



Structural Analysis Report

Structural Analysis: Self-Supporting Pole Crank-Up Tower

Tower Model: MA40

With Connection to building eave - by others

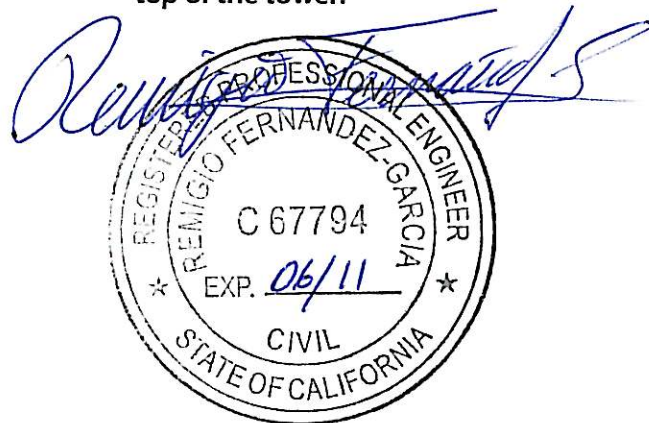
Design Code: IBC 2006 (TIA-222-F)

Basic Wind Velocity:	85	mph 3 second gust
	71	mph fastest mile
Exposure:	C	
Ice:	None	

Loads shown for an Effective Tower Height of 21 ft

Max. Allowable Antenna Wind Load (lbs):	105
Max. Allowable Antenna Weight (lbs):	65
Max. Allowable Antenna Wind Area (sq. ft.):	4.8

Note: The maximum antenna values shown above include the antenna, rotator, and any other items placed at the top of the tower. For purposes of these calculations the antenna was placed 1 ft. above the top of the tower.



Date Prepared: 7/22/2010
 Prepared By: Remigio Fernandez-Garcia, P.E.

Sheet 1 of 14

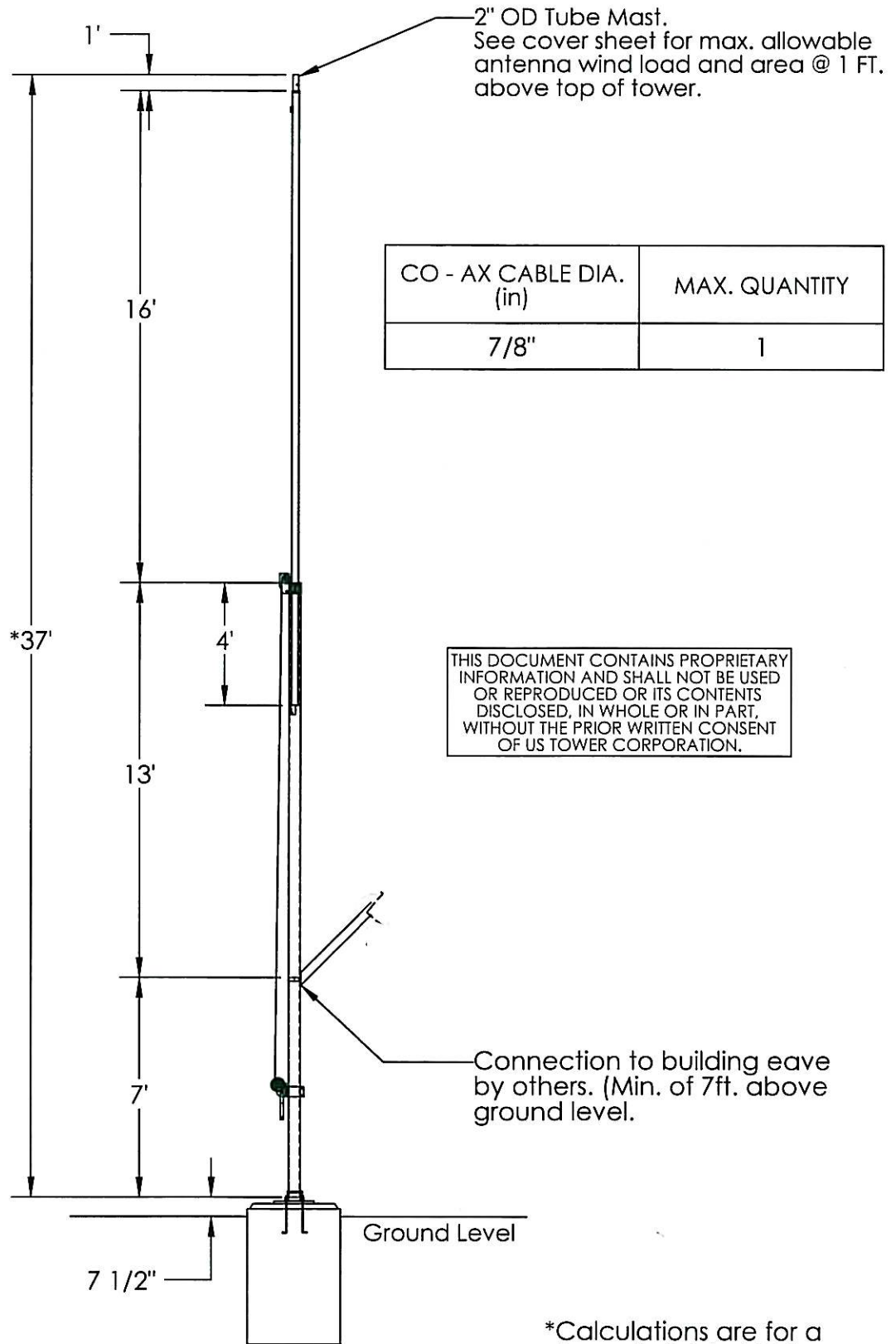
1099 W. Ropes Ave - Woodlake, CA 93285 - Ph: 559-564-6000

CHK: MC 7-23-10



MA-40 TOWER ELEVATION WITH EAVE CONNECTION

SECTION NO.	TUBE SIZE
MA 3	SQUARE TUBE 3" X 0.120" WALL
MA 4.5	ROUND TUBE 4 1/2" OD X 0.120" WALL



Elevation View
No Scale

*Calculations are for a tower height of 23ft.



General Notes

Tower Model: MA40

1. All work shall be in conformance with the requirements of the "International Building Code - 2006" and "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures TIA/EIA-222-F", by the Telecommunications Industry Association.
2. The 2006 International Building Code requires the use TIA/EIA-222-F for tower design. TIA/EIA requires the use of the American Institute of Steel Construction, ASD Specification for Structural Steel Buildings, June 1, 1989. (AISC 9th Edition). Consequently, all steel design was performed using the AISC 9th Ed.
3. All concrete shall have a minimum compressive strength of 2500 psi at 28 days unless noted otherwise. All concrete shall conform to the requirements of the International Building Code and referenced edition of ACI 318. Slump shall not exceed 4-1/2 inches.
4. Reinforcing steel shall be intermediate grade deformed bars conforming to ASTM A-615. No. 4 bars and smaller shall be Grade 40, No. 5 bars and larger shall be Grade 60. All reinforcing details, placement etc. shall conform to the requirements of the International Building Code and ACI 318. No welding allowed.
5. All reinforcing steel, anchor bolts, dowels and other inserts etc. shall be securely anchored in place, in the required positions, prior to pouring concrete.
6. Steel fabrication and erection shall conform to the requirements of the AISC Manual of Steel Construction and the Electronic Industries Association (as referenced in note 1 & 2 above).
7. All welding shall be performed by AWS certified welders for each type of weld used. (Using the GMAW (spray arc) welding process with ER70S-6 welding wire.
8. All tower section lift cables & guy cables shall be 7 x 19 Aircraft cable with the following minimum strengths:

<u>Cable diameter (in)</u>	<u>Minimum Strength (lbs)</u>
3/16	4200
1/4	7000
5/16	9800
3/8	14400
7/16	17600
1/2	22800

9. This tower analysis is based the antenna being installed at a height of one foot above the top of the tower. The wind load of the antenna(s) shall not exceed the load shown in these calculations. The Owner of the tower shall assume full liability for verification of the antenna loading.
10. This tower is designed to be used in its fully extended position.
11. The design of the hoist system is not with in the scope of these calculations and shall be designed by others.
12. This tower has not been designed to meet any twist or sway criteria.
13. The Owner shall verify that the quantity and size of waveguide / Coax cables match the values used in these calculations.
14. The engineering and design of the antennas are not with-in the scope of these calculations.
15. Installations on hills, escarpments and other special wind areas is not with-in the scope of these calculations.
16. US Tower Corp. recommends that the installation of this tower and its foundation be performed by a Professional, licensed Contractor with experience installing these types of structures.
17. The Contractor is responsible for conducting all construction in accordance with all Federal, State, OSHA, and Local laws and ordinances. The Contractor is also responsible for checking the site for underground facilities prior to the start of work.



General Notes

Tower Model: MA40

18. US Tower Corp. and its Engineers shall not be responsible for errors and omissions in the project not in conformance with these calculations and the Codes and Standards referenced here-in.
19. US Tower Corp. and its Engineers accept no responsibility for field inspection during construction nor for the method of construction.
20. The Owner shall assume full responsibility & liability for the periodic inspection of all tower section lift cables & guy cables. Any cable with any sign of distress or excessive stretch shall be replaced immediately.
21. The information contained in these calculations is the property of US Tower Corp. and shall only be used to obtain an installation permit. Any other use shall be authorized by US Tower in writing prior to utilizing the information contained herein.
22. The connection at the eave shall be designed by others, depending on the characteristics of the particular structure at which the tower will be connected



Code & Material Specifications

Tower Model: MA40

Governing Codes, Stresses, and Materials (Min.)

International Building Code TIA-222-F AISC Specification for Steel Bldgs ACI 318	2006 Edition (Occ. Cat. II) AISC ASD 9th Edition 2005 Edition
Wind Loading Governed by the TIA/EIA standard	Basic Wind Speed 85 mph, 3 second gust 71 mph Fastest Mile
Structural Steel (All plates, bars, angles)	ASTM A36 (F-y = 36 ksi) (Min. F-y for plates - 42 ksi)
Structural Pipe	ASTM A53 Gd. B, A500 Gd. B (F-y = 50 ksi for tower legs)
Structural Tubing (HSS)	ASTM A500 Gd. B (F-y = 46 ksi)
Welding	AWS D1.1-04 GMAW w/ ER70S-6 wire
Hot-Dip Galvanizing Hardware	ASTM A123 ASTM A153
Bolts: Tower & Accessories	ASTM A325
Reinforced Concrete	2500 psi strength @ 28 days
Reinforcing Steel	ASTM A615 Gd. 40 for #4 & smaller dia. Gd. 60 for #5 & larger dia.
Anchor Rods	ASTM A-36 or ASTM F1554 Gr.36
Foundation & Soils Lateral Bearing Pressure	1500 psf Bearing (TL = DL+LL) 100 psf/ft of depth



Tower Section Properties

Tower Model: MA40

Structure Classification:	1	Gh (Poles) =	1.69	Wind Speed is Fastest Mile Speed
Wind velocity (mph):	71	Tower Height (ft):	24	Equivalent to 85 mph for 3 second gust
Exposure:	C	Topo Category:	1	Per EIA-222-F (IBC2006/CBC2006)

<u>Section Name</u>	<u>MA3</u>	<u>MA4.5</u>	<u>MA6.625</u>	<u>MA8</u>	<u>MA10</u>	<u>MA12</u>	<u>MA14</u>	<u>MA16</u>
Section length (ft):	20	20	20	20	20	20	20	20
Top lap length (ft):	0	4	0	0	0	0	0	0
Bot lap length (ft):	4	0	0	0	0	0	0	0

Tube shape:								
1=round, 2=sq., 3=16 side	2	1	1	1	1	1	1	1
Tube O.D. :	3	4.5	6.625	8	10	12	14	16
(Note: OD = face width of square tubes, outside point to point of 16 sided polygons.)								
Wall thk'ness:	0.12	0.12	0.135	0.135	0.135	0.135	0.135	0.135
Tube I.D.:	2.76	4.26	6.36	7.73	9.73	11.73	13.73	15.73
Tube F-y: (Steel only)	42000	42000	42000	42000	42000	42000	42000	42000
C: (Is aspect ratio for sq. tubes)	17.8	26.6	39.2	47.3	59.2	71.0	82.8	94.7
C-f, force coefficient:	1.20	1.20	1.10	0.86	0.65	0.59	0.59	0.59

Linear Appurtenances:	Co-ax Cable dia. (in):	0.875	Lift Cable dia. (in):	0.188
	Cable wt (lb/ft):	0.3	Cable wt. (lb/ft):	0.07
	No. of Cables:	1	No. of Cables:	1

<u>Projected Area:</u>								
Tube (s.f. / ft.):	0.300	0.450	0.609	0.576	0.538	0.590	0.688	0.787
Co-ax cable (s.f./ft.):	0.088	0.088	0.088	0.088	0.088	0.088	0.088	0.088
Lift cable(sq. ft. /ft.):	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
Tot. Unif. PA (sq.ft./ft.):	0.406	0.556	0.715	0.682	0.645	0.696	0.795	0.893

Appurtenance @ top of Section:	(Includes top caps & other items, coax arms not included since R-a < 0.1)							
Width (in):	6	7.5	9.625	11	13	15	17	19
Height (in):	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
C-f, force coefficient (Tbl. 2-8)	1.40	0.81	0.86	0.89	0.93	0.98	1.02	1.07
Conc. PA @ top (sq. ft.):	0.058	0.042	0.057	0.068	0.084	0.102	0.121	0.141

<u>Weight:</u>								
Top cap:	5	6	10	12	15	20	25	30
Tube:	94	113	188	227	285	343	401	459
Bot. anchor:	5	5	8	10	12	15	20	25
Lift cable & standoff:	5	5	5	5	5	5	5	5
Misc.:	11	13	21	25	32	38	45	52
Total weight:	120	141	232	280	349	421	496	570

Top Mounted Equipment: (Antenna etc.)

Antenna / Camera Area (sq.ft.):	4	Antenna Mast Area (sq.ft.):	0.67
Shape (1= round, 2 = flat):	1	Shape (1= round, 2 = flat):	1
C-f:	1.2	C-f:	1.2
Concentrated PA (sq. ft.)	4.8	Concentrated PA (sq. ft.)	0.80
Weight (lbs):	65	Weight (lbs):	10



Lift Cable Analysis

Tower Model: MA40

Note: All units are in pounds.

Tower Data:

No. of twr. sections:	2	Tower Section	Wt. (lb):	Vert. Component of Guy Cables (lb):
Antenna weight (lb):	65	MA3	120	0
Ant. mount wt. (lb):	10	MA4.5	141	0
Accessories wt. (lb):	0	MA6.625	0	0
Coax cable wt. (lb):	7	MA8	0	0
		MA10	0	0
		0	0	0

Pulley Frame - Tower Section: MA3

F-v: 82 (Force on Section 3)

Pulley Frame - Tower Section: MA4.5

Cable dia (in): 0.188
 Cable MBS: 4200
 No. of faces w/cable: 1
 Sum F-v: 405 (Force on Section)
 CF-tot: 202 (At Anchor in above section)
 CF-face: 202 (At Anchor in above section)
Cable Safety Factor: 20.76

Pulley Frame - Tower Section: MA6.625

Cable dia (in): 0.188
 Cable MBS: 4200
 No. of faces w/cable: 1
 Bottom locked out? 1=y, 2=n: 2
 Sum F-v: 890 (Force on Section)
 CF-tot: 546 (At Anchor in above section)
 CF-face: 546 (At Anchor in above section)
Cable Safety Factor: 7.69

Pulley Frame - Tower Section: MA8

Cable dia (in): 0.188
 Cable MBS: 4200
 No. of faces w/cable: 1
 Sum F-v: 1234 (Force on Section)
 CF-tot: 890 (At Anchor in above section)
 CF-face: 890 (At Anchor in above section)
Cable Safety Factor: 4.72

Pulley Frame - Tower Section: MA10

Cable dia (in): 0.25
 Cable MBS: 7000
 No. of faces w/cable: 4
 Bottom locked out? 1=y, 2=no: 2
 Sum F-v: 1577 (Force on Section)
 CF-tot: 1234 (At Anchor in above section)
 CF-face: 308 (At Anchor in above section)
Cable Safety Factor: 22.70

Pulley Frame - Tower Section: 0

Cable dia (in): 0.25
 Cable MBS: 7000
 No. of faces w/cable: 1
 Sum F-v: 1921 (Force on Section)
 CF-tot: 1577 (At Anchor in above section)
 CF-face: 1577 (At Anchor in above section)
Cable Safety Factor: 4.44



Tower Section Analysis
Tower Model: MA40
Round & Square Sections (Steel)

Note: All units are in inches and lbs unless noted otherwise.

Modulus of Elasticity: **29000000** Design Thickness Modifier: **0.93**

	Section							
	MA3	MA4.5	MA6.625	MA8	MA10	MA12	MA14	MA16
Tube Shape:	Square	Round	Round	Round	Round	Round	Round	Round
Tube OD:	3	4.5	6.625	8	10	12	14	16
Tube Design. Thkn's:	0.112	0.112	0.126	0.126	0.126	0.126	0.126	0.126
Tube Spec. Thkn's:	0.120	0.120	0.135	0.135	0.135	0.135	0.135	0.135
Tube ID:	2.777	4.277	6.374	7.749	9.749	11.749	13.749	15.749
Tube Area:	1.29	1.54	2.56	3.11	3.89	4.68	5.47	6.26
Tube I (in ⁴):	1.796	3.706	13.541	24.079	47.477	82.559	131.691	197.241
Tube S (in ³):	1.197	1.647	4.088	6.020	9.495	13.760	18.813	24.655
Tube r:	1.180	1.552	2.298	2.784	3.491	4.198	4.906	5.613
Tube Z (in ³):	1.397	2.150	5.304	7.786	12.242	17.704	24.169	31.639
Tube J (in ⁴):	3.591	7.412	27.083	48.159	94.954	165.117	263.382	394.481
Tube F-y (psi):	42000	42000	42000	42000	42000	42000	42000	42000
Design Length(ft):	16	20	20	20	20	20	20	20

Forces: (Includes P-delta moments)

Dead Ld. (P):	202	405	0	0	0	0	0	0
Shear (V):	201	291	0	0	0	0	0	0
Torsion Mom (T) ft-lb:	0	0	0	0	0	0	0	0
Moment (M) ft-lb:	275	3309	0	0	0	0	0	0

Tube D/t: 23.9 40.3 52.8 63.7 79.6 95.6 111.5 127.4

Note: D/t shall not exceed 400

Axial Strength

K: **2.1**

fa (psi):	157	263	0	0	0	0	0	0
Fa (psi):	1706	1888	4140	6077	9555	13817	18863	24692

Flexural Strength

fb (psi):	2758	24104	0	0	0	0	0	0
Fb (psi):	36960	36960	36960	36960	36960	36960	36960	36960

Shear Strength

fv (psi):	156	189	0	0	0	0	0	0
fvt (psi):	0	0	0	0	0	0	0	0
Fv (psi):	22400	22400	22400	22400	22400	22400	22400	22400

Tube CSI:	0.17	0.79	0.00	0.00	0.00	0.00	0.00	0.00
	MA3	MA4.5	MA6.625	MA8	MA10	MA12	MA14	MA16



Foundation Design MA40

For Tower with Eave Bracket

Tower Reactions:

Moment (ft-lbs): **0**
 Shear (lbs): **473**
 Mast Weight (lbs): **343**
 Modification Factor: **1.3**
 (Req'd by EIA-F 3.1.16.1)
 Base Plate (in): **8**
 Distance from ground
 to top of concrete (ft): **0.667**
 Square ft'g width (ft): **2**
 Footing depth (ft): **4**

H (ft): 0.67
 S-1: 267
 (Increased S1 by 2x per IBC 1804.3.1 for isolated footing not adversely affected by 1/2" motion at ground surface.)
 A: 1.906
Depth req'd (ft): 2.5

Foundation Design Reactions:

Moment (ft-lbs): 410
 Shear (lbs): 614
 Mast Weight (lbs): 446
 Concrete f-c' (psi): **2500**

Soil Design Parameters:

Allow. Lateral bearing (psf/ft): **100**
 Allow. Soil bearing (psf): **1500**
 Design is for non-constrained condition per IBC reqmt's.

Allow. bearing (psf): 2400 Increased 20% for ea.
Act. bearing (psf): 686 ft. of depth

Max. Moment in Footing (ft-lbs): 2212

Check concrete tensile stress: (neglect outer 2" of footing)

S-x (in³): 1333
 f-t (psi): 32
 F-t (psi): 138
CSI: 0.23

CSI is < 1.0 therefore reinforcing is not req'd. Use minimal reinforcing.

rho: **0.0018**
 A-s req'd (sq. in.): 1.04
 Rebar dia (in): **0.625**
 No. of bars provided: **4**
 A-s provided (sq. in.): 1.23 OK

Anchor Bolt Anchorage Design Load:

Anchorage Tension Design Force (lbs): **N/A** (LRFD level force)

Summary:

Use foundation 2 ft. square by 4 ft. deep (below undisturbed soil).
 Reinforce foundation with 4 #5 vertical bars (total) with #3 ties at 12" on center, and 3 ties in the top 5".
 Use 1 vertical bar at each corner of the foundation.
 Use 1/2" dia. ASTM A-36 or ASTM F1554 Gr.36 anchor bolts, 10" long. Min. Total of 2 anchor bolts.



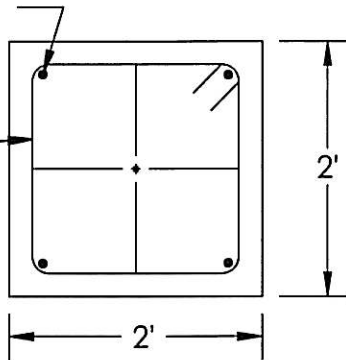
MA-40 FOUNDATION

With Eave Bracket

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SHALL NOT BE USED OR REPRODUCED OR ITS CONTENTS DISCLOSED, IN WHOLE OR IN PART, WITHOUT THE PRIOR WRITTEN CONSENT OF US TOWER CORPORATION.

- ① 4 - #5 Vertical Bars (1 bar @ corners)

- ② #3 Ties @ 12" O.C. (max) 3 in Top 5"



Foundation has been designed to accommodate the following loads:

Overturning Moment = 0.60 ft - kips
 Base Shear = 0.90 kips
 Structure Weight = 0.75 kips

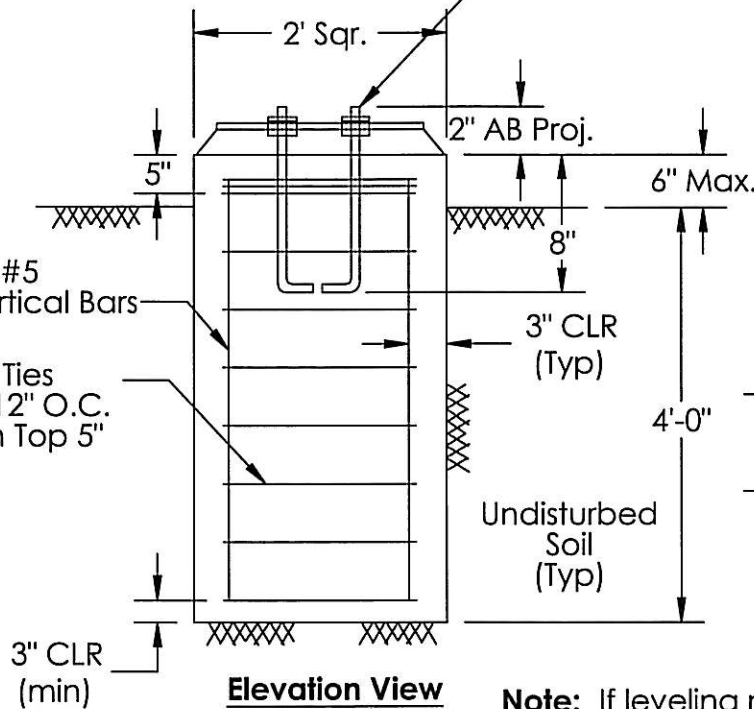
Soil and Concrete Design Parameters.

Allowable Foundation Pressure 1500 psf (Increases based on depth)
 Lateral Bearing Pressure 100 psf/ft (Increases based on depth)
 Concrete $f_c' = 2500$ psi min. @ 28 days.

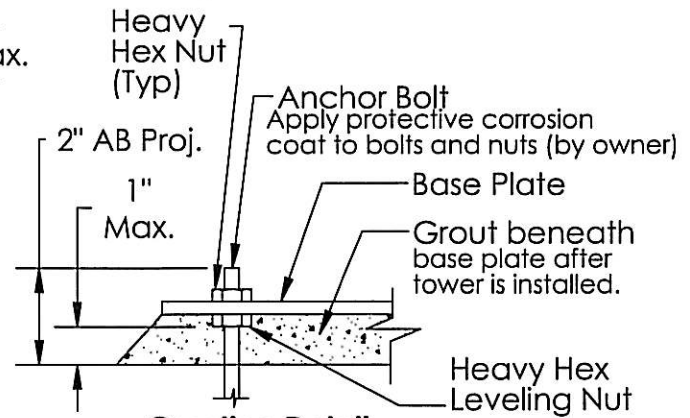
Plan View - Reinforcing
No Scale

1/2" Ø x 10" ASTM A36 J anchor bolt, (2 total), w/8" min. embedment.

- ① 4 - #5 Vertical Bars
- ② #3 Ties @ 12" O.C. 3 in Top 5"



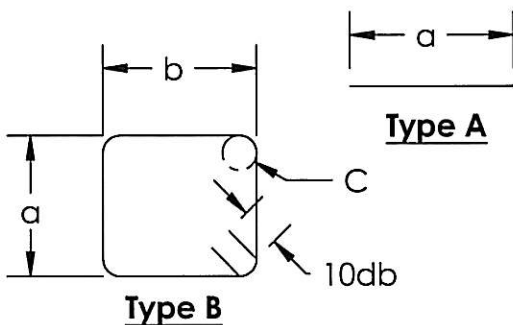
Elevation View
No Scale



Grouting Detail

Extreme care should be taken to assure that all leveling nuts are level with respect to each other prior to installation of tower.

Note: If leveling nuts are not used, grout is not required, and reduce AB projection to 4".



Reinforcement Material List

Sym	Type	Bar Size	Dimensions				Qty
			a	b	c	10db	
①	A	#5	4' - 0" *	---	---	---	4
②	B	#3	1' - 6" *	1' - 6" *	2"	3.75"	7

* = Nominal dimension

