Structural Analysis Report

Structural Analysis: Self-Supporting Triangular Crank-Up Tower

Tower Model: HDX-572

Design Code: IBC 2003 (TIA-222-G)

Basic Wind Velocity:	90	mph	
Exposure	C	Ice:	None
Topographic Cathegory:			1
Structure Classification:			1

Max. Allowable Antenna Wind Load (lbs) - Unfactored:	167
Max. Allowable Antenna Weight (lbs):	300
Max. Allowable Effective Antenna Wind Area (sq. ft.):	10.8

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: 4/1/2013 Sheet 1 of 13
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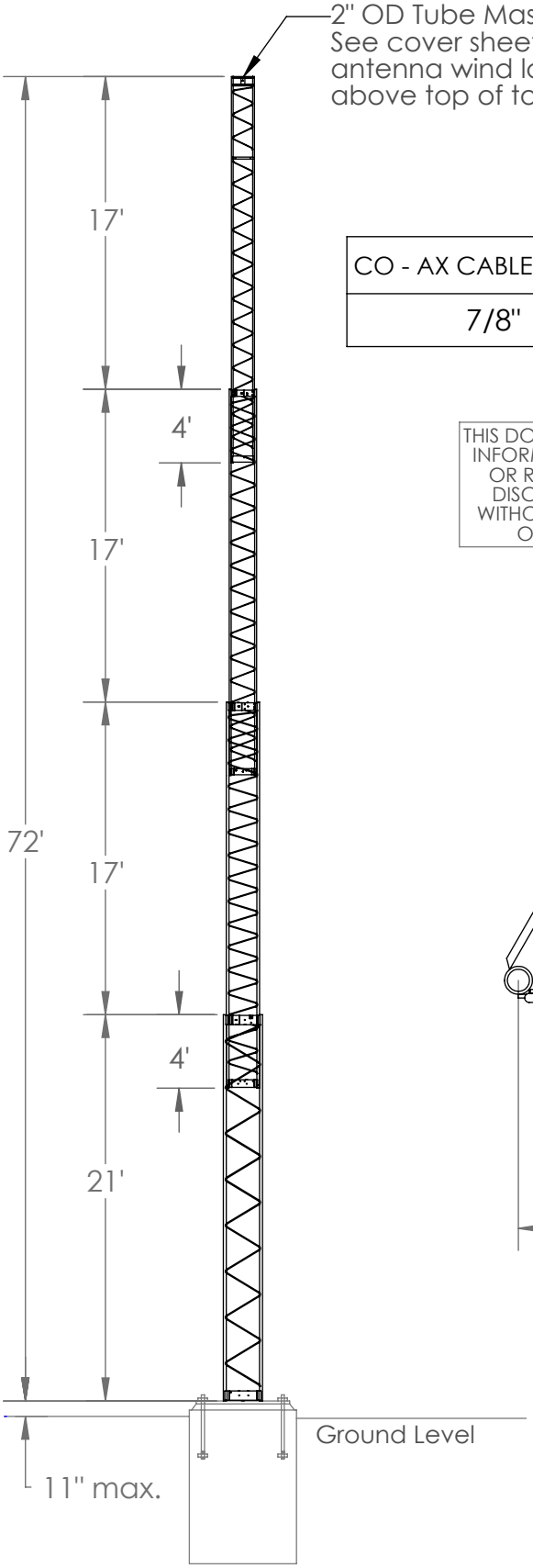
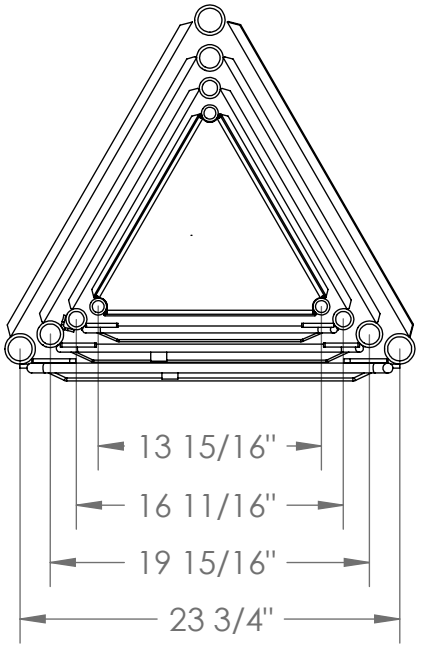
HDX-572 TOWER ELEVATION

SECTION NO.	LEG SIZE	DIAGONAL SIZE
NO. 5 TOP	PIPE 1.05" OD X 0.154" WALL	3/8" SOLID ROD
NO. 6	PIPE 1.315" OD X 0.179" WALL	7/16" SOLID ROD
NO. 7	PIPE 1.66" OD X 0.191" WALL	1/2" SOLID ROD
NO. 8 BASE	PIPE 1.9" OD X 0.2" WALL	5/8" SOLID ROD



Elevation View
No Scale

CO - AX CABLE DIA. (in)	MAX. QUANTITY
7/8"	1



Plan View
No Scale

General Notes:

Tower Model: **HDX-572**

1. All work shall be in conformance with the requirements of the "International Building Code - 2003" and "Structural Standards for Antenna Supporting Structures and Antennas ANSI/TIA-222-G", by the Telecommunications Industry Association.
2. Steel design is per the requirements of ANSI/TIA-222-G and the Americal Institute of Steel Construction Specification for Structural Steel Buildings, ANSI/AISC 360-05.
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 Telecommunications Industry 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 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:

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

9. 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. Unless otherwise noted.
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 calcuations.
16. Seismic analysis is not with-in the scope of these calculations. Unless noted otherwise.
17. 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.
18. 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.
19. US Tower Corp. and it's 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.
20. US Tower Corp. and it's Engineers accept no responsibility for field inspection during construction nor for the method of construction.
21. 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.
22. 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.
23. This tower has not been designed for snow or ice loading per TIA-G T. 2-3, Structure Class 1 The tower shall be fully retracted prior to any snow or ice event. Unless noted otherwise.
24. Foundation design covers F0,S0, P0, C0 & C1 exposure classes. If local conditions are known to differ, a qualified local professional engineer shall provide the foundation design.
25. Foundation Design does not include considerations for frost depth or high ground water level.

Code & Material Specifications

Tower Model: HDX-572

Governing Codes, Stresses, and Materials (Min.)

International Building Code	**2003 Edition (Occ. Cat. II)**
TIA-222-G	**ANSI/TIA-222-G**
AISC Spec for Structural Steel Bldgs	**ANSI/AISC 360-05**
ACI 318	**2008 Edition**
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) ASTM A513 Type 1A (F-y = 42 ksi)**
Welding	**AWS D1.1-08 GMAW w/ ER70S-6 wire per AWS A5.18**
Hot-Dip Galvanizing	**ASTM A123**
Hardware	**ASTM A153**
Bolts: Tower & Accessories	**ASTM A325**
Reinforced Concrete	**2500 psi strength @ 28 days Exposure Class F0, S0, P0, C0 & C1**
Reinforcing Steel	**ASTM A615 Gd. 40 for #4 & smaller dia. Gd. 60 for $5 & larger dia.**
Anchor Rods	**ASTM F1554 Gd. 36 or ASTM A-36**
Foundation & Soils	**1500 psf Bearing (TL = DL+LL)**
Lateral Bearing Pressure	**100 psf/ft of depth**

Tower Section Properties

Tower Model: HDX-572

Design per TIA-222-G
All units are in lbs. and inches U.O.N.

Note: If a tower section is not in the tower being designed then input 0 for section length and top & bottom lap lengths.

Tower Height (ft):	72
Ice t (in):	0
Density (pcf):	56
Design Ice t (in):	0

Design Thickness Modifier: 1.00

Tower section No.:	3	4	5	6	7	8	9	10
Lgth. of Section (ft):	0	0	21	21	21	21	0	0
Face width (C.L.):	8.95	11.47	13.94	16.68	19.94	23.725	28.25	34.25
Leg dia.:	1.05	1.05	1.05	1.315	1.66	1.9	2.375	2.875
Leg Thkn's: Spec.	0.154	0.154	0.154	0.179	0.191	0.2	0.218	0.276
Leg Thkn's: Design	0.154	0.154	0.154	0.179	0.191	0.200	0.218	0.276
Leg F-y:	50000	50000	50000	50000	50000	50000	50000	50000
Web dia:	0.375	0.375	0.375	0.4375	0.5	0.625	0.75	0.875
Web F-y:	36000	36000	36000	36000	36000	36000	36000	36000
Web spacing: (leg unsupported length)	15	15	15	15	15	30	30	30
Web "phi":	40	31	25	21	17	31	26	21.5
Web clear width:	7.90	10.42	12.89	15.37	18.28	21.83	25.88	31.38
Web L:	10.31	12.16	14.22	16.46	19.12	25.46	28.79	33.72
No. of diagonal webs:	0	0	41	46	46	21	0	0
Top Lap (ft):	0	0	0	4	4	4	0	0
Bottom Lap (ft):	0	0	4	4	4	0	0	0
No. of additional lap diagonal webs:	0	0	7	13	13	4	0	0
Top plate depth:	4	4	5	4	6	8	6	8
Bot plate depth:	2.5	2.5	3	6	5	8	8	8
Plate Thkn's:	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375

Yellow = No Ice Condition Green = With Ice Condition

Appurtenance @ top of Section: (Coax arms need not be included since R-a <0.1)

Weight (lbs):	0	0	0	0	0	0	0	0
Area - No Ice (sq. ft.):	0	0	0	0	0	0	0	0
Area - w/ Ice (sq. ft.):	0	0	0	0	0	0	0	0
C-f, (TIA Tbl 2-8):	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Conc. EPA No Ice:	0	0	0	0	0	0	0	0
Conc. EPA w/ Ice:	0	0	0	0	0	0	0	0

Projected Areas Outside Lap Areas:

Section L (ft) Used:	0	0	17	13	13	17	0	0
Section PA (sqft/ft):	0.000	0.000	0.442	0.472	0.590	0.810	0.000	0.000
Section PA (sqft/ft):	0.000	0.000	0.442	0.472	0.590	0.810	0.000	0.000

Projected Areas at Laps:

Lap PA (sqft/ft):	**Lap 3+4:**	0.000	0.000	**Lap 6+7:**	1.966	1.966	**Lap9+10:**	0.000
	Lap 4+5:	0.000	0.000	**Lap 7+8:**	2.358	2.358		0.000
	Lap 5+6:	1.290	1.290	**Lap 8+9:**	0.000	0.000		

Weight:

Legs:	0	0	93	137	189	229	0	0
Webs:	0	0	65	114	171	154	0	0
Anchors:	0	0	36	53	70	121	0	0
Misc.:	0	0	19	30	43	50	0	0
Total weight:	0	0	213	335	473	555	0	0
Total weight:	0	0	213	335	473	555	0	0

Tower Loading - Shear & Moments

Wind Loads

Tower Model: HDX-572

Design per TIA-222-G

Wind velocity (mph):	90
Exposure:	C
Topo Category:	1
Tower Height (ft):	72
Structure Classif.:	1
Load Factor - Wind:	1.6
Load Factor - Dead:	1.2
Ant. Height Above Top of Tower (ft):	1

Antenna & Mast / Mount Data:

Antenna Area (ft2):	9	Mast Dia. (in):	2
Force Coefficient C-f:	1.2	Mast Lgth (in):	48
EPA (ft^2):	10.8	Force Coeff. C-f:	1.2
Ant. + Mt. wt. (lbs):	300	EPA (ft^2):	0.800

Co-ax Cable Data:

Cable dia. (in):	0.875	
No. of cables:	1	
C-a:	1.2	Table 3 - EIA
Cable Proj. Area	0.088	(sq.ft. / ft.):
Wght. / Cable (lb/ft):	0.30	
Total Wght (lb):	22	

G-h:	0.85	Gust factor
I:	0.87	Importance factor
Kd:	0.85	Wind direction probablility factor
f:	1	Topographic coefficient
Zg:	900	Exposure category coefficient
alfa:	9.5	Exposure category coefficient
Kz-min:	0.85	Exposure category coefficient
H (ft):	0	Ht. of crest above surrounding terrain
K-h:	N.A.	Height reduction factor
K-zt:	1	Topo wind speed up factor
K-e:	1	Terrain constant
Kt:	1	Topographic constant

Wind Velocicity Coeficient

Kz = 2.01*(z/Zg)^2/a z > 15'

q-z = 0.00256 * Kz * Kzt * Kd * I * G-h * V^2

No ICE — Controlling Loading & Condition

Tower Section	Projected Area	Analysis height (ft)	z height (ft)	Kz	q-z (basic)	w (plf) or P (lb)	Shear (lbs)	Moment (ft-lbs)	P-Delta Mom. (ft-lbs)	Total Moment	Deflection (in)	Sway (deg)	Shear (lbs)	Moment (ft-lbs)	Lift Cable Force (lbs)	Load Condition
Antenna	10.8	73	73	1.184	18.16	267	267	0	0	0	24.7	2.9	267	0		No Ice
Mast	0.800	72	72.5	1.183	18.14	20	287	287	0	287	24.7	2.9	287	287		No Ice
Top of 3	0.000	72	72	1.181	18.11	0	287	287	0	287	24.7	2.9				
3	0.000	72	72	1.181	18.11	0	287	287	0	287	24.7	2.9	287	287		No Ice
Top of 4	0.000	72	72	1.181	18.11	0	287	287	0	287	24.7	2.9				
3&4	0.000	72	72	1.181	18.11	0	287	287	0	287	-	-	287	287		No Ice
4	0.000	72	72	1.181	18.11	0	287	287	0	287	24.7	2.9	287	287		No Ice
Top of 5	0.000	72	72	1.181	18.11	0	287	287	0	287	24.7	2.9				
4&5	0.000	72	72	1.181	18.11	0	287	287	0	287	-	-	287	287		No Ice
5	0.529	55	63.5	1.150	17.64	13	502	6992	300	7292	15.1	2.5	502	7292		No Ice
Top of 6	0.000	55	55	1.116	17.11	0	502	6992	300	7292	15.1	2.5				
5&6	1.377	51	53	1.107	16.98	32	630	9255	300	9556	-	-	630	9556		No Ice
6	0.560	38	44.5	1.067	16.37	12	791	18492	691	19183	7.4	1.8	791	19183		No Ice
Top of 7	0.000	38	38	1.032	15.83	0	791	18492	691	19183	7.4	1.8				
6&7	2.054	34	36	1.021	15.65	44	966	22008	691	22699	-	-	966	22699		No Ice
7	0.677	21	27.5	0.964	14.79	14	1143	35721	1099	36820	2.4	1.0	1143	36820		No Ice
Top of 8	0.000	21	21	0.911	13.97	0	1143	35721	1099	36820	2.4	1.0				
7&8	2.446	17	19	0.892	13.68	46	1325	40658	1099	41757	-	-	1325	41757		No Ice
8	0.897	0.1	8.55	0.850	13.03	16	1594	65328	1378	66707	0.0	0.0	1594	66707		No Ice
Top of 9	0.000	0	0	0.850	13.03	0	0	0	0	0	0.0	0.0				
8&9	0.088	0	0	0.850	13.03	2	0	0	0	0	-	-	0	0		Ice
9	0.000	0	0	0.850	13.03	0	0	0	0	0	0.0	0.0	0	0		Ice
Top of 10	0.000	0	0	0.850	13.03	0	0	0	0	0	0.0	0.0				
9&10	0.000	0	0	0.850	13.03	0	0	0	0	0	-	-	0	0		Ice
10	0.000	0	0	0.850	13.03	0	0	0	0	0	0.0	0.0	0	0		Ice

Note: Top of ____ = concentrated load applied at the top of the tower section.

Tower Section Weights: (No Ice)

Section	Weight (lbs)	
Co-ax Wt:	22	(at top of tower)
3	0	
4	0	
5	213	
6	335	
7	473	
8	555	
9	0	
10	0	
Total:	1598	lbs

Section	Lift cable force (lbs)
5	**642**
6	**1283**
7	**2728**
8	**2710**
NA	**0**
NA	**0**
NA	**0**
NA	**0**

Lift Cable Analysis

No Ice

Tower Model: HDX-572

Design per TIA-222-G

Note: All units are in pounds.

Tower Data:	
No. of twr. sections:	**4**
Ant & Mt weight (lb):	360
Misc. wt. (lb):	0
Accessories wt. (lb):	0
Coax cable wt. (lb):	26
Weight at Top (lbs):	386

Tower Section:	**Section Wt. (lb):**	**Vert. Component of Guy Cables (lb):**
5	256	0
6	402	0
7	568	0
8	666	0
1	0	0
1	0	0
1	0	0
1	0	0

Cable Phi Factor:	0.60	
Load Factor - Dead:	1.2	(Included in calc)
Load Factor - Wind:	1.6	(Included w/ guy cable forces)

Anchor Frame-Tower Section: **5** — Cable Force Section: 6

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	1
F-v = CFtot:	642

Cable force per face: 642

Cable CSI: 0.15

Anchor Frame-Tower Section: **NA** — Cable Force Section: 1

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	5
F-v = CFtot:	0

Cable force per face: 0

Cable CSI: N/A

Pulley Frame-Tower Section: **6**

Sum F-vp: 1283 (=Lift cable force for section analysis)

Pulley Frame-Tower Section: **NA**

Sum F-vp: 0 (=Lift cable force for section analysis)

Anchor Frame-Tower Section: **6** — Cable Force Section: 7

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	1
F-v = CFtot:	1685

Cable force per face: 1685

Cable CSI: 0.40

Anchor Frame-Tower Section: **NA** — Cable Force Section: 1

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	1
F-v = CFtot:	0

Cable force per face: 0

Cable CSI: N/A

Pulley Frame-Tower Section: **7**

Sum F-vp: 2728 (=Lift cable force for section analysis)

Pulley Frame-Tower Section: **NA**

Sum F-vp: 0 (=Lift cable force for section analysis)

Anchor Frame-Tower Section: **7** — Cable Force Section: 8

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	3
F-v = CFtot:	3296

Cable force per face: 1099

Cable CSI: 0.26

Anchor Frame-Tower Section: **NA** — Cable Force Section: 1

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	1
F-v = CFtot:	0

Cable force per face: 0

Cable CSI: N/A

Pulley Frame-Tower Section: **8**

Sum F-vp: 2710 (=Lift cable force for section analysis)

Pulley Frame - Tower Section: **NA**

Sum F-vp: 0 (=Lift cable force for section analysis)

Anchor Frame-Tower Section: **8** — Cable fForce Section: 1

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	3
F-v = CFtot:	0

Cable force per face: 0

Cable CSI: NA

Note:

1. At the bottom tower section input the No. of faces w/ cable = the no. of tower sections -1. (i.e. For a tower made up of 6 sections you would input 5 as the no. of faces w/ cable.)

Pulley Frame-Tower Section: **NA**

Sum F-vp: 0 (=Lift cable force for section analysis)

Tower Sections - Analysis

Tower Model: HDX-572

Design per TIA-222-G

	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10
Shear (lb):	0	0	502	791	1143	1594	0	0
Lift Cable Force (lb):	0	0	642	1283	2728	2710	0	0
Moment (ft-lb):	0	0	7292	19183	36820	66707	0	0
Face Width (in):	8.95	11.47	13.94	16.68	19.94	23.725	28.25	34.25
Panel Height (in):	15	15	15	15	15	30	30	30
Lap length (ft):	0	0	4	4	4	4	0	0
Lap X Braced? Y=1, N=2	2	1	1	1	1	1	1	1
Web Analysis:	Web Phi:	0.9		Weld Phi:	0.75	Weld F-exx:	70,000	psi
Dia. (in):	0.375	0.375	0.375	0.4375	0.5	0.625	0.75	0.875
F-y (psi):	36000	36000	36000	36000	36000	36000	36000	36000
Area(in^2):	0.110	0.110	0.110	0.150	0.196	0.307	0.442	0.601
L (in):	10.89	12.84	14.91	17.10	19.76	26.48	29.91	34.78
r (in):	0.094	0.094	0.094	0.109	0.125	0.156	0.188	0.219
L/r:	116.2	136.9	159.1	156.3	158.1	169.5	159.5	159.0
K:	0.74	0.70	0.70	0.70	0.70	0.70	0.70	0.70
KL/r:	85.8	95.9	111.4	109.4	110.6	118.6	111.7	111.3
λ-c:	0.96	1.08	1.25	1.23	1.24	1.33	1.25	1.25
Web Force (lbs):	0	0	320	489	690	1074	0	0
Ø*P-n (lbs);	2430	2206	1863	2593	3339	4738	7425	10151
Web CSI:	**0.00**	**0.00**	**0.17**	**0.19**	**0.21**	**0.23**	**0.00**	**0.00**
Effective Weld size (in):	0.141	0.141	0.141	0.164	0.188	0.234	0.281	0.328
50% of Tot. Weld L (in):	0.5	0.5	0.5	0.625	0.625	0.625	0.75	0.75
Ø*F-w (lbs);	2215	2215	2215	3230	3691	4614	6645	7752
Weld CSI:	**0.00**	**0.00**	**0.14**	**0.15**	**0.19**	**0.23**	**0.00**	**0.00**

Web Analysis - Lap Area	Section 3	Section 4	Section 5	Section 6	Section 7	Section 8	Section 9	Section 10
Addt'l Lap shear (lbs):	0	0	1823	4796	9205	9205	0	0
F-y (psi):	36000	36000	36000	36000	36000	36000	36000	36000
L (in):	10.89	6.42	7.46	8.55	9.88	13.24	14.95	17.39
L/r:	116.2	68.5	79.5	78.2	79.0	84.7	79.8	79.5
K:	0.77	1.00	1.00	1.00	1.00	0.97	1.00	1.00
KL/r	89.9	68.5	79.5	78.2	79.0	82.2	79.8	79.5
λ-c:	1.01	0.77	0.89	0.88	0.89	0.92	0.89	0.89
Web Force (lbs):	0	0	741	1728	3124	3637	0	0
Ø*P-n (lbs);	2338	2796	2565	3531	4579	6963	10241	13970
Web CSI:	**0.00**	**0.00**	**0.29**	**0.49**	**0.68**	**0.52**	**0.00**	**0.00**
Effective Weld size (in):	0.141	0.141	0.141	0.164	0.188	0.234	0.281	0.328
50% of Tot. Weld L (in):	0.5	0.5	0.5	0.625	0.625	0.9375	1.125	1.125
Ø*F-w (lbs);	2215	2215	2215	3230	3691	6921	9967	11628
Weld CSI:	**0.00**	**0.00**	**0.33**	**0.53**	**0.85**	**0.53**	**0.00**	**0.00**

Leg Analysis:	Leg phi:	0.9						
Leg Eccentricity (in):	0	0.6	1.09	1.66	2.45	0.46	1.32	1.82
Dia. (in):	1.05	1.05	1.05	1.315	1.66	1.9	2.375	2.875
Thk. (in):	0.154	0.154	0.154	0.179	0.191	0.200	0.218	0.276
F-y (psi):	50000	50000	50000	50000	50000	50000	50000	50000
Area(in^2):	0.433	0.433	0.433	0.639	0.881	1.068	1.477	2.254
r (in):	0.321	0.321	0.321	0.407	0.524	0.605	0.766	0.924
D/t:	6.82	6.82	6.82	7.35	8.69	9.50	10.89	10.42
F-y' for compression (psi):	50000	50000	50000	50000	50000	50000	50000	50000
K:	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
KL/r:	46.7	46.7	46.7	36.9	28.6	49.6	39.1	32.5
λ-c:	0.62	0.62	0.62	0.49	0.38	0.66	0.52	0.43
Leg Comp. load (lb):	0	0	7462	16364	26497	39864	0	0
ØP-n (lbs);	16636	16636	16636	26024	37357	40162	59433	93888
M-u = M-ecc (in-lb):	0	0	682	2056	4475	1723	0	0
ØM-n (in-lbs);	5618	5618	5618	10481	18652	26130	45798	84210
Leg CSI:	**0.00**	**0.00**	**0.50**	**0.77**	**0.91**	**0.99**	**0.00**	**0.00**
	Section 3	**Section 4**	**Section 5**	**Section 6**	**Section 7**	**Section 8**	**Section 9**	**Section 10**

Tower Base Connection
Base Section #8
Tower Model: HDX-572

Base Connection:

Shear (lbs):	1594	Leg Comp. (lbs):	39864		
Moment (ft-lbs):	66707	Leg Tension (lbs):	38057		
Lift Cable force (lbs):	2710	Leg O.D. (in):	1.9		
Face width (in):	23.725				
Tab Plate to Leg:		C.L. bolt to leg (in):	1.25		
Plate width (in):	2.5	Bolt dia. (in):	0.75	(A325N)	
Plate height (in):	13	No. of bolts:	6		
Plate Thkn. (in):	0.375	Dist. between bolts:	2		
Bolt force (lbs):	9132	Weld tab to leg:		Weld size (in):	0.188
Allow. bolt shr. (lbs):	12370	Moment (in-lbs):	87701		
Br'g check	**OK**	Weld Zx (in3):	5.616		
Bolt CSI:	**0.74**	Weld stress (lbs/in2):	19537		
		Allow Stress (lbs/in2):	31500	**Weld CSI:**	**0.62**
4x4x1/2 Angle to Base:					
F-y (psi):	42000	KL/r:	3	Pu (lbs):	39864
S-x (in3):	1.97	Lambda-c:	0.04	Mu (lbs-in):	87701
Area (in2):	3.75	Fcr (psi):	41978	Vu (lbs):	531
Zx (in3):	3.56				
Bolt ecc. (in):	1.57	Pn (lbs):	133803	**Angle CSI:**	**0.77**
Shear ecc. (in):	8	Mn (lb-in):	124110		
Distance from first bolt to base plate:	3	Vn (lb):	85050		
Weld tab to base:		Weld size (in):	0.375		
Weld Zx (in3):	8.754				
Moment (in-lbs):	64001				
Weld stress (lbs/in2):	7311	**Weld CSI:**	**0.27**		
Allow Stress (lbs/in2):	27000				

Base Plate Assembly:

Top Plate:		Bot. Plate:		Concrete bearing:	f-c (psi):	2500	
W (in):	6.000	W (in):	5.750	f-p (psi):	1206		
L (in):	6.000	L (in):	5.750	F-p (psi):	1275	**CSI:**	**0.95**
Thkn. (in):	0.500	Thkn. (in):	0.500				

Combined Plate Properties:

Top Plate:		Bot. Plate:		Combined Section	
Area:	3.00	Area:	2.88	Zx (in3):	2.94

Moment - from comp (in-lbs):	28652		
Mn (lb-in):	111038	**CSI:**	**0.26**

Foundation Design

Tower Model: HDX-572

Tower Reactions: (ASD)		Foundation Design Reactions: (LRFD)	
Ft'g size per ASD		Concrete design per LRFD	
Moment (ft-lbs):	41692	Moment (ft-lbs):	84713
Shear (lbs):	996	Shear (lbs):	1993
Lift Cable Force (lbs):	2259	Lift Cable Force (lbs):	2710
		Concrete f-c' (psi):	2500
Tower Face Width(in):	23.725		
Distance from ground to top of concrete (ft):	0.667	Soil Design Parameters:	
Square ft'g width (ft):	5	Allow. Lateral bearing (psf/ft):	100
Footing depth (ft):	8	Allow. Soil bearing (psf):	1500
		Design is for non-constained condition per IBC reqmt's.	
H (ft):	42.51	**Allow. bearing (psf):**	**1500**
S-1:	533	**Act. bearing (psf):**	**1290**
(Increased S1 by 2x per IBC 1806.3.4 for isolated footing not adversely affected by 1/2" motion at ground surface.)			
A:	0.618		
Depth req'd (ft):	**5.7**	Max. Moment in Footing (ft-lbs):	95488
Check concrete tensile stress: (neglect outer 2" of footing)			
S-x (in^3):	29269		
f-t (psi):	39	CSI is < 1.0 therefore reinforcing is not req'd. Use	
F-t (psi):	150	minimal reinforcing.	
CSI:	**0.26**	rho:	0.0018
		A-s req'd (sq. in.):	6.48
		Rebar dia (in):	0.75
		No. of bars provided:	16
		A-s provided (sq. in.):	7.07 OK

Anchor Bolt Anchorage Design Load:

Anchorage Tension Design Force (lbs): **46894** (LRFD level force)

(See Anchor Bolt Anchorage page for anchorage design)

Summary:

Use foundation : **5** ft square by : **8** ft. deep (below undisturbed soil).

Reinforce foundation with: **16** # **6** (total) with #3 ties at 12" on center, and 3 ties in the top 5".

Use bundles of 2 vertical bars at each corner of the foundation and two at the middle of each face of the fdn.

Use 2 - 1" dia. ASTM F1554 Gd. 36 or ASTM A-36 headed anchor bolts, 27" long.

Total of 6 anchor rods, two near each tower leg with a minimum embedment of 21". Use hex nuts.

Anchor Bolt Anchorage

Tower Model: HDX-572

ACI 318-08 App. D Tension Anchorage Calculations - Cast in Place Straight Anchors

All units are pounds and inches unless noted otherwise.

Anchorage Description: 2 - 1" dia, F1554 Grd. 36 or A-36 anchor rods

Concrete f-c' (psi): 2500
Embedment: 21

Is this in a moderate or High Seismic area: 1.00
AND do the loads include seismic loads? (Yes = 0.75, No = 1.0) ACI D.3.3 doesn't require this if loads don't include seismic.

Factored Req'd Tens. Load (lb): **46894** (LRFD value)

h-ef: 20.00 If embedment x 1.5 is > 3 of the edge distances then use h-ef = the largest of the 3 edge distances / 1.5 App. D Section D5.2.3.

Anchor Input:
No. of Anchors n: 2
Anchor dia: 1
No. of threads / in: 8
Anchor f-y (psi): 36000
Anchor f-u (psi): 58000
phi: 0.75
phi = 0.65 if material used is not ductile

Edge Distances:
c-a1: **30.00**
c-a2: **30.00**
c-a3: **16.94**
c-a4: **43.06**

Concrete Breakout Input: (Tension)
A-Nco: 3600.0 Projected breakout area of single anchor
A-Nc: 3001.1 Proj'd breakout area of anchor group (For a single anchor use A-Nco value)
(If have more than two anchors need to hand input A-Nc)
ecc: **0.00** Eccentricity of tension load - anchor groups only
AdjF-ec,N: 1.000 (ACI D5.2.4) for anchor groups loaded eccentrically
AdjF-ed,N: 0.954 (ACI D5.2.5) for edge effects
AdfF-c,N: 1.25 (ACI D5.2.6) Assumed cracked at service load levels
Can use 1.25 if is uncracked
phi: 0.7 Use 0.75 if supplemental reinforcement is provided
. Use 0.70 is supplemental reinforcement is not provided

Steel Strength of Anchor in Tension (ACI D5.1)
A-se: 0.606 Effective anchor area (in^2)
N-sa: 70266

Concrete Pullout Input:
A-head: **1.501** Area of anchor bolt head (Input 0 if plate washer is used)

Plate w: 0.00 Width of plate washer at embed end of anchor
Plate L: 0.00 Length of plate washer at embed end of anchor
A-pl: 1.501 Area of plate washer minus rod area
(Plate thkn's must be >= 0.5 * bolt dia.)
AdfF-c,P: 1.4 Assumed cracked at service load levels
Can used 1.4 if is uncracked
phi: 0.7 Use 0.75 if supplemental reinforcement is provided
Use 0.70 is supplemental reinforcement is not provided

Concrete Breakout Strength of Anchor in Tension (ACI D5.2)
N-b: 107331 ACI D5.2.2
N-cbg: 106707

Side Face Blowout Input
Spacing: 3.94 Min. distance between multiple anchors (input 0 for one anchor)
c2: 30.00 Edge distance perp. To c-min.
c-min: 16.938 Min. edge distance considering all fasteners
AdjF1: 0.693 Factor for single anchor if c2 < 3(c-min)
AdjF2: 1.000 Factor for multiple anchors if c-min < .4(h-ef)
and anchor spacing is < 6(c-min)
phi: 0.7 Use 0.75 if supplemental reinforcement is provided
Use 0.70 is supplemental reinforcement is not provided

Anchor Pullout Strength (ACI D5.3)
N-p: 30020
N-pn: 84056

Concrete Side-Face Blowout, Tension
N-sbg: 115012 Note: If Ca1 is >0.4*h-ef then blowout does not occur.

Anchor Design Strength - LRFD
Steel: 52700
Breakout: 74695
Pullout: 58839
Blowout: 80509

(Note: If supplemental reinforcement is provided then the concrete strength limit does not apply, App. D D.4.2.1.)

LRFD Design Strength: 52700 Lbs
ASD Design Strength: 32937 Lbs
Design Controlled By: Steel Tension
Min. center to center of anchor spacing (in): 4 ACI D.8.1
Min. edge distance is same as min. cover per ACI 7.7.

Loads at Bolts
Vu = 332 lbs
Pu = 23447 lbs
Stress check Phi = 0.75
Pn = 26350 lbs
n = 0.55 Det.C F4.4
(Pu+Vu/n)/(Phi.Pn) <= 1.0
CSI = 0.91

Notes:
1. For normal weight concrete only.
2. Anchors shall be either a headed bolt or have nuts and a bearing plate at the embed end as indicated above.
3. ACI Section D.5.2.3 is not included in this spreadsheet. (i.e. End of wall applications are not covered.)
4. If the design is controlled by concrete failure (i.e. non-ductile failure) then the Design Strengths controlled by concrete must be at least 2.5 times the factored forces transmitted by the attachment. Alternatively, the steel anchor "or the attachment that the anchor is connecting to the structure shall be designed so that the attachment will undergo ductile yielding at a load level corresponding to anchor forces no greater than the design strength of the anchors" determined above. If "Steel Tension" controlled above then the connection is considered ductile and no further adjustments etc. are required. (Also see note 6.)
5. Any supplemental reinforcing shall have f-y = 60,000 psi min.
6. Per ACI D.3.3 if anchor design does not include seismic loads then the design does not have to be controlled by steel ductility.

FOUNDATION

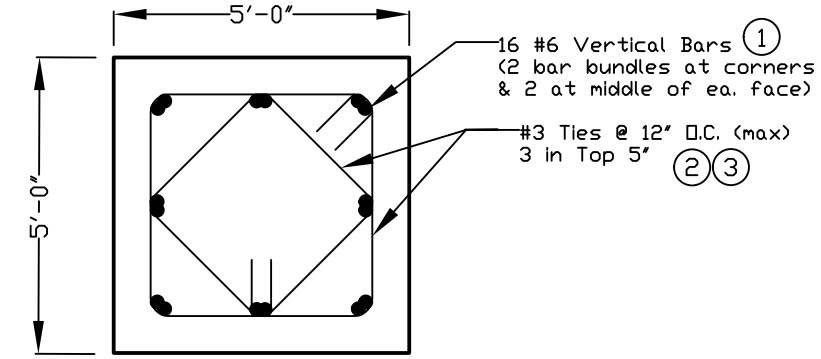
HDX-572

FOUNDATION DESIGN LOADS

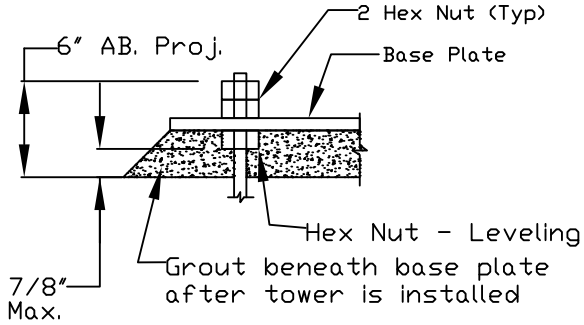
OVERTURNING MOMENT: 84.71 ft.kips
BASE SHEAR: 1.99 Kips
STRUCTURE WEIGHT: 2.71 Kips

SOIL & CONCRETE DESIGN PARAMETERS

ALLOWABLE VERTICAL BEARING PRESSURE: 1500 PSF
ALLOWABLE LATERAL PRESSURE: 100 PSF
CONCRETE F'c = 2500 psi @ 28 DAIS



Plan View - Reinforcing
Not to Scale

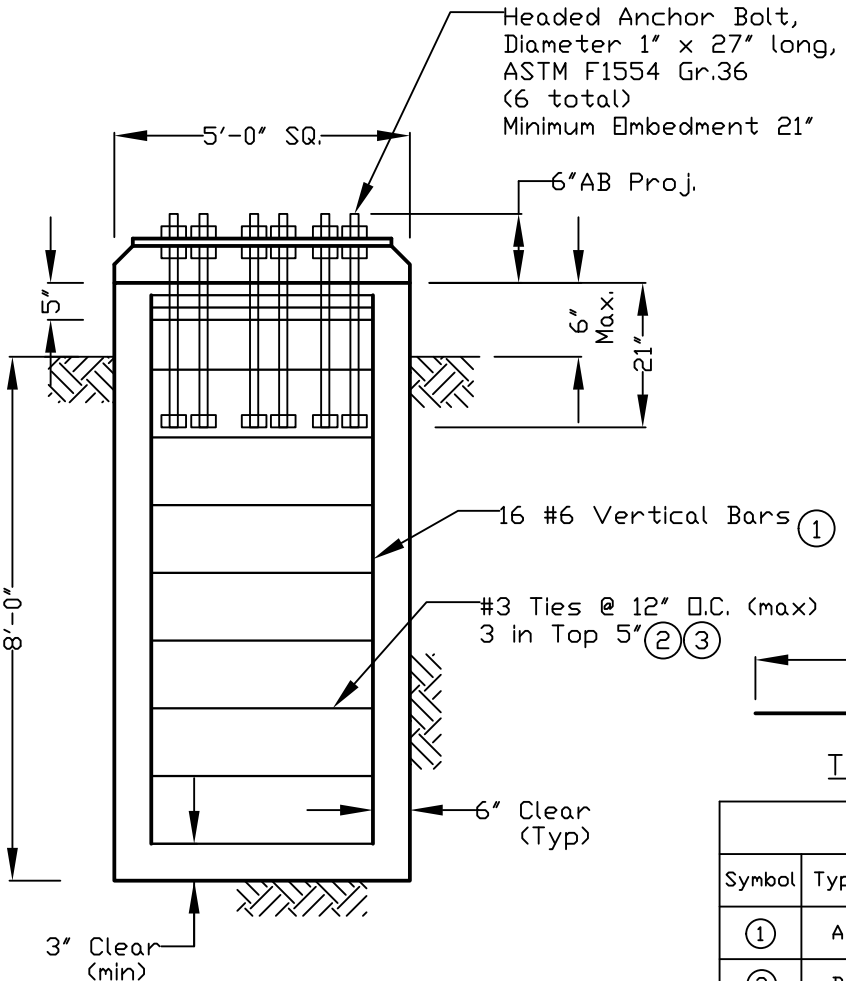


Grouting Detal

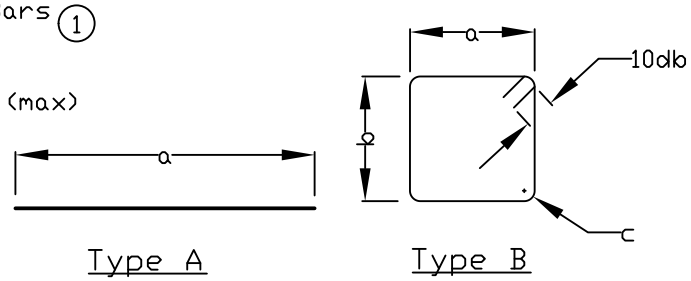
Extreme care should be taken to assure that all leveling nuts are level with respect to each other prior to instalation of tower.

Note:
If leveling nuts are not used, make sure that base plate is in full contact with concrete, grout is not required, and reduce AB projection to 4".

By Owner
Apply Corrosion protection to exposed anchor bolts and nuts..



Elevation View
Not to Scale



Type A Type B

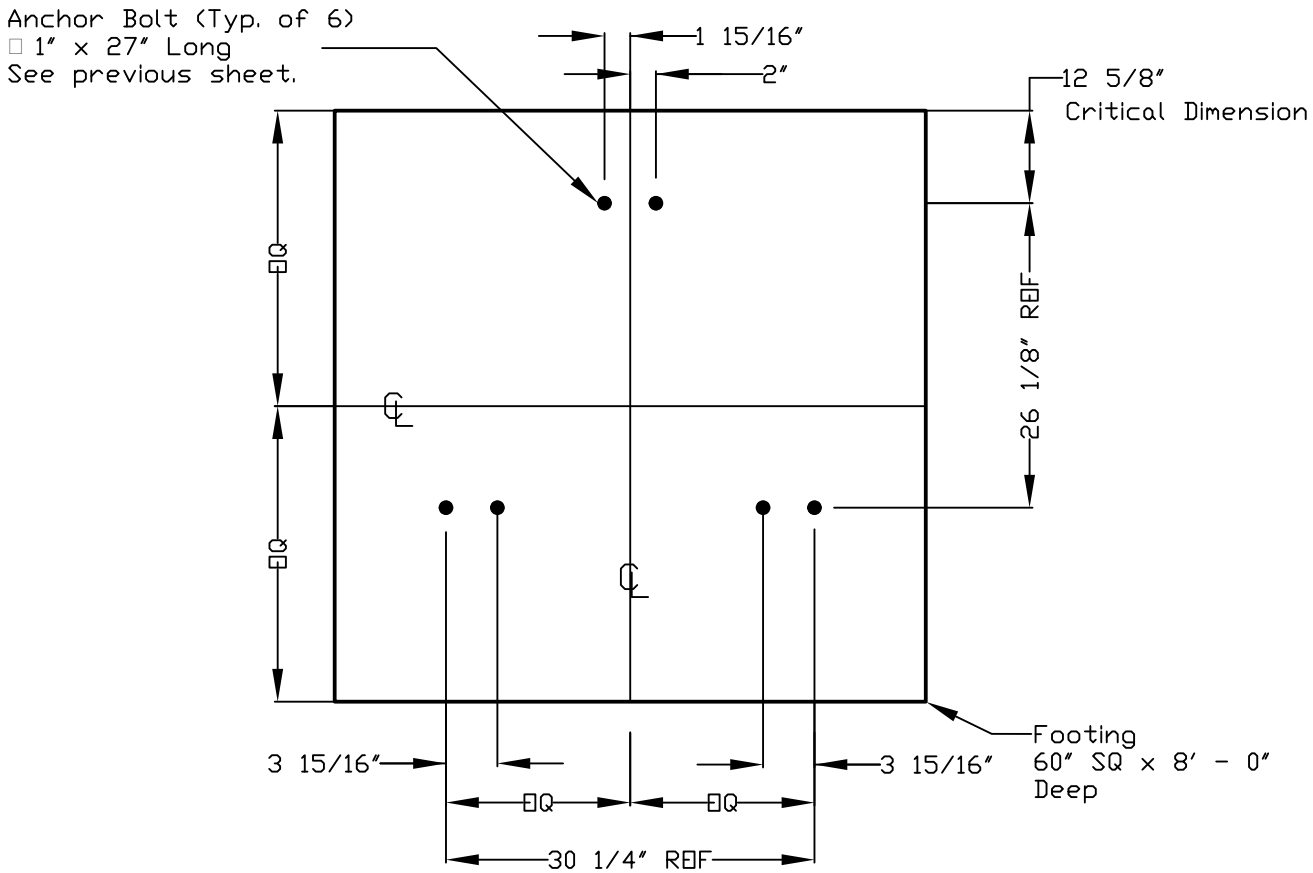
Reinforcement Material List

Symbol	Type	Bar Size	Dimensions				Qty
			a	b	c	10db	
(1)	A	#6	8'-0"	——	——	——	16
(2)	B	#3	4'-0" *	4'-0" *	2"	3.75"	11
(3)	B	#3	2'-10" *	2'-10" *	2"	3.75"	11

* = Nominal dimension

FOUNDATION

HDX-572



Plan View - Anchor Bolt Layout

Not to Scale

"REF" dimensions are provided for reference only. Use the tower base plate assembly to locate anchor bolts.

Foundation Notes:

1. 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 the referenced edition of ACI 318. Slump shall not exceed 4-1/2 inches.
2. 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.
3. All reinforcing steel, anchor bolts, dowels and other inserts etc. shall be securely anchored in place, in the required positions, prior to pouring concrete.
4. The allowable lateral soil bearing value was doubled as allowed per 2009 IBC section 1806.3.4 for isolated foundations not adversely affected by a 0.5" motion at the ground surface due to short term lateral loads.
5. The foundation design does not consider the effects of ground water.
6. The contractor is responsible for safe excavations in accordance with all Federal & Local laws and ordinances and OSHA requirements.
7. The contractor is responsible for the correct placement of all anchor bolts. US Tower recommends that the anchor bolts be placed using the tower base plate assembly provided with the tower. (The base plate assembly can be provided before the tower if desired.)
8. The foundation shall be one continuous pour such that cold joints do not develop. The contractor is responsible for verifying adequate concrete coverage is provided for all reinforcement to avoid the potential for rebar corrosion. Concrete shall be consolidated using vibratory methods.
9. The top of the footing shall be troweled level and smooth (or have a broom finish if preferred) in the area of the tower. Water shall be directed away from the tower base and anchor bolts outside of the tower area.
10. See General Notes sheet (earlier in calcs) for additional information & requirements