Structural Analysis Report

Structural Analysis: Self-Supporting Triangular Crank-Up Tower

Tower Model: HDX-589

Design Code:	IBC 2009 (TIA-222-G) CBC 2010		
Basic Wind Velocity:	85	mph	
Exposure	C	Ice:	None
Topographic Cathegory:			1
Structure Classification:			1

Max. Allowable Antenna Wind Load (lbs) - Unfactored:	225
Max. Allowable Antenna Weight (lbs):	350
Max. Allowable Effective Antenna Wind Area (sq. ft.):	15.6

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.

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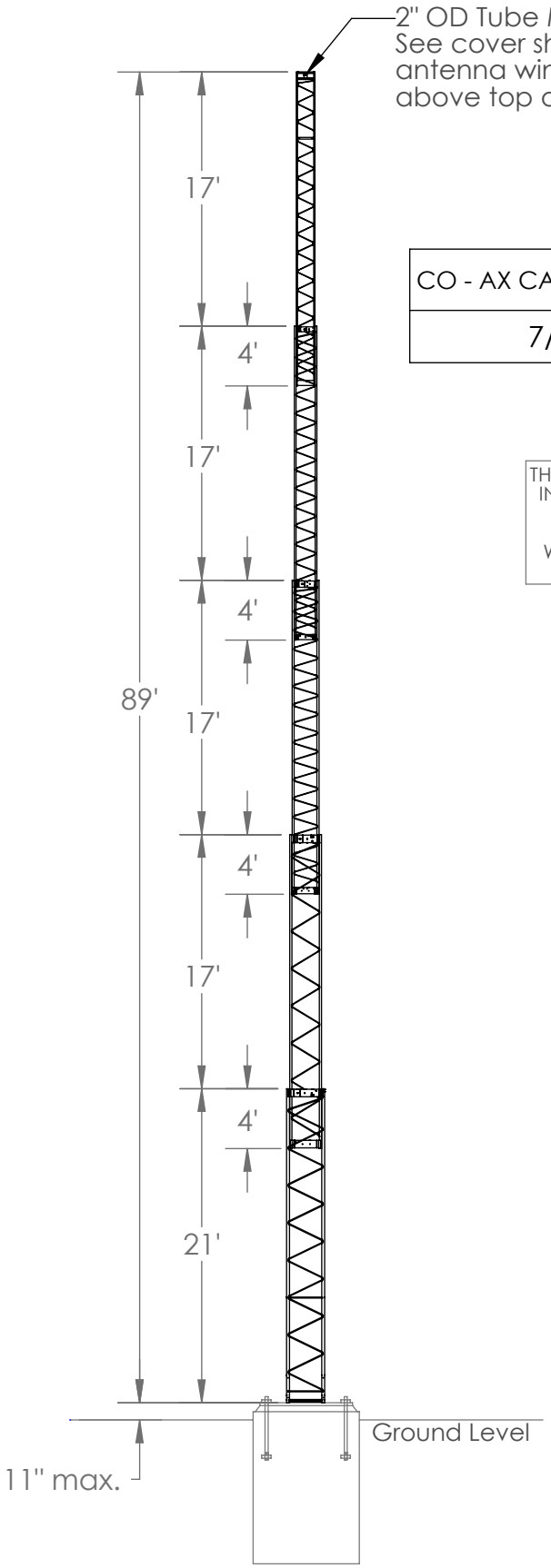
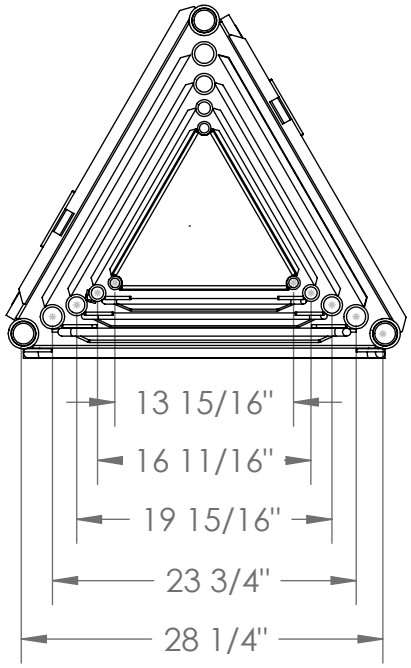
HDX-589 TOWER ELEVATION

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	PIPE 1.9" OD X 0.2" WALL	5/8" SOLID ROD
NO. 9 BASE	PIPE 2.375" OD X 0.218" WALL	3/4" 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-589**

1. All work shall be in conformance with the requirements of the "International Building Code - 2009" 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-589

Governing Codes, Stresses, and Materials (Min.)

International Building Code	2009 Edition (Occ. Cat. II)
California Building Code	*2010 Edition*
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-589

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):	89
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	21	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	24	21	0
Top Lap (ft):	0	0	0	4	4	4	4	0
Bottom Lap (ft):	0	0	4	4	4	4	0	0
No. of additional lap diagonal webs:	0	0	7	13	13	7	4	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	13	17	0
Section PA (sqft/ft):	**0.000**	**0.000**	**0.442**	**0.472**	**0.590**	**0.642**	**0.997**	**0.000**
Section PA (sqft/ft):	**0.000**	**0.000**	**0.442**	**0.472**	**0.590**	**0.642**	**0.997**	**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:**	**2.792**	**2.792**		

Weight:

Legs:	0	0	93	137	189	229	317	0
Webs:	0	0	65	114	171	176	251	0
Anchors:	0	0	36	53	70	121	126	0
Misc.:	0	0	19	30	43	53	69	0
Total weight:	**0**	**0**	**213**	**335**	**473**	**579**	**764**	**0**
Total weight:	**0**	**0**	**213**	**335**	**473**	**579**	**764**	**0**

Tower Loading - Shear & Moments

Wind Loads

Tower Model: HDX-589

Design per TIA-222-G

Wind velocity (mph):	85
Exposure:	C
Topo Category:	1
Tower Height (ft):	89
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):	13	Mast Dia. (in):	2
Force Coefficient C-f:	1.2	Mast Lgth (in):	48
EPA (ft^2):	15.6	Force Coeff. C-f:	1.2
Ant. + Mt. wt. (lbs):	350	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):	27	

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	15.6	90	90	1.238	16.93	359	359	0	0	0	38.2	3.9	359	0		No Ice
Mast	0.800	89	89.5	1.236	16.91	18	378	378	0	378	38.2	3.9	378	378		No Ice
Top of 3	0.000	89	89	1.235	16.89	0	378	378	0	378	38.2	3.9				
3	0.000	89	89	1.235	16.89	0	378	378	0	378	38.2	3.9	378	378		No Ice
Top of 4	0.000	89	89	1.235	16.89	0	378	378	0	378	38.2	3.9				
3&4	0.000	89	89	1.235	16.89	0	378	378	0	378	-	-	378	378		No Ice
4	0.000	89	89	1.235	16.89	0	378	378	0	378	38.2	3.9	378	378		No Ice
Top of 5	0.000	89	89	1.235	16.89	0	378	378	0	378	38.2	3.9				
4&5	0.000	89	89	1.235	16.89	0	378	378	0	378	-	-	378	378		No Ice
5	0.529	72	80.5	1.209	16.54	12	580	8517	470	8987	25.0	3.4	580	8987		No Ice
Top of 6	0.000	72	72	1.181	16.15	0	580	8517	470	8987	25.0	3.4				
5&6	1.377	68	70	1.174	16.06	30	700	11078	470	11548	-	-	700	11548		No Ice
6	0.560	55	61.5	1.142	15.63	12	855	21186	1068	22254	14.3	2.6	855	22254		No Ice
Top of 7	0.000	55	55	1.116	15.26	0	855	21186	1068	22254	14.3	2.6				
6&7	2.054	51	53	1.107	15.15	42	1024	24944	1068	26012	-	-	1024	26012		No Ice
7	0.677	38	44.5	1.067	14.60	13	1199	39393	1729	41123	6.6	1.7	1199	41123		No Ice
Top of 8	0.000	38	38	1.032	14.12	0	1199	39393	1729	41123	6.6	1.7				
7&8	2.446	34	36	1.021	13.96	46	1385	44560	1729	46290	-	-	1385	46290		No Ice
8	0.729	21	27.5	0.964	13.19	13	1555	63666	2315	65981	2.0	0.9	1555	65981		No Ice
Top of 9	0.000	21	21	0.911	12.46	0	1555	63666	2315	65981	2.0	0.9				
8&9	2.880	17	19	0.892	12.20	48	1746	70267	2315	72582	-	-	1746	72582		No Ice
9	1.084	0.1	8.55	0.850	11.63	17	2036	102220	2656	104875	0.0	0.0	2036	104875		No Ice
Top of 10	0.000	0	0	0.850	11.63	0	0	0	0	0	0.0	0.0				
9&10	0.088	0	0	0.850	11.63	1	0	0	0	0	-	-	0	0		Ice
10	0.000	0	0	0.850	11.63	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:	27	(at top of tower)
3	0	
4	0	
5	213	
6	335	
7	473	
8	579	
9	764	
10	0	
Total:	2391	lbs

Section	Lift cable force (lbs)
5	**708**
6	**1415**
7	**2927**
8	**5172**
9	**3840**
NA	**0**
NA	**0**
NA	**0**

Lift Cable Analysis

No Ice

Tower Model: HDX-589

Design per TIA-222-G

Note: All units are in pounds.

Tower Data:	
No. of twr. sections:	**5**
Ant & Mt weight (lb):	420
Misc. wt. (lb):	0
Accessories wt. (lb):	0
Coax cable wt. (lb):	32
Weight at Top (lbs):	452

Tower Section:	Section Wt. (lb):	Vert. Component of Guy Cables (lb):
5	256	0
6	402	0
7	568	0
8	695	0
9	916	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:	2
F-v = CFtot:	708
Cable force per face:	354
Cable CSI:	0.08

Anchor Frame-Tower Section: 9 — 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: 6
Sum F-vp: 1415 (=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:	2
F-v = CFtot:	1817
Cable force per face:	909
Cable CSI:	0.22

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: 2927 (=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:	3495
Cable force per face:	1165
Cable CSI:	0.28

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: 5172 (=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: 9

Cable dia (in):	0.25
Cable MBS:	7000
No. of faces w/cable:	4
F-v = CFtot:	5868
Cable force per face:	1467
Cable CSI:	0.35

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: 9
Sum F-vp: 3840 (=Lift cable force for section analysis)

Tower Sections - Analysis

Tower Model: HDX-589

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	580	855	1199	1555	2036	0
Lift Cable Force (lb):	0	0	708	1415	2927	5172	3840	0
Moment (ft-lb):	0	0	8987	22254	41123	65981	104875	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	4	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	369	529	724	1047	1308	0
Ø*P-n (lbs);	2430	2206	1863	2593	3339	4738	7425	10151
Web CSI:	**0.00**	**0.00**	**0.20**	**0.20**	**0.22**	**0.22**	**0.18**	**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**	**0.17**	**0.16**	**0.20**	**0.23**	**0.20**	**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	2247	5564	10281	16495	16495	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	900	1985	3465	6079	5952	0
Ø*P-n (lbs);	2338	2796	2565	3531	4579	6963	10241	13970
Web CSI:	**0.00**	**0.00**	**0.35**	**0.56**	**0.76**	**0.87**	**0.58**	**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**	**0.41**	**0.61**	**0.94**	**0.88**	**0.60**	**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	9170	18960	29553	40261	52722	0
ØP-n (lbs);	16636	16636	16636	26024	37357	40162	59433	93888
M-u = M-ecc (in-lb):	0	0	830	2361	4964	2880	6888	0
ØM-n (in-lbs);	5618	5618	5618	10481	18652	26130	45798	84210
Leg CSI:	**0.00**	**0.00**	**0.62**	**0.88**	**1.01**	**1.00**	**0.94**	**0.00**
	Section 3	**Section 4**	**Section 5**	**Section 6**	**Section 7**	**Section 8**	**Section 9**	**Section 10**

Tower Base Connection
Base Section #9
Tower Model: HDX-589

Base Connection:

Shear (lbs):	2036	Leg Comp. (lbs):	52722		
Moment (ft-lbs):	104875	Leg Tension (lbs):	50162		
Lift Cable force (lbs):	3840	Leg O.D. (in):	2.375		
Face width (in):	28.25				
Tab Plate to Leg:		C.L. bolt to leg (in):	1.5		
Plate width (in):	3.5	Bolt dia. (in):	1	(A325N)	
Plate height (in):	13	No. of bolts:	4		
Plate Thkn. (in):	0.5	Dist. between bolts:	3		
Bolt force (lbs):	19352	Weld tab to leg:		Weld size (in):	0.1875
Allow. bolt shr. (lbs):	21991	Moment (in-lbs):	141690		
Br'g check	**OK**	Weld Zx (in3):	5.602		
Bolt CSI:	**0.88**	Weld stress (lbs/in2):	29728		
		Allow Stress (lbs/in2):	31500	**Weld CSI:**	**0.94**
5x5x1/2 Angle to Base:					
F-y (psi):	36000	KL/r:	3	Pu (lbs):	52722
S-x (in3):	3.16	Lambda-c:	0.04	Mu (lbs-in):	141690
Area (in2):	4.75	Fcr (psi):	35979	Vu (lbs):	679
Zx (in3):	5.68				
Bolt ecc. (in):	1.2	Pn (lbs):	145266	**Angle CSI:**	**0.91**
Shear ecc. (in):	8.75	Mn (lb-in):	170640		
Distance from first bolt to base plate:	4.25	Vn (lb):	92340		
Weld tab to base:		Weld size (in):	0.375		
Weld Zx (in3):	13.733				
Moment (in-lbs):	66132				
Weld stress (lbs/in2):	4816	**Weld CSI:**	**0.15**		
Allow Stress (lbs/in2):	31500				

Base Plate Assembly:

Top Plate:		Bot. Plate:		Concrete bearing:	f-c (psi):	2500	
W (in):	8.000	W (in):	8.000	f-p (psi):	864		
L (in):	7.625	L (in):	7.625	F-p (psi):	1275	**CSI:**	**0.68**
Thkn. (in):	0.500	Thkn. (in):	0.500				

Combined Plate Properties:

Top Plate:		Bot. Plate:		Combined Section	
Area:	4.0000	Area:	4.0000	Zx (in3):	4.00

Moment - from comp (in-lbs):	50251		
Mn (lb-in):	129600	**CSI:**	**0.39**

Foundation Design

Tower Model: HDX-589

Tower Reactions: (ASD)		Foundation Design Reactions: (LRFD)	
Ft'g size per ASD		Concrete design per LRFD	
Moment (ft-lbs):	65547	Moment (ft-lbs):	106233
Shear (lbs):	1272	Shear (lbs):	2036
Lift Cable Force (lbs):	3200	Lift Cable Force (lbs):	3840
		Concrete f-c' (psi):	2500
Tower Face Width(in):	28.25		
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):	52.19	**Allow. bearing (psf):**	**1500**
S-1:	533	**Act. bearing (psf):**	**1328**
(Increased S1 by 2x per IBC 1806.3.4 for isolated footing not adversely affected by 1/2" motion at ground surface.)			
A:	0.789		
Depth req'd (ft):	**7.1**	Max. Moment in Footing (ft-lbs):	117215
Check concrete tensile stress: (neglect outer 2" of footing)			
S-x (in^3):	29269		
f-t (psi):	48	CSI is < 1.0 therefore reinforcing is not req'd. Use	
F-t (psi):	150	minimal reinforcing.	
CSI:	**0.32**	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): **48882** (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 1/8" 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-589

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 1/8" dia, F1554 Grd. 36 or A-36 anchor rods

Concrete f-c' (psi):	2500	Is this in a moderate or High Seismic area	1.00	Factored Req'd Tens. Load (lb):	**48882** (LRFD value)
Embedment:	21	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.	

h-ef: 20.28 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:	1.125
No. of threads / in:	7
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:	**30.42**
c-a2:	**29.58**
c-a3:	**14.75**
c-a4:	**45.25**

Concrete Breakout Input: (Tension)

A-Nco:	3700.3	Projected breakout area of single anchor
A-Nc:	2935.7	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:	**0.42**	Eccentricity of tension load - anchor groups only
AdjF-ec,N:	0.987	(ACI D5.2.4) for anchor groups loaded eccentrically
AdjF-ed,N:	0.918	(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:	0.763	Effective anchor area (in^2)
N-sa:	88540	

Concrete Breakout Strength of Anchor in Tension (ACI D5.2)

N-b:	109567	ACI D5.2.2
N-cbg:	98428	

Anchor Pullout Strength (ACI D5.3)

N-p:	37020
N-pn:	103656

Concrete Side-Face Blowout, Tension

N-sbg: 120634 Note: If Ca1 is >0.4*h-ef then blowout does not occur.

Anchor Design Strength - LRFD

Steel:	66405
Breakout:	68899
Pullout:	72559
Blowout:	84444

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

Concrete Pullout Input:

A-head:	**1.851**	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:	1.851	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

Side Face Blowout Input

Spacing:	5.00	Min. distance between multiple anchors (input 0 for one anchor)
c2:	29.58	Edge distance perp. To c-min.
c-min:	14.749	Min. edge distance considering all fasteners
AdjF1:	0.751	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

LRFD Design Strength:	**66405 Lbs**
ASD Design Strength:	**41503 Lbs**
Design Controlled By:	Steel Tension
Min. center to center of anchor spacing (in):	4.5
Min. edge distance is same as min. cover per ACI 7.7.	

ACI D.8.1

Loads at Bolts

Vu =	339	lbs
Pu =	24441	lbs
Stress check	Phi = 0.75	
Pn =	33202	lbs
n =	0.55	Det.C F4.4
(Pu+Vu/n)/(Phi.Pn) <= 1.0		
CSI =	**0.75**	

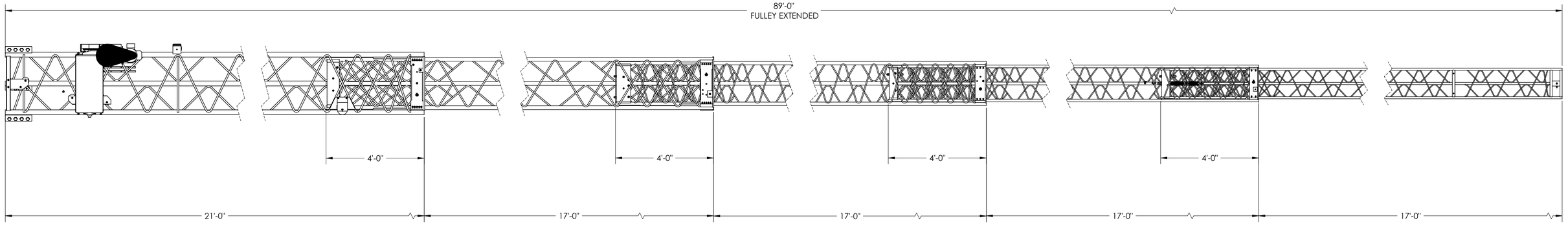
Notes:

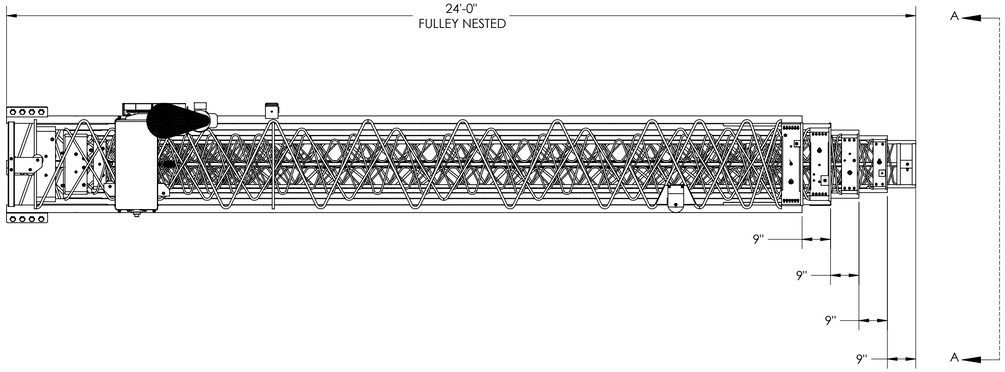
1. For normal weight concrete only.
2. Anchors shall be either a headed bolt or have nuts and a bearing plate at the embed end as indicated above.
3. ACI Section D.5.2.3 is not included in this spreadsheet. (i.e. End of wall applications are not covered.)
4. If the design is controlled by concrete failure (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.

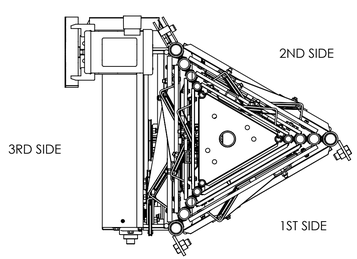
NOTES:

1. INTERPRET PER ANSI/ASME Y14.
2. SEE WORK INSTRUCTIONS ON INSTALLING CABLES. (ITEMS 20, 27, 28, 32, 39, 40, 44, & 63) NOT SHOWN.
3. HOLES & COUNTERSINK ARE DONE IN 1 OF ITEM 2 PRIOR TO ASSEMBLING ON TOWER.

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	G	CHANGE PER ECO NO. 04600	12/7/12	MARK







SECTION A-A
SCALE 1 : 12

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
65	99612-0003-0003	NUT, HEX, LOCK, 3/8-16, GRD 2, ZINC, NYLON	1
64	99652-0019-0005	SCREW, F.H.S.C.S., 3/8-16 X 1" ZINC GRD 5	1
63	16500-0006-1004	1/4" GALV., CABLE, LOOP-LOOP, 20'-11"	2
62	99904-0004-0008	SCREW, H.T.C.S., 1/2-20 X 1 3/4" LG, ZINC, GRD 5	8
61	99904-0005-0005	SCREW, H.T.C.S., 1/2-13 X 1 1/4" LG, GRD 5 ZINC	4
60	20201-0007-0040	MDPL PULLDOWN BRACKET-A	1
59	20301-0002-0199	#7, 8, & 9 SHORT PULLDOWN ANGLE	1
58	16700-0006-0000	3.5 PULLEY ASSEMBLY W/K8, 1/4 GROOVE	6
57	10600-0005-2011	#9 LONG PULLDOWN ANGLE WELDMENT	1
56	99818-0006-0004	SCREW, HEX HD, THRD-CUTTING, 1/4-20 x 3/4", F-TYPE, STL ZINC	4
55	10802-2013-0000	# 9 MOTOR DRIVE COVER WELDMENT	1
54	10005-0003-2010	#9 BELT GUARD WELDMENT	1
53	10802-2008-0000	CHAIN GUARD WELDMENT	1
52	99904-0003-0007	SCREW, H.T.C.S., 3/8-16 X 1-1/4" LG, GRD 5, ZINC	4
51	10400-2004-0000	SECTION # 5 TOP, WELDMENT	1
50	99754-0003-0003	SCREW, SET, SQ HEAD, CUP POINT, 3/8-16 X 1" LG, STL ZINC	2
49	12003-2003-0000	THREADED ROD-21" WELDMENT	1
48	12006-2010-0000	SECTION 5 PULLDOWN WELDMENT	1
47	20201-0007-0010	#5 ROTOR PLATE	1
46	99612-0001-0006	NUT, HEX, LOCK, 1/4-20, STL ZINC, GRD 5	6
45	99652-0015-0024	SCREW, F.H.S.C.S., 1/4-20 X 1" LG, ALLOY STL, ZINC	6
44	37001-0001-0006	CABLE, 7 X 19 GALV. 1/4"	1200
43	37022-0004-0003	1/4" FORGED CABLE CLIP, WIRE ROPE, GALV.	2
42	37004-0002-0006	1/4" HEAVY DUTY THIMBLE	1
41	99000-0005-0002	DIE SPRING, 56 LB/IN, 2" O.D., 1" I.D., GRAY	2
40	16504-0006-0988	1/4" CABLE, LOOP W/ 3/8" ANCHOR THREADED ROD, 20'-7" LG.	1
39	16500-0006-1000	1/4" GALV. CABLE, 7 X 19, LOOP-LOOP, 20'-10" LG.	1
38	15003-2032-0002	ANCHOR THREADED ROD WELDMENT - 3/8"	4
37	10600-0005-2010	#6 CABLE ANCHOR CHANNEL WELDMENT	1
36	15003-2015-0000	SECTION #6, PULLEY FRAME WELDMENT	2
35	10400-2010-0000	SECTION #6 PULLEY DOWN	1
34	99904-0005-0007	SCREW, H.T.C.S., 1/2-13 X 1-1/2" LG, GRD 5 ZINC	17
33	99623-0002-0027	NUT, HEX, 1/2-13, GRD 5, ZINC	7

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
32	16504-0006-0994	1/4" CABLE, LOOP W/ 3/8" ANCHOR THREADED ROD, 20'-8-1/2" LG.	1
31	10600-0005-2009	#7 CABLE ANCHOR CHANNEL WELDMENT	2
30	10400-2014-0000	SECTION #7 PULLEY DOWN WELDMENT	1
29	10400-2031-0000	#7 PULLEY FRAME WELDMENT	2
28	16504-0006-0998	1/4" GALV. CABLE LOOP-LOOP W/3/8" ANCHOR THREADED ROD, 20'-9 1/2" "LG.	2
27	16500-0006-0996	1/4" GALV. CABLE, 7 X 19, LOOP-LOOP, 20'-9" LG.	1
26	99718-0001-0006	WASHER, FLAT 1/2", ZINC, GRD 5	26
25	15003-2019-0000	SECTION 8, PULLEY FRAME WELDMENT, MTU/MTS	3
24	10400-2015-0000	SECTION #8 PULLEY UP WELDMENT	1
23	99625-0029-0000	NUT, HEX, LOCK, 5/8-18, ZINC, GRD 5, NYLON INSERT	1
22	99904-0013-0007	BOLT, H.T.C.S., 5/8-18 X 2-1/2"LG, ZINC, GRD 5	1
21	16700-0009-0000	5" ALUM. PULLEY, 1/4" GROOVE W/K10 BEARING	1
20	16501-0006-5376	1/4" GALV. CABLE, 7 X 19, LOOP-ST, 112' LG.	1
19	99652-0023-0009	F.H.S.S., 1/2"-13 X 2 SPECIAL MACHINED HEAD	3
18	16700-0008-0000	5" ALUM. PULLEY, 1/4" GROOVE W/K8 BEARING	9
17	99718-0001-0008	WASHER, FLAT, 5/8", 1.43 OD, ZINC GRD 5	2
16	99904-0004-0009	SCREW, H.T.C.S., 1/2-20 X 2" LG, ZINC, GRD 5	14
15	99612-0001-0024	NUT, HEX, LOCK, 1/2-20, GRD 5 ZINC, NYLON INSERT	22
14	25502-0004-0001	ALUMINUM SPACER	5
13	99612-0001-0010	NUT, LOCK, 1/2-13, ZINC, GR 5, NYLON INSERT	38
12	99652-0023-0008	SCREW, F.H.S.C., 1/2"-13 X 2", STL, ZINC	8
11	20021-0008-0001	UST CABLE KEEPER	2
10	99612-0003-0005	NUT, LOCK, JAM, 1/2-13, GRD 2 ZINC, NYLON INSERT	3
9	99904-0003-0005	BOLT, H.T.C.S., 3/8-16 X 1" LG, ZINC, GRD 5	67
8	99612-0001-0008	NUT, HEX, LOCK, 3/8"-16, ZINC, GRD 5, NYLON	71
7	99623-0002-0032	NUT, HEX, 1"-8, ZINC, GRD 5	12
6	99904-0011-0011	SCREW, H.T.C.S., 1-8 X 2" LG, GRD 5 ZINC	12
5	15003-2022-0000	PULL DOWN WELDMENT	1
4	10400-1004-0000	# 9 MDPL MOTOR DRIVE ASSEMBLY	1
3	10400-2039-0000	# 9 MDPL TOP IDLER WELDMENT	1
2	10600-0005-2008	#9 PULLEY FRAME W/GUSSETS, WELDMENT	1
1	10400-2018-0000	SECTION #9-BASE WELDMENT	1

THIRD ANGLE PROJECTION

	NAME	DATE
DRAWN	KAREN	4-20-10
CHECKED	JOHN	5-5-10
APPROVED	JOHN	5-5-10

DO NOT SCALE THIS DOCUMENT

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
MACHINE SURFACES WILL BE 125
TOLERANCES:
± 1/16" ON ALL FRACTIONAL DIMENSIONS
± .03" ON ALL .XX DIMENSIONS
± .015 ON ALL .XXX DIMENSIONS
± 1/2° ON ALL ANGLE DIMENSIONS

US TOWER CORPORATION
1099 W. ROPES AVE.
WOODLAKE, CA 93285
(559) 564-6000
FAX: (559) 564-6009
www.ustower.com

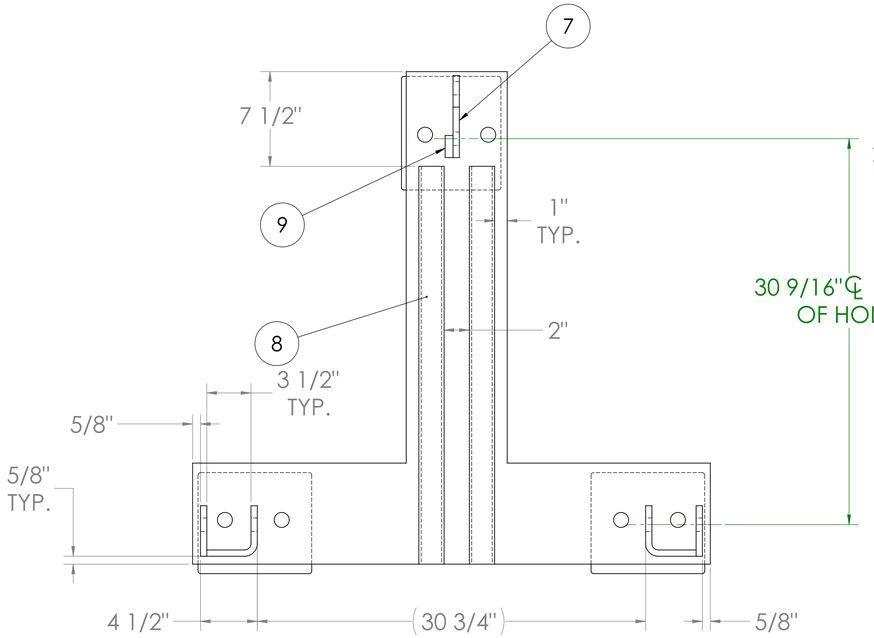
TITLE:

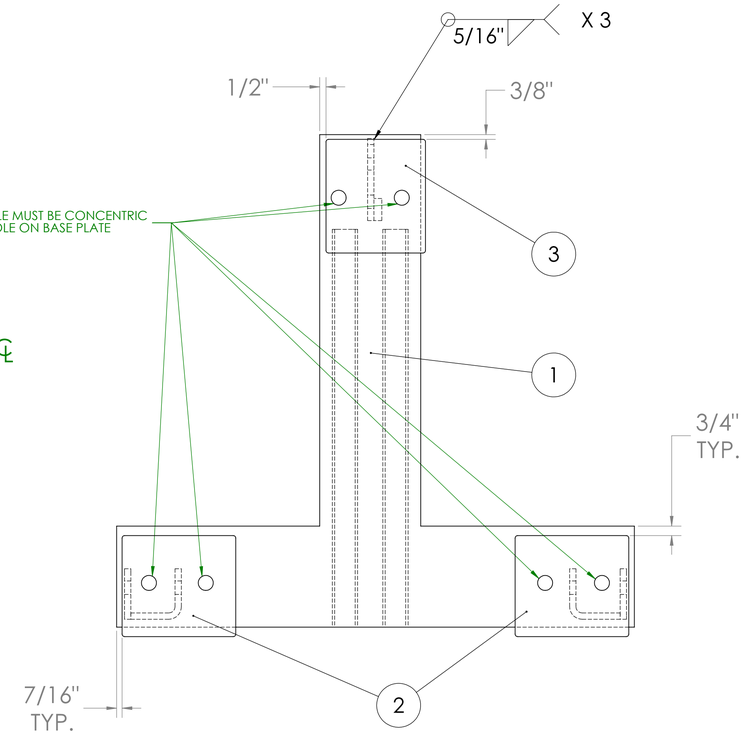
HDX - 589 MDPL TOWER ASSEMBLY

SIZE	CAGE CODE	DWG. NO.	REV
D	0BB47	10600-0005-0000	G

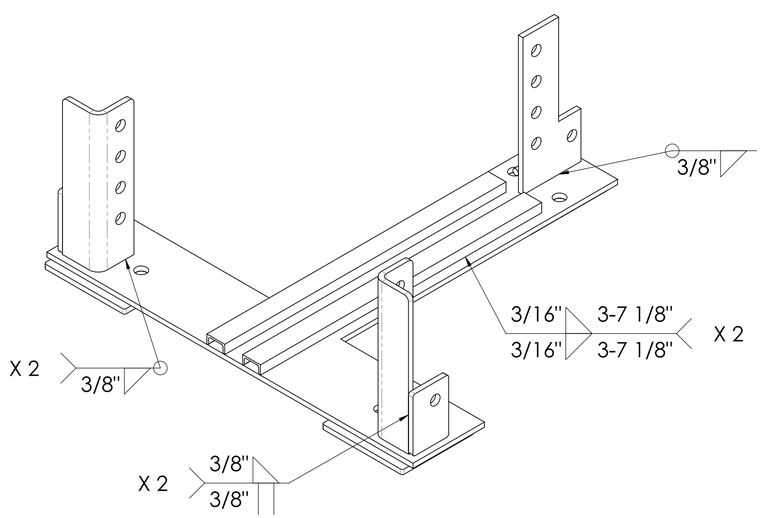
SCALE: 1:24 SHEET 1 OF 6

REVISION HISTORY				
ZONE	REV	DESCRIPTION	DATE	APPROVED
	B	CHANGE PER ECO NO.02568	1-15-11	KAREN

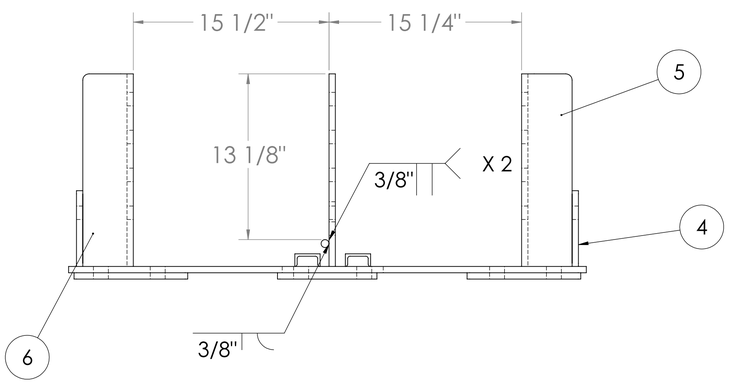




BOTTOM VIEW



TOP VIEW



ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
9	20101-0011-0040	#8 T-BASE STOP	BAR, STEEL, RND, HR, ASTM A36, Ø5/8"	1
8	20403-0014-0022	#9 T-BASE CHANNEL	STEEL, CHANNEL, A-36, 2" X 1" X 3/16" THK.	2
7	20301-0006-0033	#9 T-BASE TOP EAR	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	1
6	20301-0006-0067	#9 T-BASE BOTTOM EAR-LH	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	1
5	20301-0006-0066	#9 T-BASE BOTTOM EAR-RH	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	1
4	20301-0006-0035	#9 T-BASE SIDE EAR	PLATE, STEEL,HR, ASTM A36, 1/2" THK.	2
3	20301-0006-0036	#9 T-BASE TOP PAD	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	1
2	20301-0006-0037	#9 T-BASE BOTTOM PAD	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	2
1	20301-0006-0038	#9 T-BASE PLATE	PLATE, STEEL, HR, ASTM A36, 1/2" THK.	1

THIRD ANGLE PROJECTION

DO NOT SCALE THIS DOCUMENT

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
MACHINE SURFACES WILL BE 125
TOLERANCES:
± 1/16" ON ALL FRACTIONAL DIMENSIONS
± .03" ON ALL .XX DIMENSIONS
± .015 ON ALL .XXX DIMENSIONS
± 1/2° ON ALL ANGLE DIMENSIONS

	NAME	DATE
DRAWN	PERVEZ	07-07-09
CHECKED	JOHN	07-13-09
APPROVED	JOHN	07-13-09

US TOWER CORPORATION
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WOODLAKE, CA 93285
(559) 564-6000
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TITLE:

#9 TOWER BASE WELDMENT

SIZE	CAGE CODE	DWG. NO.	REV
D	0BB47	10810-0004-2006	B

SCALE: 1:8 SHEET 1 OF 1

LAST SAVED: Saturday, January 15, 2011 10:09:40 AM

FOUNDATION

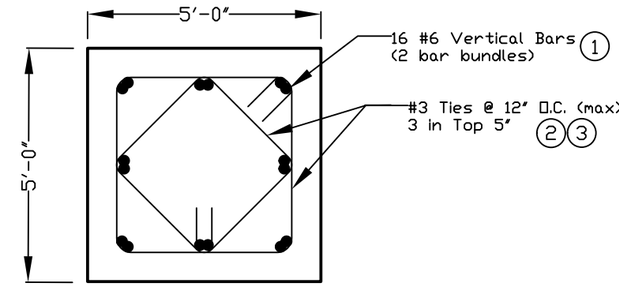
HDX-589

FOUNDATION DESIGN LOADS

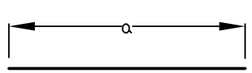
OVERTURNING MOMENT: 106.23 ft.kips
BASE SHEAR: 2.04 kips
STRUCTURE WEIGHT: 3.84 kips

SOIL & CONCRETE DESIGN PARAMETERS

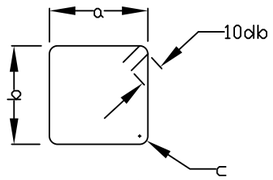
ALLOWABLE VERTICAL BEARING PRESSURE: 1500 PSF
ALLOWABLE LATERAL PRESSURE: 100 PSF
CONCRETE F'c = 2500 psi @ 28 DAYS



Plan View - Reinforcing
Not to Scale



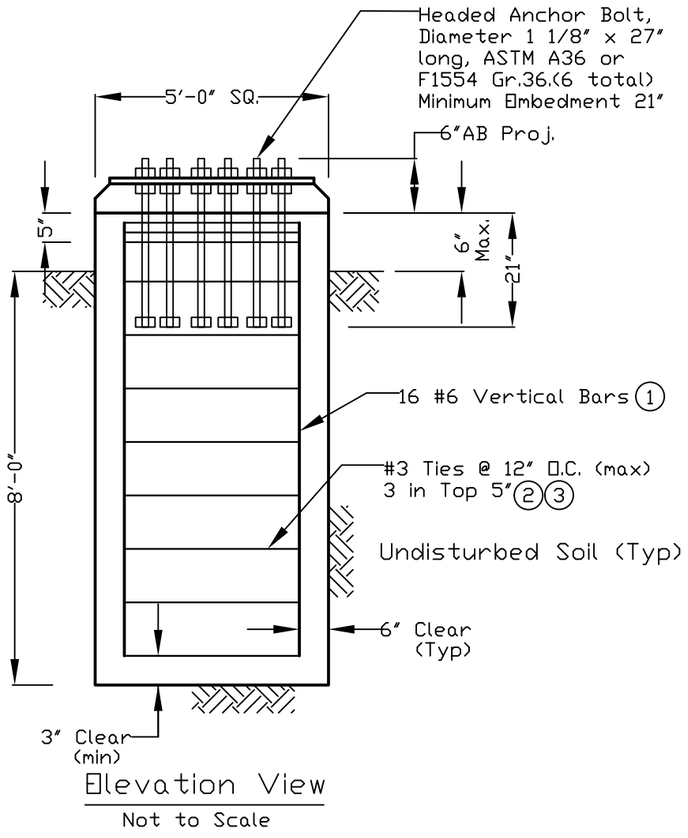
Type A



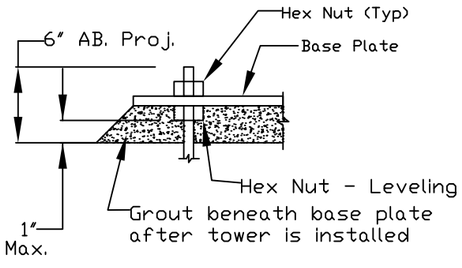
Type B

Reinforcement Material List							
Symbol	Type	Bar Size	Dimensions a	b	c	10db	Qty
(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



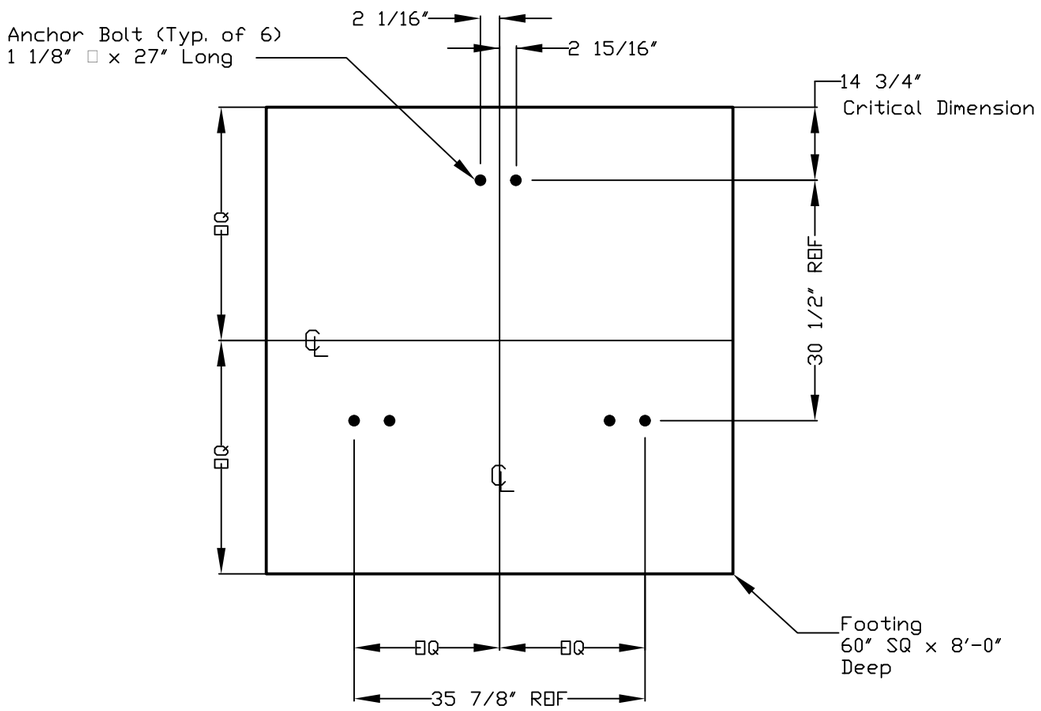
Elevation View
Not to Scale



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".



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