000	70.549	0.000	836.26
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	5.747	0.000	226.94
T5	40.64-20.96	A	0.993	0.000	0.000	69.496	0.000	806.86
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	5.549	0.000	222.05
T6	20.96-1.28	A	0.897	0.000	0.000	54.728	0.000	609.91
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	4.193	0.000	172.82
T7	1.28-0.00	A	0.674	0.000	0.000	0.000	0.000	0.00
		B		0.000	0.000	0.000	0.000	0.00
		C		0.000	0.000	0.000	0.000	0.00

Feed Line Center of Pressure



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Section	Elevation	CP _x	CP _z	CP _x	CP _z
	ft	in	in	Ice	Ice
				in	in
T1	100.00-90.00	-0.8782	-0.4278	-0.9528	-0.2416
T2	90.00-80.00	-1.0962	-0.5608	-1.0316	-0.3266
T3	80.00-60.32	-1.4741	-0.7580	-1.3016	-0.4791
T4	60.32-40.64	-1.9537	-1.0041	-1.7204	-0.6610
T5	40.64-20.96	-2.3992	-1.2326	-2.1838	-0.8498
T6	20.96-1.28	-2.3990	-1.2322	-2.3410	-0.9355
T7	1.28-0.00	0.0000	0.0000	0.0000	0.0000

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K _a No Ice	K _a Ice
T1	1	Feedline Ladder (Af)	90.00 - 99.40	0.6000	0.3430
T1	2	Climbing Ladder	90.00 - 99.40	0.6000	0.3430
T1	3	7/8	90.00 - 99.40	0.6000	0.3430
T1	4	7/8	90.00 - 94.00	0.6000	0.3430
T2	1	Feedline Ladder (Af)	80.00 - 90.00	0.6000	0.3710
T2	2	Climbing Ladder	80.00 - 90.00	0.6000	0.3710
T2	3	7/8	80.00 - 90.00	0.6000	0.3710
T2	4	7/8	80.00 - 90.00	0.6000	0.3710
T2	5	7/8	80.00 - 88.00	0.6000	0.3710
T3	1	Feedline Ladder (Af)	60.32 - 80.00	0.6000	0.5338
T3	2	Climbing Ladder	60.32 - 80.00	0.6000	0.5338
T3	3	7/8	60.32 - 80.00	0.6000	0.5338
T3	4	7/8	60.32 - 80.00	0.6000	0.5338
T3	5	7/8	60.32 - 80.00	0.6000	0.5338
T4	1	Feedline Ladder (Af)	40.64 - 60.32	0.6000	0.6000
T4	2	Climbing Ladder	40.64 - 60.32	0.6000	0.6000
T4	3	7/8	40.64 - 60.32	0.6000	0.6000
T4	4	7/8	40.64 - 60.32	0.6000	0.6000
T4	5	7/8	40.64 - 60.32	0.6000	0.6000
T5	1	Feedline Ladder (Af)	20.96 - 40.64	0.6000	0.6000
T5	2	Climbing Ladder	20.96 - 40.64	0.6000	0.6000
T5	3	7/8	20.96 - 40.64	0.6000	0.6000
T5	4	7/8	20.96 - 40.64	0.6000	0.6000
T5	5	7/8	20.96 - 40.64	0.6000	0.6000
T6	1	Feedline Ladder (Af)	5.00 - 20.96	0.6000	0.6000
T6	2	Climbing Ladder	5.00 - 20.96	0.6000	0.6000
T6	3	7/8	5.00 - 20.96	0.6000	0.6000
T6	4	7/8	5.00 - 20.96	0.6000	0.6000
T6	5	7/8	5.00 - 20.96	0.6000	0.6000

Discrete Tower Loads



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Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert	Azimuth Adjustment	Placement	C _{AA} Front	C _{AA} Side	Weight	
			ft ft ft	°	ft	ft ²	ft ²	lb	
BM-0303	A	From Leg	1.50 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
SCADA ANTENNAS	A	From Leg	3.00 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.30 0.39	0.31 0.40	2.50 5.38

BM-0303	B	From Leg	1.50 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
SCADA ANTENNAS	B	From Leg	3.00 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.30 0.39	0.31 0.40	2.50 5.38
BM-0303	C	From Leg	1.50 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
SCADA ANTENNAS	C	From Leg	3.00 0.00 0.00	0.0000	99.00 - 95.00	No Ice 1/2" Ice	0.30 0.39	0.31 0.40	2.50 5.38

BM-0303	C	From Leg	1.50 0.00 0.00	0.0000	92.00 - 90.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
SCADA ANTENNAS	C	From Leg	3.00 0.00 0.00	0.0000	92.00 - 90.00	No Ice 1/2" Ice	0.30 0.39	0.31 0.40	2.50 5.38
BM-0303	B	From Leg	1.50 0.00 0.00	0.0000	92.00 - 90.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
SCADA ANTENNAS	B	From Leg	3.00 0.00 0.00	0.0000	92.00 - 90.00	No Ice 1/2" Ice	0.30 0.39	0.31 0.40	2.50 5.38

BM-0303	A	From Leg	1.50 0.00 0.00	0.0000	88.00 - 86.00	No Ice 1/2" Ice	0.58 0.81	3.25 4.55	120.00 170.00
5200AP	A	From Leg	3.00 0.00 0.00	0.0000	88.00 - 86.00	No Ice 1/2" Ice	0.39 0.49	0.39 0.49	1.00 4.60
Flash Beacon Lighting	C	None		0.0000	100.00	No Ice 1/2" Ice	2.70 3.10	2.70 3.10	50.00 70.00

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load lb	Ratio Load Allowable	Allowable Ratio	Criteria
T1	100	Leg	A325X	0.7500	4	52.39	29820.60	0.002	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	861.52	9787.50	0.088	✓	1 Member Bearing



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Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt lb	Allowable Load lb	Ratio Load / Allowable	Allowable Ratio	Criteria
T2	90	Leg	A325X	0.7500	4	1371.33	29820.60	0.046	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	1468.52	9787.50	0.150	✓	1 Member Bearing
T3	80	Leg	A325X	0.7500	4	4290.62	29820.60	0.144	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	1649.73	9787.50	0.169	✓	1 Member Bearing
T4	60.32	Leg	A325X	0.7500	4	9647.36	29820.60	0.324	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	1932.08	11092.50	0.174	✓	1 Member Bearing
T5	40.64	Leg	A325X	1.0000	4	14732.90	53014.40	0.278	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	1649.86	11092.50	0.149	✓	1 Member Bearing
T6	20.96	Leg	A325X	1.0000	4	18712.50	53014.40	0.353	✓	1 Bolt Tension
		Diagonal	A325X	0.6250	1	4888.46	11092.50	0.441	✓	1 Member Bearing
T7	1.28	Leg	A572-55	1.5000	4	23782.10	69581.40	0.342	✓	1 Bolt Tension

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L _u ft	Kl/r	A in ²	P _u lb	φP _n lb	Ratio P _u / φP _n
T1	100 - 90	P2.5x.203	10.00	3.33	42.2 K=1.00	1.7040	-3672.76	67311.90	0.055 ¹
T2	90 - 80	P2.5x.203	10.00	3.33	42.2 K=1.00	1.7040	-13833.00	67311.90	0.206 ¹
T3	80 - 60.32	P2.5x.203	19.69	4.92	62.4 K=1.00	1.7040	-34705.20	57705.10	0.601 ¹
T4	60.32 - 40.64	P2.5x.203	19.69	4.92	62.4 K=1.00	1.7040	-56422.70	57705.10	0.978 ¹
T5	40.64 - 20.96	P3x.216	19.71	4.93	50.8 K=1.00	2.2285	-73593.30	83032.90	0.886 ¹
T6	20.96 - 1.28	P3.5x.226	19.69	4.92	44.2 K=1.00	2.6795	-96095.30	104530.00	0.919 ¹
T7	1.28 - 0	P4x.337	1.28	1.28	10.4 K=1.00	4.4074	-99054.50	196772.00	0.503

¹ P_u / φP_n controls

Leg Bending Design Data (Compression)

Section No.	Elevation ft	Size	M _{ux} lb-ft	φM _{ux} lb-ft	Ratio M _{ux} / φM _{ux}	M _{uy} lb-ft	φM _{uy} lb-ft	Ratio M _{uy} / φM _{uy}
T1	100 - 90	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000



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Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{ux} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{ux}}$	M_{uy} lb-ft	ϕM_{uy} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{uy}}$
T2	90 - 80	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T3	80 - 60.32	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T4	60.32 - 40.64	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T5	40.64 - 20.96	P3x.216	0.00	8748.17	0.000	0.00	8748.17	0.000
T6	20.96 - 1.28	P3.5x.226	0.00	12085.42	0.000	0.00	12085.42	0.000
T7	1.28 - 0	P4x.337	8736.58	16017.50	0.545	0.00	16017.50	0.000

Leg Interaction Design Data (Compression)

Section No.	Elevation ft	Size	Ratio $\frac{P_u}{\phi P_n}$	Ratio $\frac{M_{ux}}{\phi M_{ux}}$	Ratio $\frac{M_{uy}}{\phi M_{uy}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
T1	100 - 90	P2.5x.203	0.055	0.000	0.000	0.055 ¹	1.000	4.9-4 ✓
T2	90 - 80	P2.5x.203	0.206	0.000	0.000	0.206 ¹	1.000	4.9-3 ✓
T3	80 - 60.32	P2.5x.203	0.601	0.000	0.000	0.601 ¹	1.000	4.9-3 ✓
T4	60.32 - 40.64	P2.5x.203	0.978	0.000	0.000	0.978 ¹	1.000	4.9-3 ✓
T5	40.64 - 20.96	P3x.216	0.886	0.000	0.000	0.886 ¹	1.000	4.9-3 ✓
T6	20.96 - 1.28	P3.5x.226	0.919	0.000	0.000	0.919 ¹	1.000	4.9-3 ✓
T7	1.28 - 0	P4x.337	0.503	0.545	0.000	0.932	1.000	4.9-3 ✓

¹ $P_u / \phi P_n$ controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in ²	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	100 - 90	L1 1/2x1 1/2x3/16	3.43	1.58	78.4 K=1.21	0.5273	-733.09	12363.20	0.059 ¹
T2	90 - 80	L1 1/2x1 1/2x3/16	3.40	1.57	78.1 K=1.22	0.5273	-1550.94	12396.60	0.125 ¹
T3	80 - 60.32	L1 1/2x1 1/2x3/16	5.31	2.63	110.8 K=1.03	0.5273	-1744.57	8950.93	0.195 ¹
T4	60.32 - 40.64	L1 1/2x1 1/2x3/16	6.04	2.97	121.6 K=1.00	0.5273	-2076.10	7845.19	0.265 ¹
T5	40.64 - 20.96	L1 1/2x1 1/2x3/16	7.06	3.50	143.2 K=1.00	0.5273	-1657.60	5805.78	0.286 ¹
T6	20.96 - 1.28	L1 3/4x1 3/4x3/16	8.13	4.00	139.8 K=1.00	0.6211	-4158.37	7180.71	0.579 ¹



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¹ $P_u / \phi P_n$ controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	100 - 90	L1 1/2x1 1/2x3/16	2.50	2.26	106.2 K=1.15	0.5273	-113.15	9432.29	0.012 ¹ ✓

¹ $P_u / \phi P_n$ controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u lb	ϕP_n lb	Ratio $\frac{P_u}{\phi P_n}$
T1	100 - 90	P2.5x.203	10.00	3.33	42.2	1.7040	2755.62	76682.30	0.036 ¹
T2	90 - 80	P2.5x.203	10.00	3.33	42.2	1.7040	12919.30	76682.30	0.168 ¹
T3	80 - 60.32	P2.5x.203	19.69	4.92	62.4	1.7040	33201.30	76682.30	0.433 ¹
T4	60.32 - 40.64	P2.5x.203	19.69	4.92	62.4	1.7040	54301.40	76682.30	0.708 ¹
T5	40.64 - 20.96	P3x.216	19.71	4.93	50.8	2.2285	70523.00	100281.00	0.703 ¹
T6	20.96 - 1.28	P3.5x.226	19.69	4.92	44.2	2.6795	91342.30	120579.00	0.758 ¹
T7	1.28 - 0	P4x.337	1.28	1.28	10.4	4.4074	95128.60	198335.00	0.480

¹ $P_u / \phi P_n$ controls

Leg Bending Design Data (Tension)

Section No.	Elevation ft	Size	M_{ux} lb-ft	ϕM_{nx} lb-ft	Ratio $\frac{M_{ux}}{\phi M_{nx}}$	M_{uy} lb-ft	ϕM_{ny} lb-ft	Ratio $\frac{M_{uy}}{\phi M_{ny}}$
T1	100 - 90	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T2	90 - 80	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T3	80 - 60.32	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T4	60.32 - 40.64	P2.5x.203	0.00	5445.47	0.000	0.00	5445.47	0.000
T5	40.64 - 20.96	P3x.216	0.00	8748.17	0.000	0.00	8748.17	0.000
T6	20.96 - 1.28	P3.5x.226	0.00	12085.42	0.000	0.00	12085.42	0.000
T7	1.28 - 0	P4x.337	7161.95	21949.33	0.326	0.00	21949.33	0.000

Leg Interaction Design Data (Tension)



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Section No.	Elevation ft	Size	Ratio	Ratio	Ratio	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
			$\frac{P_u}{\phi P_n}$	$\frac{M_{ux}}{\phi M_{nx}}$	$\frac{M_{uy}}{\phi M_{ny}}$			
T1	100 - 90	P2.5x.203	0.036	0.000	0.000	0.036 ¹	1.000	4.9-4 ✓
T2	90 - 80	P2.5x.203	0.168	0.000	0.000	0.168 ¹	1.000	4.9-4 ✓
T3	80 - 60.32	P2.5x.203	0.433	0.000	0.000	0.433 ¹	1.000	4.9-3 ✓
T4	60.32 - 40.64	P2.5x.203	0.708	0.000	0.000	0.708 ¹	1.000	4.9-3 ✓
T5	40.64 - 20.96	P3x.216	0.703	0.000	0.000	0.703 ¹	1.000	4.9-3 ✓
T6	20.96 - 1.28	P3.5x.226	0.758	0.000	0.000	0.758 ¹	1.000	4.9-3 ✓
T7	1.28 - 0	P4x.337	0.480	0.326	0.000	0.716 ¹	1.000	4.9-3 ✓

¹ $P_u / \phi P_n$ controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L	L _u	Kl/r	A	P _u	φP _n	Ratio
			ft	ft		in ²	lb	lb	$\frac{P_u}{\phi P_n}$
T1	100 - 90	L1 1/2x1 1/2x3/16	3.43	1.58	45.0	0.2900	861.52	12616.70	0.068 ¹
T2	90 - 80	L1 1/2x1 1/2x3/16	3.40	1.57	44.7	0.2900	1468.52	12616.70	0.116 ¹
T3	80 - 60.32	L1 1/2x1 1/2x3/16	5.31	2.63	72.8	0.2900	1649.73	12616.70	0.131 ¹
T4	60.32 - 40.64	L1 1/2x1 1/2x3/16	6.04	2.97	81.9	0.2900	1932.08	12616.70	0.153 ¹
T5	40.64 - 20.96	L1 1/2x1 1/2x3/16	7.06	3.50	95.8	0.2900	1649.86	12616.70	0.131 ¹
T6	20.96 - 1.28	L1 3/4x1 3/4x3/16	8.13	4.00	92.7	0.3604	4888.46	15675.30	0.312 ¹

¹ $P_u / \phi P_n$ controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L	L _u	Kl/r	A	P _u	φP _n	Ratio
			ft	ft		in ²	lb	lb	$\frac{P_u}{\phi P_n}$
T1	100 - 90	L1 1/2x1 1/2x3/16	2.50	2.26	59.4	0.5273	87.08	17085.90	0.005 ¹



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* DL controls
¹ $P_u / \phi P_n$ controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P lb	ϕP_{allow} lb	% Capacity	Pass Fail	
T1	100 - 90	Leg	P2.5x.203	1	-3672.76	67311.90	5.5	Pass	
		Diagonal	L1 1/2x1 1/2x3/16	8	861.52	12616.70	6.8	Pass	
T2	90 - 80	Top Girt	L1 1/2x1 1/2x3/16	4	-113.15	9432.29	8.8 (b)	Pass	
		Leg	P2.5x.203	26	-13833.00	67311.90	20.6	Pass	
		Diagonal	L1 1/2x1 1/2x3/16	31	-1550.94	12396.60	12.5	Pass	
T3	80 - 60.32	Leg	P2.5x.203	47	-34705.20	57705.10	15.0 (b)	Pass	
		Diagonal	L1 1/2x1 1/2x3/16	50	-1744.57	8950.93	60.1	Pass	
T4	60.32 - 40.64	Leg	P2.5x.203	74	-56422.70	57705.10	19.5	Pass	
		Diagonal	L1 1/2x1 1/2x3/16	77	-2076.10	7845.19	97.8	Pass	
T5	40.64 - 20.96	Leg	P3x.216	101	-73593.30	83032.90	26.5	Pass	
		Diagonal	L1 1/2x1 1/2x3/16	103	-1657.60	5805.78	88.6	Pass	
T6	20.96 - 1.28	Leg	P3.5x.226	128	-96095.30	104530.00	28.6	Pass	
		Diagonal	L1 3/4x1 3/4x3/16	130	-4158.37	7180.71	91.9	Pass	
T7	1.28 - 0	Leg	P4x.337	155	-99054.50	196772.00	57.9	Pass	
							93.2	Pass	
							Summary		
							Leg (T4)	97.8	Pass
							Diagonal (T6)	57.9	Pass
							Top Girt (T1)	1.2	Pass
							Bolt Checks	44.1	Pass
							RATING =	97.8	Pass