Structure Design For
40m Self-Support Tower

Client : www.asmtower.com
Project: ASMTower Verification

A	12/21/2017	First issue	M.Joe	ASM
Rev.	**Date**	**Description**	**Designed by**	**Reviewed by**

Design Basics

The design is according to ANSI/TIA-222-G-2, the following is the main design parameters:

- Basic wind speed is 45 m/s.
- Service wind speed is 35 m/s.
- Exposure category is C.
- Structure class is II.
- Topographic category is 1.
- Elevation at bottom of tower is 0 m.
- Wind directions applied on tower in the analysis are generated manually.
- Wind directions applied on tower in the analysis are 0, 45 Deg.
- Wind load on each panel antenna are based on actual direction.
- Wind load on each microwave are based on actual direction.

Antenna Loading Configuration

The tower is designed to carry the following:

- 1 panel antenna 2560x250x135 with mount Pipe 76x3000 at 39m.
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- 1 panel antenna 2560x250x135 with mount Pipe 76x3000 at 39m.
- 1 panel antenna 2560x250x135 with mount Pipe 76x3000 at 39m.
- 1 panel antenna 2560x250x135 with mount Pipe 76x3000 at 39m.
- 1 panel antenna 560x430x120 with mount Pipe 76x1500 at 37m.
- 1 panel antenna 560x430x120 with mount Pipe 76x1500 at 37m.
- 1 MW type HP 1.2m with mount Pipe 76x1500 at 35m.
- 1 MW type HP 1.2m with mount Pipe 76x1500 at 35m.
- 1 MW type HP 1.2m with mount Pipe 76x1500 at 37m.
- 1 MW type HP 1.2m with mount Pipe 76x1500 at 37m.

Latticed Panel Geometry

Panel No.	Bottom Elev. m	Top Elev. m	Bottom Width m	Top Width m	Type	Sub Divide
1	38	40	1.45	1.45	X	0
2	36	38	1.45	1.45	X	0
3	34	36	1.45	1.45	X	1
4	32	34	1.45	1.45	X	1
5	30	32	1.45	1.45	X	1
6	28	30	1.45	1.45	X	1
7	26	28	1.618	1.45	X	1
8	24	26	1.786	1.618	X	1
9	22	24	1.953	1.786	X	1
10	20	22	2.121	1.953	X	1
11	18	20	2.289	2.121	X	1
12	16	18	2.457	2.289	X	1
13	14	16	2.625	2.457	X	1
14	12	14	2.793	2.625	X	1
15	10	12	2.96	2.793	X	1
16	8	10	3.128	2.96	X	1
17	6	8	3.296	3.128	X	1
18	4	6	3.464	3.296	X	1
19	0	4	3.8	3.464	A	2

Section Properties

ID	Name	Area mm^2	ey mm	ez mm	q Deg	rmin mm	rmax mm	ry mm	rz mm
1	L70x5	675	19.4	19.4	45	13.9	27.6	21.8	21.8
2	L70x7	940	20.1	20.1	45	13.8	27.2	21.5	21.5
3	L80x8	1230	22.9	22.9	45	15.7	31.1	24.6	24.6
4	L90x9	1539	25.8	25.8	45	17.7	35	27.7	27.7
5	L100x10	1915	28.7	28.7	45	19.7	38.8	30.8	30.8
6	L120x10	2318	33.7	33.7	45	23.7	47	37.2	37.2
7	L60x4	464	16.5	16.5	45	11.9	23.7	18.8	18.8
8	L50x5	480	14.3	14.3	45	9.8	19.4	15.4	15.4
9	L40x4	308	11.5	11.5	45	7.9	15.5	12.3	12.3
10	L80x6	924	22.2	22.2	45	15.8	31.5	24.9	24.9

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ID	Name	Area mm²	ey mm	ez mm	q Deg	rmin mm	rmax mm	ry mm	rz mm
11	Rod 16	201.1	8	8	0	4	4	4	4
12	Rod 8	50.3	4	4	0	2	2	2	2
13	L70x5	675	19.4	19.4	45	13.9	27.6	21.8	21.8

Latticed Panel Weights

Panel No.	Main Leg Weight kg	Main Diag. Weight kg	Main Horiz. Weight kg	Sec. Diag. Weight kg	Sec. Horiz. Weight kg	Hip bracing Weight kg	Plan bracing Weight kg	Total Weight kg
1	43.2	73.4	22.3	0	0	0	0	138.9
2	43.2	73.4	22.3	0	0	0	0	138.9
3	43.2	73.4	0	0	14.3	0	0	130.9
4	43.2	73.4	0	0	14.3	0	0	130.9
5	60.2	73.4	0	0	14.3	0	0	147.9
6	60.2	73.4	0	0	14.3	0	0	147.9
7	78.9	74.9	22.3	0	15.1	0	0	191.2
8	78.9	78.1	0	0	16.7	0	0	173.7
9	78.9	81.4	0	0	18.4	0	0	178.7
10	98.7	84.9	0	0	20.1	0	0	203.7
11	98.7	88.5	0	0	21.7	0	0	208.9
12	98.7	92.2	0	0	23.4	0	0	214.4
13	122.8	96.1	0	0	25	0	0	244
14	122.8	100.1	0	0	26.7	0	0	249.6
15	122.8	104.1	0	0	28.3	0	0	255.3
16	148.7	108.3	0	0	30	0	0	287
17	148.7	112.5	0	0	31.7	0	0	292.8
18	148.7	116.7	0	0	33.3	0	0	298.7
19	297.4	262.2	74.9	62.4	34.2	0	0	731
Total	1938.3	1840.4	141.7	62.4	381.8	0	0	4364.5

List of used profiles in the tower

ID	Type	Name	Grade	Length m	Weight kg	Paint Area m²
1	EqualAngle	L70x5	S355J0	32	172.9	8.64
2	EqualAngle	L70x7	S355J0	16	120.4	4.256

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ID	Type	Name	Grade	Length m	Weight kg	Paint Area m^2
3	EqualAngle	L80x8	S355J0	24.042	236.7	7.309
4	EqualAngle	L90x9	S355J0	24.042	296.2	8.222
5	EqualAngle	L100x10	S355J0	24.042	368.5	9.136
6	EqualAngle	L120x10	S355J0	40.07	743.5	18.432
7	EqualAngle	L60x4	S235J0	424.909	1578.2	98.579
8	EqualAngle	L50x5	S235J0	97.4	374.2	18.506
9	EqualAngle	L40x4	S235J0	180.136	444.1	27.381
10	EqualAngle	L80x6	S235J0	35.452	262.2	10.919
11	SolidRound	Rod 16	S235J0	56	90.1	2.815
12	SolidRound	Rod 8	S235J0	40	16.1	1.005
13	EqualAngle	L70x5	S235J0	13.856	74.9	3.741
Total					4778.1	218.942

Wind Calculation Of Basic Design Wind Speed 45 m/s Dir. 0

Gust effect factor	G_h	=	0.85
Direction probability	K_d	=	0.85
Important factor	I	=	1

Wind forces on latticed panels

Panel No.	Mean Elev. m	Flat Area m^2	Round Area m^2	Gross Area m^2	Solidity Ratio	Cf	Df	Dr	EPA m^2	q_z N/m^2	Force KN
1	39	0.649	0	2.977	0.22	2.9	1	1	1.885	1406.9	2.25
2	37	0.649	0	2.977	0.22	2.9	1	1	1.885	1391.4	2.23
3	35	0.634	0	2.977	0.21	2.92	1	1	1.855	1375.2	2.17
4	33	0.634	0	2.977	0.21	2.92	1	1	1.855	1358.2	2.14
5	31	0.634	0	2.98	0.21	2.93	1	1	1.856	1340.5	2.11
6	29	0.634	0	2.98	0.21	2.93	1	1	1.856	1321.8	2.09
7	27	0.757	0	3.16	0.24	2.82	1	1	2.132	1302.1	2.36
8	25	0.704	0	3.495	0.2	2.97	1	1	2.093	1281.1	2.28
9	23	0.724	0	3.831	0.19	3.03	1	1	2.192	1258.8	2.35
10	21	0.785	0	4.178	0.19	3.03	1	1	2.38	1235	2.5
11	19	0.806	0	4.514	0.18	3.07	1	1	2.478	1209.2	2.55
12	17	0.828	0	4.85	0.17	3.11	1	1	2.574	1181.2	2.58

Panel No.	Mean Elev. m	Flat Area m^2	Round Area m^2	Gross Area m^2	Solidity Ratio	Cf	Df	Dr	EPA m^2	q_z N/m^2	Force KN
13	15	0.89	0	5.197	0.17	3.11	1	1	2.766	1150.5	2.7
14	13	0.913	0	5.532	0.17	3.14	1	1	2.863	1116.4	2.72
15	11	0.936	0	5.868	0.16	3.16	1	1	2.959	1077.8	2.71
16	9	1.04	0	6.224	0.17	3.13	1	1	3.25	1033.2	2.85
17	7	1.063	0	6.559	0.16	3.15	1	1	3.348	980	2.79
18	5	1.087	0	6.895	0.16	3.17	1	1	3.446	912.9	2.67
19	2	2.305	0	14.798	0.16	3.18	1	1	7.325	896.9	5.58
Total									50.998	---	49.64

Wind force from ladder

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	38 To 40	0.6	0.47	0.419	0.267	0	1406.9	45	0.32
2	36 To 38	0.6	0.47	0.419	0.267	0	1391.4	45	0.32
3	34 To 36	0.6	0.47	0.419	0.267	0	1375.2	45	0.31
4	32 To 34	0.6	0.47	0.419	0.267	0	1358.2	45	0.31
5	30 To 32	0.6	0.47	0.419	0.267	0	1340.5	45	0.3
6	28 To 30	0.6	0.47	0.419	0.267	0	1321.8	45	0.3
7	26 To 28	0.6	0.47	0.419	0.267	0	1302.1	45	0.3
8	24 To 26	0.6	0.47	0.419	0.267	0	1281.1	45	0.29
9	22 To 24	0.6	0.47	0.419	0.267	0	1258.8	45	0.29
10	20 To 22	0.6	0.47	0.419	0.267	0	1235	45	0.28
11	18 To 20	0.6	0.47	0.419	0.267	0	1209.2	45	0.27
12	16 To 18	0.6	0.47	0.419	0.267	0	1181.2	45	0.27
13	14 To 16	0.6	0.47	0.419	0.267	0	1150.5	45	0.26
14	12 To 14	0.6	0.47	0.419	0.267	0	1116.4	45	0.25
15	10 To 12	0.6	0.47	0.419	0.267	0	1077.8	45	0.24
16	8 To 10	0.6	0.47	0.419	0.267	0	1033.2	45	0.23
17	6 To 8	0.6	0.47	0.419	0.267	0	980	45	0.22
18	4 To 6	0.6	0.47	0.419	0.267	0	912.9	45	0.21
19	0 To 4	0.6	0.941	0.838	0.534	0	896.9	45	0.41
Total					5.338	---	---	---	5.38

Wind vector from ladder

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#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.32	0	0	0	12.45	0
2	37	-0.32	0	0	0	11.68	0
3	35	-0.31	0	0	0	10.92	0
4	33	-0.31	0	0	0	10.17	0
5	31	-0.3	0	0	0	9.43	0
6	29	-0.3	0	0	0	8.7	0
7	27	-0.3	0	0	0	7.97	0
8	25	-0.29	0	0	0	7.27	0
9	23	-0.29	0	0	0	6.57	0
10	21	-0.28	0	0	0	5.88	0
11	19	-0.27	0	0	0	5.21	0
12	17	-0.27	0	0	0	4.56	0
13	15	-0.26	0	0	0	3.91	0
14	13	-0.25	0	0	0	3.29	0
15	11	-0.24	0	0	0	2.69	0
16	9	-0.23	0	0	0	2.11	0
17	7	-0.22	0	0	0	1.56	0
18	5	-0.21	0	0	0	1.04	0
19	2	-0.41	0	0	0	0.81	0
Total		-5.38	0	0	0	116.2	0

Wind forces from transmission line clusters

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	38 To 40	0.6	0.66	0.372	0.31	0	1406.9	45	0.37
2	36 To 38	0.6	0.66	0.372	0.31	0	1391.4	45	0.37
3	34 To 36	0.6	0.66	0.372	0.31	0	1375.2	45	0.36
4	32 To 34	0.6	0.66	0.372	0.31	0	1358.2	45	0.36
5	30 To 32	0.6	0.66	0.372	0.31	0	1340.5	45	0.35
6	28 To 30	0.6	0.66	0.372	0.31	0	1321.8	45	0.35
7	26 To 28	0.6	0.66	0.372	0.31	0	1302.1	45	0.34
8	24 To 26	0.6	0.66	0.372	0.31	0	1281.1	45	0.34
9	22 To 24	0.6	0.66	0.372	0.31	0	1258.8	45	0.33
10	20 To 22	0.6	0.66	0.372	0.31	0	1235	45	0.32

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
11	18 To 20	0.6	0.66	0.372	0.31	0	1209.2	45	0.32
12	16 To 18	0.6	0.66	0.372	0.31	0	1181.2	45	0.31
13	14 To 16	0.6	0.66	0.372	0.31	0	1150.5	45	0.3
14	12 To 14	0.6	0.66	0.372	0.31	0	1116.4	45	0.29
15	10 To 12	0.6	0.66	0.372	0.31	0	1077.8	45	0.28
16	8 To 10	0.6	0.66	0.372	0.31	0	1033.2	45	0.27
17	6 To 8	0.6	0.66	0.372	0.31	0	980	45	0.26
18	4 To 6	0.6	0.66	0.372	0.31	0	912.9	45	0.24
19	2 To 4	0.6	0.66	0.372	0.31	0	896.9	45	0.24
Total					5.882	---	---	---	6.01

Wind vector from transmission line clusters

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.37	0	0	0	14.44	0
2	37	-0.37	0	0	0	13.55	0
3	35	-0.36	0	0	0	12.67	0
4	33	-0.36	0	0	0	11.8	0
5	31	-0.35	0	0	0	10.94	0
6	29	-0.35	0	0	0	10.09	0
7	27	-0.34	0	0	0	9.25	0
8	25	-0.34	0	0	0	8.43	0
9	23	-0.33	0	0	0	7.62	0
10	21	-0.32	0	0	0	6.82	0
11	19	-0.32	0	0	0	6.05	0
12	17	-0.31	0	0	0	5.28	0
13	15	-0.3	0	0	0	4.54	0
14	13	-0.29	0	0	0	3.82	0
15	11	-0.28	0	0	0	3.12	0
16	9	-0.27	0	0	0	2.45	0
17	7	-0.26	0	0	0	1.81	0
18	5	-0.24	0	0	0	1.2	0
19	3	-0.24	0	0	0	0.71	0
Total		-6.01	0	0	0	134.57	0

Wind forces from panel antenna

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	39	1	0.965	0.622	0.793	0	1406.9	45	0.95
2	39	1	0.965	0.622	0.793	0	1406.9	45	0.95
3	39	1	0.965	0.622	0.793	0	1406.9	135	0.95
4	39	1	0.965	0.622	0.793	0	1406.9	135	0.95
5	39	1	0.965	0.622	0.793	0	1406.9	45	0.95
6	39	1	0.965	0.622	0.793	0	1406.9	45	0.95
7	37	1	0.289	0.087	0.188	0	1391.4	45	0.22
8	37	1	0.289	0.087	0.188	0	1391.4	45	0.22
Total					5.136	---	---	---	6.14

Wind vector from panel antenna

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.95	0	0	0	37	1
2	39	-0.95	0	0	0	37	-1
3	39	-0.95	0	0	0	37	-1
4	39	-0.95	0	0	0	37	1
5	39	-0.95	0	0	0	37	0.67
6	39	-0.95	0	0	0	37	-1.34
7	37	-0.22	0	0	0	8.23	0.27
8	37	-0.22	0	0	0	8.23	-0.23
Total		-6.14	0	0	0	238.47	-0.64

Wind forces from mounts Of panel antenna

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	39	1	0.033	0.274	0.154	0	1406.9	45	0.18
2	39	1	0.033	0.274	0.154	0	1406.9	45	0.18
3	39	1	0.033	0.274	0.154	0	1406.9	135	0.18
4	39	1	0.033	0.274	0.154	0	1406.9	135	0.18
5	39	1	0.033	0.274	0.154	0	1406.9	45	0.18
6	39	1	0.033	0.274	0.154	0	1406.9	45	0.18

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
7	37	1	0.071	0.123	0.097	0	1391.4	45	0.12
8	37	1	0.071	0.123	0.097	0	1391.4	45	0.12
Total					1.116	---	---	---	1.33

Wind vector from mounts Of panel antenna

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.18	0	0	0	7.16	0.15
2	39	-0.18	0	0	0	7.16	-0.15
3	39	-0.18	0	0	0	7.16	-0.15
4	39	-0.18	0	0	0	7.16	0.15
5	39	-0.18	0	0	0	7.16	0.09
6	39	-0.18	0	0	0	7.16	-0.22
7	37	-0.12	0	0	0	4.26	0.11
8	37	-0.12	0	0	0	4.26	-0.1
Total		-1.33	0	0	0	51.49	-0.11

Wind forces from MW dishes

#	Elev. m	O.D. mm	Area m^2	t_{iz} mm	q_z N/m^2	q Deg	C_a	Cs_s	Cm_m	F_a KN	F_s KN	M_m KN
1	35	1200	1.131	0	1375.2	45	1.12	0.29	-0.04	1.48	0.39	-0.06
2	35	1200	1.131	0	1375.2	315	1.12	-0.29	0.04	1.48	-0.39	0.06
3	37	1200	1.131	0	1391.4	225	-0.9	-0.27	-0.09	-1.2	-0.36	-0.14
4	37	1200	1.131	0	1391.4	135	-0.9	0.27	0.09	-1.2	0.36	0.14

Wind vectors from MW dishes

#	Elev. m	F_x KN	F_y KN	F_z KN	Mx KN.m	My KN.m	Mz KN.m	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	35	-1.32	0	0.77	0	-0.06	0	27.09	46.27	0.53
2	35	-1.32	0	-0.77	0	0.06	0	-27.09	46.27	-0.53
3	37	-1.1	0	0.59	0	-0.14	0	21.87	40.87	-0.69
4	37	-1.1	0	-0.59	0	0.14	0	-21.87	40.87	0.69
Total		-4.85	0	0	---	---	---	0	174.28	0

Wind forces from mounts Of MW dishes

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	35	1	0.023	0.123	0.073	0	1375.2	45	0.09
2	35	1	0.023	0.123	0.073	0	1375.2	45	0.09
3	37	1	0.023	0.123	0.073	0	1391.4	135	0.09
4	37	1	0.023	0.123	0.073	0	1391.4	135	0.09
Total					0.293	---	---	---	0.34

Wind vectors from mounts Of MW dishes

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	35	-0.09	0	0	0	2.99	0.08
2	35	-0.09	0	0	0	2.99	-0.08
3	37	-0.09	0	0	0	3.2	-0.08
4	37	-0.09	0	0	0	3.2	0.08
Total		-0.34	0	0	0	12.38	0

Wind Calculation Of Basic Design Wind Speed 45 m/s Dir. 45

Gust effect factor	G_h	=	0.85
Direction probability	K_d	=	0.85
Important factor	I	=	1

Wind forces on laticed panels

Panel No.	Mean Elev. m	Flat Area m^2	Round Area m^2	Gross Area m^2	Solidty Ratio	Cf	Df	Dr	EPA m^2	q_z N/m^2	Force KN
1	39	0.649	0	2.977	0.22	2.9	1.16	1.16	2.193	1406.9	2.62
2	37	0.649	0	2.977	0.22	2.9	1.16	1.16	2.193	1391.4	2.59
3	35	0.634	0	2.977	0.21	2.92	1.16	1.16	2.152	1375.2	2.52
4	33	0.634	0	2.977	0.21	2.92	1.16	1.16	2.152	1358.2	2.48
5	31	0.634	0	2.98	0.21	2.93	1.16	1.16	2.152	1340.5	2.45
6	29	0.634	0	2.98	0.21	2.93	1.16	1.16	2.152	1321.8	2.42
7	27	0.757	0	3.16	0.24	2.82	1.18	1.18	2.514	1302.1	2.78
8	25	0.704	0	3.495	0.2	2.97	1.15	1.15	2.409	1281.1	2.62

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Panel No.	Mean Elev. m	Flat Area m^2	Round Area m^2	Gross Area m^2	Solidty Ratio	Cf	Df	Dr	EPA m^2	q_z N/m^2	Force KN
9	23	0.724	0	3.831	0.19	3.03	1.14	1.14	2.503	1258.8	2.68
10	21	0.785	0	4.178	0.19	3.03	1.14	1.14	2.715	1235	2.85
11	19	0.806	0	4.514	0.18	3.07	1.13	1.13	2.81	1209.2	2.89
12	17	0.828	0	4.85	0.17	3.11	1.13	1.13	2.904	1181.2	2.92
13	15	0.89	0	5.197	0.17	3.11	1.13	1.13	3.121	1150.5	3.05
14	13	0.913	0	5.532	0.17	3.14	1.12	1.12	3.217	1116.4	3.05
15	11	0.936	0	5.868	0.16	3.16	1.12	1.12	3.313	1077.8	3.04
16	9	1.04	0	6.224	0.17	3.13	1.13	1.13	3.657	1033.2	3.21
17	7	1.063	0	6.559	0.16	3.15	1.12	1.12	3.755	980	3.13
18	5	1.087	0	6.895	0.16	3.17	1.12	1.12	3.853	912.9	2.99
19	2	2.305	0	14.798	0.16	3.18	1.12	1.12	8.18	896.9	6.24
Total									57.947	---	56.53

Wind force from ladder

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	38 To 40	0.6	0.47	0.419	0.282	0	1406.9	0	0.34
2	36 To 38	0.6	0.47	0.419	0.282	0	1391.4	0	0.33
3	34 To 36	0.6	0.47	0.419	0.282	0	1375.2	0	0.33
4	32 To 34	0.6	0.47	0.419	0.282	0	1358.2	0	0.33
5	30 To 32	0.6	0.47	0.419	0.282	0	1340.5	0	0.32
6	28 To 30	0.6	0.47	0.419	0.282	0	1321.8	0	0.32
7	26 To 28	0.6	0.47	0.419	0.282	0	1302.1	0	0.31
8	24 To 26	0.6	0.47	0.419	0.282	0	1281.1	0	0.31
9	22 To 24	0.6	0.47	0.419	0.282	0	1258.8	0	0.3
10	20 To 22	0.6	0.47	0.419	0.282	0	1235	0	0.3
11	18 To 20	0.6	0.47	0.419	0.282	0	1209.2	0	0.29
12	16 To 18	0.6	0.47	0.419	0.282	0	1181.2	0	0.28
13	14 To 16	0.6	0.47	0.419	0.282	0	1150.5	0	0.28
14	12 To 14	0.6	0.47	0.419	0.282	0	1116.4	0	0.27
15	10 To 12	0.6	0.47	0.419	0.282	0	1077.8	0	0.26
16	8 To 10	0.6	0.47	0.419	0.282	0	1033.2	0	0.25
17	6 To 8	0.6	0.47	0.419	0.282	0	980	0	0.24
18	4 To 6	0.6	0.47	0.419	0.282	0	912.9	0	0.22

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
19	0 To 4	0.6	0.941	0.838	0.564	0	896.9	0	0.43
Total					5.645	---	---	---	5.69

Wind vector from ladder

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.24	0	-0.24	-9.31	9.31	0
2	37	-0.24	0	-0.24	-8.73	8.73	0
3	35	-0.23	0	-0.23	-8.16	8.16	0
4	33	-0.23	0	-0.23	-7.6	7.6	0
5	31	-0.23	0	-0.23	-7.05	7.05	0
6	29	-0.22	0	-0.22	-6.5	6.5	0
7	27	-0.22	0	-0.22	-5.96	5.96	0
8	25	-0.22	0	-0.22	-5.43	5.43	0
9	23	-0.21	0	-0.21	-4.91	4.91	0
10	21	-0.21	0	-0.21	-4.4	4.4	0
11	19	-0.21	0	-0.21	-3.9	3.9	0
12	17	-0.2	0	-0.2	-3.41	3.41	0
13	15	-0.2	0	-0.2	-2.93	2.93	0
14	13	-0.19	0	-0.19	-2.46	2.46	0
15	11	-0.18	0	-0.18	-2.01	2.01	0
16	9	-0.18	0	-0.18	-1.58	1.58	0
17	7	-0.17	0	-0.17	-1.16	1.16	0
18	5	-0.15	0	-0.15	-0.77	0.77	0
19	2	-0.3	0	-0.3	-0.61	0.61	0
Total		-4.02	0	-4.02	-86.9	86.9	0

Wind forces from transmission line clusters

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	38 To 40	0.6	0.66	0.372	0.396	0	1406.9	0	0.47
2	36 To 38	0.6	0.66	0.372	0.396	0	1391.4	0	0.47
3	34 To 36	0.6	0.66	0.372	0.396	0	1375.2	0	0.46
4	32 To 34	0.6	0.66	0.372	0.396	0	1358.2	0	0.46

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#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
5	30 To 32	0.6	0.66	0.372	0.396	0	1340.5	0	0.45
6	28 To 30	0.6	0.66	0.372	0.396	0	1321.8	0	0.44
7	26 To 28	0.6	0.66	0.372	0.396	0	1302.1	0	0.44
8	24 To 26	0.6	0.66	0.372	0.396	0	1281.1	0	0.43
9	22 To 24	0.6	0.66	0.372	0.396	0	1258.8	0	0.42
10	20 To 22	0.6	0.66	0.372	0.396	0	1235	0	0.42
11	18 To 20	0.6	0.66	0.372	0.396	0	1209.2	0	0.41
12	16 To 18	0.6	0.66	0.372	0.396	0	1181.2	0	0.4
13	14 To 16	0.6	0.66	0.372	0.396	0	1150.5	0	0.39
14	12 To 14	0.6	0.66	0.372	0.396	0	1116.4	0	0.38
15	10 To 12	0.6	0.66	0.372	0.396	0	1077.8	0	0.36
16	8 To 10	0.6	0.66	0.372	0.396	0	1033.2	0	0.35
17	6 To 8	0.6	0.66	0.372	0.396	0	980	0	0.33
18	4 To 6	0.6	0.66	0.372	0.396	0	912.9	0	0.31
19	2 To 4	0.6	0.66	0.372	0.396	0	896.9	0	0.3
Total					7.524	---	---	---	7.68

Wind vector from transmission line clusters

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.33	0	-0.33	-13.06	13.06	0
2	37	-0.33	0	-0.33	-12.25	12.25	0
3	35	-0.33	0	-0.33	-11.46	11.46	0
4	33	-0.32	0	-0.32	-10.67	10.67	0
5	31	-0.32	0	-0.32	-9.89	9.89	0
6	29	-0.31	0	-0.31	-9.12	9.12	0
7	27	-0.31	0	-0.31	-8.37	8.37	0
8	25	-0.3	0	-0.3	-7.62	7.62	0
9	23	-0.3	0	-0.3	-6.89	6.89	0
10	21	-0.29	0	-0.29	-6.17	6.17	0
11	19	-0.29	0	-0.29	-5.47	5.47	0
12	17	-0.28	0	-0.28	-4.78	4.78	0
13	15	-0.27	0	-0.27	-4.11	4.11	0
14	13	-0.27	0	-0.27	-3.45	3.45	0

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#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
15	11	-0.26	0	-0.26	-2.82	2.82	0
16	9	-0.25	0	-0.25	-2.21	2.21	0
17	7	-0.23	0	-0.23	-1.63	1.63	0
18	5	-0.22	0	-0.22	-1.09	1.09	0
19	3	-0.21	0	-0.21	-0.64	0.64	0
Total		-5.43	0	-5.43	-121.71	121.71	0

Wind forces from panel antenna

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	39	1	0.965	0.622	0.622	0	1406.9	90	0.74
2	39	1	0.965	0.622	0.965	0	1406.9	0	1.15
3	39	1	0.965	0.622	0.622	0	1406.9	90	0.74
4	39	1	0.965	0.622	0.965	0	1406.9	180	1.15
5	39	1	0.965	0.622	0.622	0	1406.9	90	0.74
6	39	1	0.965	0.622	0.965	0	1406.9	0	1.15
7	37	1	0.289	0.087	0.087	0	1391.4	90	0.1
8	37	1	0.289	0.087	0.289	0	1391.4	0	0.34
Total					5.136	---	---	---	6.14

Wind vector from panel antenna

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.53	0	-0.53	-20.5	20.5	1.11
2	39	-0.82	0	-0.82	-31.83	31.83	0
3	39	-0.53	0	-0.53	-20.5	20.5	-1.11
4	39	-0.82	0	-0.82	-31.83	31.83	0
5	39	-0.53	0	-0.53	-20.5	20.5	1.11
6	39	-0.82	0	-0.82	-31.83	31.83	-0.58
7	37	-0.07	0	-0.07	-2.7	2.7	0.17
8	37	-0.24	0	-0.24	-8.94	8.94	0
Total		-4.34	0	-4.34	-168.62	168.62	0.71

Wind forces from mounts Of panel antenna

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	39	1	0.033	0.274	0.274	0	1406.9	90	0.33
2	39	1	0.033	0.274	0.033	0	1406.9	0	0.04
3	39	1	0.033	0.274	0.274	0	1406.9	90	0.33
4	39	1	0.033	0.274	0.033	0	1406.9	180	0.04
5	39	1	0.033	0.274	0.274	0	1406.9	90	0.33
6	39	1	0.033	0.274	0.033	0	1406.9	0	0.04
7	37	1	0.071	0.123	0.123	0	1391.4	90	0.15
8	37	1	0.071	0.123	0.071	0	1391.4	0	0.08
Total					1.116	---	---	---	1.33

Wind vector from mounts Of panel antenna

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	39	-0.23	0	-0.23	-9.02	9.02	0.39
2	39	-0.03	0	-0.03	-1.1	1.1	0
3	39	-0.23	0	-0.23	-9.02	9.02	-0.39
4	39	-0.03	0	-0.03	-1.1	1.1	0
5	39	-0.23	0	-0.23	-9.02	9.02	0.39
6	39	-0.03	0	-0.03	-1.1	1.1	-0.02
7	37	-0.1	0	-0.1	-3.82	3.82	0.2
8	37	-0.06	0	-0.06	-2.21	2.21	0
Total		-0.94	0	-0.94	-36.41	36.41	0.57

Wind forces from MW dishes

#	Elev. m	O.D. mm	Area m^2	t_{iz} mm	q_z N/m^2	q Deg	C_a	Cs_s	Cm_m	F_a KN	F_s KN	M_m KN
1	35	1200	1.131	0	1375.2	90	-0.11	0.62	0.1	-0.14	0.83	0.16
2	35	1200	1.131	0	1375.2	0	1.26	0	0	1.67	0	0
3	37	1200	1.131	0	1391.4	270	-0.11	-0.62	-0.1	-0.15	-0.84	-0.16
4	37	1200	1.131	0	1391.4	180	-1.02	0	0	-1.36	0	0

Wind vectors from MW dishes

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#	Elev. m	F_x KN	F_y KN	F_z KN	Mx KN.m	My KN.m	Mz KN.m	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	35	-0.48	0	-0.69	0	0.16	0	-24.03	16.87	1.42
2	35	-1.18	0	-1.18	0	0	0	-41.28	41.28	0
3	37	-0.69	0	-0.49	0	-0.16	0	-18.04	25.7	-1.43
4	37	-0.96	0	-0.96	0	0	0	-35.54	35.54	0
Total		-3.32	0	-3.31	---	---	---	-118.89	119.39	-0.02

Wind forces from mounts Of MW dishes

#	Elev. m	Ka	EPA_n m^2	EPA_t m^2	EPA_a m^2	t_{iz} mm	q_z N/m^2	q Deg	Force KN
1	35	1	0.023	0.123	0.123	0	1375.2	90	0.14
2	35	1	0.023	0.123	0.023	0	1375.2	0	0.03
3	37	1	0.023	0.123	0.123	0	1391.4	90	0.15
4	37	1	0.023	0.123	0.023	0	1391.4	180	0.03
Total					0.293	---	---	---	0.34

Wind vectors from mounts Of MW dishes

#	Elev. m	F_x KN	F_y KN	F_z KN	OTM_x KN.m	OTM_z KN.m	Torque KN.m
1	35	-0.1	0	-0.1	-3.57	3.57	0.2
2	35	-0.02	0	-0.02	-0.66	0.66	0
3	37	-0.1	0	-0.1	-3.82	3.82	-0.2
4	37	-0.02	0	-0.02	-0.71	0.71	0
Total		-0.24	0	-0.24	-8.76	8.76	0

Combination

Comb. No.	Description
1	1.2D.L.+1.6DesignWL_0Deg_45m/s
2	1.2D.L.+1.6DesignWL_45Deg_45m/s
3	0.9D.L.+1.6DesignWL_0Deg_45m/s
4	0.9D.L.+1.6DesignWL_45Deg_45m/s
5	1D.L.+1ServiceWL_0Deg_35m/s
6	1D.L.+1ServiceWL_45Deg_35m/s

Maximum Forces In Tower Members

Maximum compression force

Panel No.	Bottom Elevation m	Top Elevation m	Main Leg KN	Main Diag KN	Main Horiz KN
1	38	40	2.97 (2)	2.92 (1)	0.27 (3)
2	36	38	16.04 (2)	9.37 (2)	1.5 (4)
3	34	36	50.2 (2)	13.55 (3)	0 (1)
4	32	34	74.95 (2)	16.27 (1)	0 (1)
5	30	32	124.61 (2)	17.24 (4)	0 (1)
6	28	30	156.77 (2)	20.22 (1)	0 (1)
7	26	28	194.21 (2)	13.34 (2)	0.96 (3)
8	24	26	233.36 (2)	12.53 (4)	0 (1)
9	22	24	252.64 (2)	11.72 (1)	0 (1)
10	20	22	284.94 (2)	12.05 (1)	0 (1)
11	18	20	307.54 (2)	12.21 (1)	0 (1)
12	16	18	336.13 (2)	12.74 (1)	0 (1)
13	14	16	360.92 (2)	13.02 (1)	0 (1)
14	12	14	387.64 (2)	13.66 (1)	0 (1)
15	10	12	413.71 (2)	13.96 (1)	0 (1)
16	8	10	439.19 (2)	14.76 (1)	0 (1)
17	6	8	466.9 (2)	14.94 (1)	0 (1)
18	4	6	490.47 (2)	15.68 (1)	0 (1)
19	0	4	505.85 (2)	35.64 (1)	15.1 (1)

Maximum tension force

Panel No.	Bottom Elevation m	Top Elevation m	Main Leg KN	Main Diag KN	Main Horiz KN
1	38	40	2.84 (2)	2.66 (1)	0.13 (3)
2	36	38	12.24 (2)	9.74 (2)	1.57 (4)
3	34	36	46.84 (2)	11.73 (3)	0 (1)
4	32	34	72.79 (2)	15.76 (1)	0 (1)
5	30	32	123.26 (2)	18.23 (4)	0 (1)
6	28	30	161.23 (2)	19.38 (1)	0 (1)

Panel No.	Bottom Elevation m	Top Elevation m	Main Leg KN	Main Diag KN	Main Horiz KN
7	26	28	198.9 (2)	13.31 (2)	1.39 (3)
8	24	26	237.07 (2)	12.47 (4)	0 (1)
9	22	24	256.4 (2)	11.58 (1)	0 (1)
10	20	22	287.71 (2)	12.12 (1)	0 (1)
11	18	20	309.78 (2)	12.09 (1)	0 (1)
12	16	18	337.31 (2)	12.76 (1)	0 (1)
13	14	16	361.18 (2)	12.94 (1)	0 (1)
14	12	14	386.68 (2)	13.63 (1)	0 (1)
15	10	12	411.54 (2)	13.92 (1)	0 (1)
16	8	10	435.7 (2)	14.68 (1)	0 (1)
17	6	8	461.87 (2)	14.96 (1)	0 (1)
18	4	6	484.02 (2)	15.57 (1)	0 (1)
19	0	4	497.15 (2)	35.08 (1)	15.06 (1)

Design Of Tower Members Under Compression Force

Reactions From The Tower

Total reaction on foundation

Comb No.	Shear X KN	Vertical KN	Shear Z KN	Horiz. Shear KN	Moment Mx KN.m	Torque My KN.m	Moment Mz KN.m	Horiz. Moment KN.m
1	117.91	65.89	0	117.91	-0.19	1.2	-2663	2663
2	93.24	65.89	93.23	131.85	2085.56	-2.01	-2085.16	2949.14
3	117.91	49.42	0	117.91	-0.14	1.2	-2663.34	2663.34
4	93.24	49.42	93.23	131.85	2085.6	-2.01	-2085.51	2949.42
5	44.58	54.91	0	44.58	-0.16	0.46	-1006.21	1006.21
6	35.25	54.91	35.25	49.85	788.43	-0.76	-787.74	1114.52

Individual support reaction

Joint No.	Comb No.	Rx KN	Ry KN	Rz KN	RMx KN.m	RMy KN.m	RMz KN.m
1	1	28.79	-338.05	-14.24	0	0	0

Joint No.	Comb No.	Rx KN	Ry KN	Rz KN	RMx KN.m	RMy KN.m	RMz KN.m
	2	10.7	25.42	13.05	0	0	0
	3	28.98	-342.21	-14.43	0	0	0
	4	10.89	21.26	12.85	0	0	0
	5	10.54	-120.24	-5.03	0	0	0
	6	3.7	17.18	5.28	0	0	0
2	1	28.64	-329.79	13.77	0	0	0
	2	34.39	-541.2	34.65	0	0	0
	3	28.83	-333.96	13.97	0	0	0
	4	34.58	-545.37	34.84	0	0	0
	5	10.48	-117.09	4.86	0	0	0
	6	12.65	-197.02	12.75	0	0	0
3	1	30.17	362.79	-15.3	0	0	0
	2	12.78	25.31	10.44	0	0	0
	3	29.98	358.71	-15.11	0	0	0
	4	12.59	21.24	10.63	0	0	0
	5	11.76	144.59	-6.13	0	0	0
	6	5.18	17	3.6	0	0	0
4	1	30.32	370.95	15.77	0	0	0
	2	35.37	556.36	35.1	0	0	0
	3	30.13	366.88	15.58	0	0	0
	4	35.18	552.29	34.91	0	0	0
	5	11.81	147.66	6.31	0	0	0
	6	13.72	217.76	13.62	0	0	0

Comparison of Reaction Force Vs. Applied Loads

Base moment reaction Vs. applied base moment

Comb No.	Reaction OTM X KN.m	Reaction Torque KN.m	Reaction OTM Z KN.m	Applied OTM X KN.m	Applied Torque KN.m	Applied OTM Z KN.m	Change %
1	-0.19	1.2	-2663	0.19	-1.2	2663	0
2	2085.56	-2.01	-2085.16	-2085.56	2.01	2085.16	0
3	-0.14	1.2	-2663.34	0.14	-1.2	2663.34	0
4	2085.6	-2.01	-2085.51	-2085.6	2.01	2085.51	0

Comb No.	Reaction OTM X KN.m	Reaction Torque KN.m	Reaction OTM Z KN.m	Applied OTM X KN.m	Applied Torque KN.m	Applied OTM Z KN.m	Change %
5	-0.16	0.46	-1006.21	0.16	-0.46	1006.21	0
6	788.43	-0.76	-787.74	-788.43	0.76	787.74	0

Force reaction Vs. applied forces

Comb No.	Reaction Shear X KN	Reaction Vertical KN	Reaction Shear Z KN	Applied Shear X KN	Applied Vertical KN	Applied Shear Z KN	Error %
1	117.91	65.89	0	-117.91	-65.89	0	0
2	93.24	65.89	93.23	-93.24	-65.89	-93.23	0
3	117.91	49.42	0	-117.91	-49.42	0	0
4	93.24	49.42	93.23	-93.24	-49.42	-93.23	0
5	44.58	54.91	0	-44.58	-54.91	0	0
6	35.25	54.91	35.25	-35.25	-54.91	-35.25	0

Displacement at non service condition

Elevation m	Deflection X mm	Down mm	Deflection Z mm	Horiz. Deflection mm	Tilt Deg	Twist My Deg
40	-397.2 (3)	-0.9 (2)	-306.7 (4)	433.7 (4)	1.2 (4)	0.78 (2)
38	-358.9 (3)	-0.9 (2)	-277.4 (4)	392.3 (4)	1.2 (4)	0.72 (2)
36	-320.6 (3)	-0.9 (2)	-248.1 (4)	350.7 (4)	1.18 (4)	0.66 (2)
34	-283 (3)	-0.9 (2)	-219.2 (4)	309.9 (4)	1.14 (4)	0.61 (2)
32	-246.9 (3)	-0.8 (2)	-191.5 (4)	270.8 (4)	1.08 (4)	0.55 (2)
30	-213 (3)	-0.8 (2)	-165.3 (4)	233.8 (4)	1.01 (4)	0.5 (2)
28	-181.7 (3)	-0.7 (2)	-141.2 (4)	199.7 (4)	0.91 (4)	0.46 (2)
26	-153.7 (3)	-0.7 (1)	-119.6 (4)	169.1 (4)	0.82 (4)	0.34 (2)
24	-128.5 (3)	-0.6 (2)	-100.1 (4)	141.6 (4)	0.73 (4)	0.25 (4)
22	-106.3 (3)	-0.6 (1)	-82.8 (4)	117.2 (4)	0.64 (4)	0.18 (4)
20	-86.5 (3)	-0.6 (2)	-67.5 (4)	95.5 (4)	0.57 (4)	0.13 (4)
18	-69.1 (3)	-0.5 (1)	-54 (4)	76.4 (4)	0.5 (4)	0.1 (4)
16	-54 (3)	-0.5 (2)	-42.2 (4)	59.7 (4)	0.42 (4)	0.07 (4)
14	-41 (3)	-0.4 (1)	-32.1 (4)	45.4 (4)	0.36 (4)	0.05 (4)
12	-29.8 (3)	-0.3 (2)	-23.4 (4)	33 (4)	0.3 (4)	0.03 (4)
10	-20.5 (3)	-0.3 (1)	-16.1 (4)	22.8 (4)	0.24 (4)	0.02 (4)
8	-12.9 (3)	-0.2 (2)	-10.1 (4)	14.3 (4)	0.2 (4)	0.01 (4)

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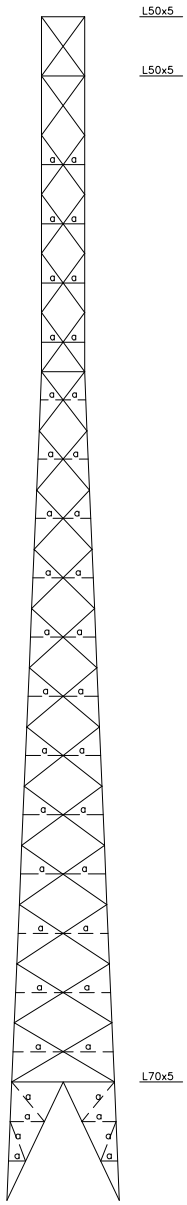
Elevation m	Deflection X mm	Down mm	Deflection Z mm	Horiz. Deflection mm	Tilt Deg	Twist My Deg
6	-6.8 (3)	-0.2 (1)	-5.3 (4)	7.5 (4)	0.15 (4)	0.02 (4)
4	-2.1 (1)	-0.1 (2)	-1.7 (2)	2.4 (2)	0.1 (4)	0 (4)

PANEL NO.	ELEVATION (m)	TOWER WIDTH (m)	MAIN LEGS	DIAGONALS	PANELS HEIGHT (m)
1	40	1.45	L70x5	L60x4	18@2
2					
3					
4					
5			L70x7		
6	28	1.45			
7			L80x8		
8					
9					
10			L90x9		
11					
12					
13			L100x10		
14					
15					
16			L120x10		
17					
18					
19	0	3.8		L80x6	1@4



REDUNDANT TABLE

NOTATION	SIZE	MATERIAL
a	L40x4	S235J0

REV.	DATE	REVISION/ISSUE	DRN	DGN	CHD	APD
A	5/11/2017	First issue	M.Joe	M.Joe	A.S.M	

REVISIONS

DRAWING TITLE :

DESIGN DRAWING

JOB NO. : GRD 20m

PROJECT : GSM Network

DRAWING NO.	REV.	SHEET NO.
ASM-S-GP-25M-01	A	1 OF 1

ASMTower Result Verification

Project no.:	40m square tower	Date: 12/21/2017	Sheet no.: of	Computed by:	M.Joe
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

WIND LOAD of latticed panels According to ANSI/TIA-222-G

Wind parameter

3-sec gust wind speed (50 year return)	V	=	45	m/s
Structure class		=	II	
Exposure categorphy		=	C	
Topographic categorphy		=	1	
Crest Height		=	0	m
Base elevation		=	0	m
Tower height		=	40	m

Calculation

Generic Parameters

Gust Effect Factor	G_H	=	0.85	(clause 2.6.7.1 Self-Supporting Latticed Structures)				
Direction probability factor	K_d	=	0.85				(Table 2-2)	
Important factor	I	=	1				(Table 2-3)	
Exposure Category Coefficients							(Table 2-4)	
Z_g = 274	α	=	9.5	K_{zmin}	=	0.85	K_c =	1
Topographic Category Coefficients				(Table 2-5)				
K_t = N.A	f	=	N.A					

Panel #1

Bottom level	=	38.0	m	Top level	=	40.0	m
Bottom width	=	1.45	m	Top width	=	1.45	m
Average height	Z	=	39.0 m				

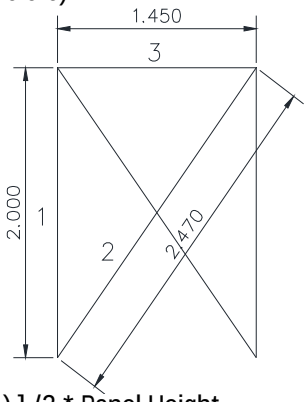
Velocity pressure coefficient: $K_z = 2.01\left(\frac{z}{Z_g}\right)^{2/\alpha}$ = 1.333 (clause 2.6.5.2)

Height reduction factor: $K_h = e^{\left(\frac{f\,z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor: $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure: $q_z = 0.613\, K_z\, K_{zt}\, K_d\, I\, V^2$ (clause 2.6.9.6)

= 1407 N/m^2



#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x5	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
3	Horiz	L50x5	1	1.45	0.05	0.0725	
					Total	0.649	0.000

Centre of gravity offset for leg: e_{Leg} = 0.019 m

Gross area of one face: A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.450 + 2 * 0.019) + (1.450 + 2 * 0.019)] /2 * 2.00

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			Approved by:

2.98 m^2

Solidity ratio $\varepsilon = (A_f + A_r) / A_g = 0.218$ (clause 2.6.9.1.1)

$C_f = 4\varepsilon^2 - 5.9\varepsilon + 4.0 = 2.90$ (clause 2.6.9.1.1)

Wind direction factor for flat $D_f = 1.00$ For normal wind (Table 2-6)

$= 1.16$ For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 1.88$ m^2 For normal wind

$= 2.19$ m^2 For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

$= 2254$ N For normal wind

$= 2622$ N For 45° wind

Panel #2 Bottom level = 36.0 m Top level = 38.0 m

Bottom width = 1.45 m Top width = 1.45 m

Average height $Z = 37.0$ m

Velocity pressure coefficient $K_z = 2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha} = 1.319$ (clause 2.6.5.2)

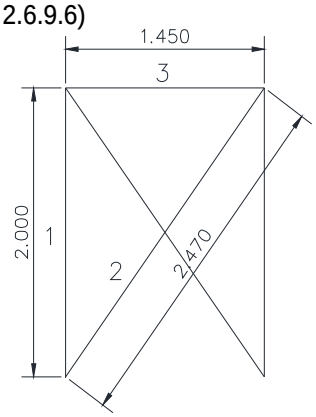
Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)} = N.A.$ (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613 K_z K_{zt} K_d I V^2$ (clause 2.6.9.6)

$= 1391$ N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x5	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
3	Horiz	L50x5	1	1.45	0.05	0.0725	
					Total	0.649	0.000



Centre of gravity offset for leg $e_{Leg} = 0.019$ m

Gross area of one face $A_g = [(\text{Top width} + 2\, e_{Leg}) + (\text{Bottom width} + 2\, e_{Leg})] / 2 * \text{Panel Height}$

$= [(1.450 + 2 * 0.019) + (1.450 + 2 * 0.019)] / 2 * 2.00$

2.98 m^2

Solidity ratio $\varepsilon = (A_f + A_r) / A_g = 0.218$ (clause 2.6.9.1.1)

$C_f = 4\varepsilon^2 - 5.9\varepsilon + 4.0 = 2.90$ (clause 2.6.9.1.1)

Wind direction factor for flat $D_f = 1.00$ For normal wind (Table 2-6)

$= 1.16$ For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 1.88$ m^2 For normal wind

ASMTower Result Verification

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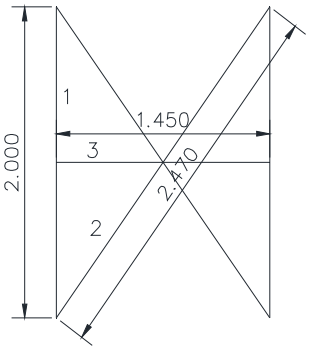
		=	2.19 m^2	For 45° wind	
Design wind force on the panel	F_{ST}	=	$q_z G_h (EPA)_S$		(clause 2.6.9.1)
		=	2229 N	For normal wind	
		=	2593 N	For 45° wind	

Panel #3

Bottom level	=	34.0	m	Top level	=	36.0	m
Bottom width	=	1.45	m	Top width	=	1.45	m
Average height	Z	=	35.0 m				
Velocity pressure coefficient	K_z	=	$2.01\left(\frac{z}{Z_g}\right)^{2/\alpha}$	=	1.303		(clause 2.6.5.2)
Height reduction factor	K_h	=	$e^{\left(\frac{f\,z}{H}\right)}$	=	N.A.		(clause 2.6.6.4)
Topographic factor	K_{zt}	=	$\left[1+\frac{K_e K_t}{K_h}\right]^2$	=	1.000		(clause 2.6.6.4)
Velocity pressure	q_z	=	0.613 K_z K_{zt} K_d I V^2				(clause 2.6.9.6)
		=	1375 N/m^2				

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x5	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
3	Sec-Horiz	L40x4	2	0.725	0.04	0.058	
					Total	0.634	0.000



Centre of gravity offset for leg	e_{Leg}	=	0.019 m		
Gross area of one face	A_g	=	[(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height		
		=	[(1.450 + 2 * 0.019) + (1.450 + 2 * 0.019)] /2 * 2.00		
			2.98 m^2		
Solidity ratio	ε	=	$(A_f + A_r) / A_g$	= 0.213	(clause 2.6.9.1.1)
	C_f	=	4ε^2 - 5.9ε + 4.0	= 2.92	(clause 2.6.9.1.1)
Wind direction factor for flat	D_f	=	1.00	For normal wind	(Table 2-6)
		=	1.16	For 45° wind	(Table 2-6)
Effective Projected Area	$(EPA)_S$	=	$C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$		(clause 2.6.9.1.1)
		=	1.86 m^2	For normal wind	
		=	2.15 m^2	For 45° wind	
Design wind force on the panel	F_{ST}	=	$q_z G_h (EPA)_S$		(clause 2.6.9.1)
		=	2169 N	For normal wind	
		=	2515 N	For 45° wind	

Panel #4

Bottom level	=	32.0	m	Top level	=	34.0	m
Bottom width	=	1.45	m	Top width	=	1.45	m
Average height	Z	=	33.0 m				

ASMTower Result Verification

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Velocity pressure coefficient $K_z = 2.01\left(\frac{Z}{Z_g}\right)^{2/\alpha} = 1.287$ (clause 2.6.5.2)

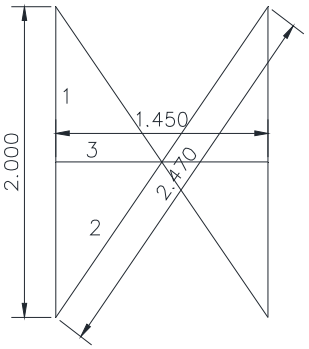
Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)} = N.A.$ (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\ K_z\ K_{zt}\ K_d\ I\ V^2$ (clause 2.6.9.6)

$= 1358\ N/m^2$

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x5	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
3	Sec-Horiz	L40x4	2	0.725	0.04	0.058	
					Total	0.634	0.000



Centre of gravity offset for leg $e_{Leg} = 0.019$ m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.450 + 2 * 0.019) + (1.450 + 2 * 0.019)] /2 * 2.00

$= 2.98\ m^2$

Solidity ratio $\varepsilon = (A_f + A_r) / A_g = 0.213$ (clause 2.6.9.1.1)

$C_f = 4\varepsilon\text{^}2 - 5.9\varepsilon + 4.0 = 2.92$ (clause 2.6.9.1.1)

Wind direction factor for flat $D_f = 1.00$ For normal wind (Table 2-6)

$= 1.16$ For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 1.86\ m^2$ For normal wind

$= 2.15\ m^2$ For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

$= 2142$ N For normal wind

$= 2484$ N For 45° wind

Panel #5 Bottom level = 30.0 m Top level = 32.0 m

Bottom width = 1.45 m Top width = 1.45 m

Average height Z = 31.0 m

Velocity pressure coefficient $K_z = 2.01\left(\frac{Z}{Z_g}\right)^{2/\alpha} = 1.270$ (clause 2.6.5.2)

Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)} = N.A.$ (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\ K_z\ K_{zt}\ K_d\ I\ V^2$ (clause 2.6.9.6)

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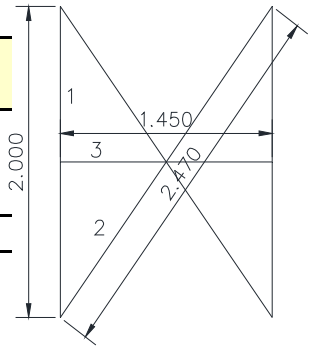
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

= 1340 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x7	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
3	Sec-Horiz	L40x4	2	0.725	0.04	0.058	
					Total	0.634	0.000



Centre of gravity offset for leg e_{Leg} = 0.020 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.450 + 2 * 0.020) + (1.450 + 2 * 0.020)] /2 * 2.00

2.98 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.213 (clause 2.6.9.1.1)

C_f = 4ε^2 - 5.9ε + 4.0 = 2.93 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.16 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 1.86 m^2 For normal wind

= 2.15 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2115 N For normal wind

= 2452 N For 45° wind

Panel #6 Bottom level = 28.0 m Top level = 30.0 m

Bottom width = 1.45 m Top width = 1.45 m

Average height Z = 29.0 m

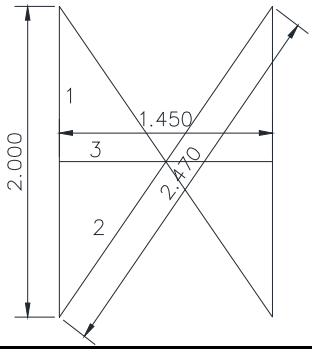
Velocity pressure coefficient K_z = $2.01 \left(\frac{z}{z_g}\right)^{2/\alpha}$ = 1.253 (clause 2.6.5.2)

Height reduction factor K_h = $e^{\left(\frac{f\,z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 1322 N/m^2



#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L70x7	2	2.000	0.07	0.28	
2	Diag	L60x4	2	2.470	0.06	0.2964389	
4	Sec-Horiz	L40x4	2	0.725	0.04	0.058	
					Total	0.634	0.000

ASMTower Result Verification

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				Approved by:	

Centre of gravity offset for leg e_{Leg} = 0.020 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.450 + 2 * 0.020) + (1.450 + 2 * 0.020)] /2 * 2.00

= 2.98 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.213 (clause 2.6.9.1.1)

C_f = 4ε^2 - 5.9ε + 4.0 = 2.93 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.16 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 1.86 m^2 For normal wind

= 2.15 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2085 N For normal wind

= 2418 N For 45° wind

Panel #7 Bottom level = 26.0 m Top level = 28.0 m

Bottom width = 1.62 m Top width = 1.45 m

Average height Z = 27.0 m

Velocity pressure coefficient K_z = $2.01 \left(\frac{z}{z_g}\right)^{2/\alpha}$ = 1.234 (clause 2.6.5.2)

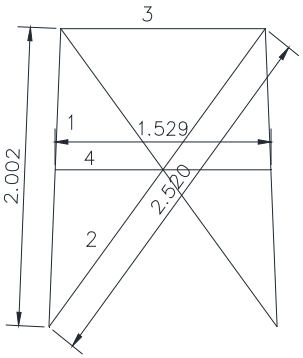
Height reduction factor K_h = $e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 1302 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L80x8	2	2.002	0.08	0.3202816	
2	Diag	L60x4	2	2.521	0.06	0.3024604	
3	Horiz	L50x5	1	1.45	0.05	0.0725	
4	Sec-Horiz	L40x4	2	0.765	0.04	0.0611735	
					Total	0.756	0.000



Centre of gravity offset for leg e_{Leg} = 0.023 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.618 + 2 * 0.023) + (1.450 + 2 * 0.023)] /2 * 2.00

= 3.16 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.239 (clause 2.6.9.1.1)

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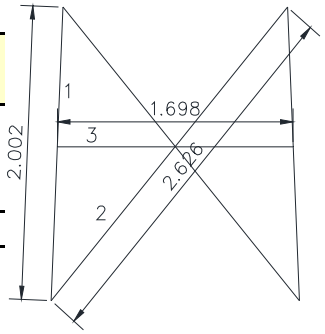
	C_f	=	$4\varepsilon^2 - 5.9\varepsilon + 4.0$	= 2.82		(clause 2.6.9.1.1)
Wind direction factor for flat	D_f	=	1.00		For normal wind	(Table 2-6)
		=	1.18		For 45° wind	(Table 2-6)
Effective Projected Area	$(EPA)_S$	=	$C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$			(clause 2.6.9.1.1)
		=	2.13 m^2		For normal wind	
		=	2.51 m^2		For 45° wind	
Design wind force on the panel	F_{ST}	=	$q_z G_h (EPA)_S$			(clause 2.6.9.1)
		=	2358 N		For normal wind	
		=	2782 N		For 45° wind	

Panel #8

Bottom level	=	24.0	m	Top level	=	26.0	m
Bottom width	=	1.79	m	Top width	=	1.62	m
Average height	Z	=	25.0 m				

Velocity pressure coefficient	K_z	=	$2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$	= 1.214	(clause 2.6.5.2)
Height reduction factor	K_h	=	$e^{\left(\frac{f z}{H}\right)}$	= N.A.	(clause 2.6.6.4)
Topographic factor	K_{zt}	=	$\left[1 + \frac{K_e K_t}{K_h}\right]^2$	= 1.000	(clause 2.6.6.4)
Velocity pressure	q_z	=	$0.613 K_z K_{zt} K_d I V^2$		(clause 2.6.9.6)
		=	1281 N/m^2		

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L80x8	2	2.002	0.08	0.3202816	
2	Diag	L60x4	2	2.626	0.06	0.3151245	
3	Sec-Horiz	L40x4	2	0.849	0.04	0.0679059	
					Total	0.703	0.000



Centre of gravity offset for leg	e_{Leg}	=	0.023 m			
Gross area of one face	A_g	=	[(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height			
		=	[(1.786 + 2 * 0.023) + (1.618 + 2 * 0.023)] /2 * 2.00			
			3.50 m^2			
Solidity ratio	ε	=	$(A_f + A_r) / A_g$	= 0.201		(clause 2.6.9.1.1)
	C_f	=	$4\varepsilon^2 - 5.9\varepsilon + 4.0$	= 2.97		(clause 2.6.9.1.1)
Wind direction factor for flat	D_f	=	1.00		For normal wind	(Table 2-6)
		=	1.15		For 45° wind	(Table 2-6)
Effective Projected Area	$(EPA)_S$	=	$C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$			(clause 2.6.9.1.1)
		=	2.09 m^2		For normal wind	
		=	2.41 m^2		For 45° wind	
Design wind force on the panel	F_{ST}	=	$q_z G_h (EPA)_S$			(clause 2.6.9.1)

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= 2278 N For normal wind

= 2622 N For 45° wind

Panel #9 Bottom level = 22.0 m Top level = 24.0 m

Bottom width = 1.95 m Top width = 1.79 m

Average height Z = 23.0 m

Velocity pressure coefficient $K_z = 2.01\left(\frac{z}{z_g}\right)^{2/\alpha}$ = 1.193 (clause 2.6.5.2)

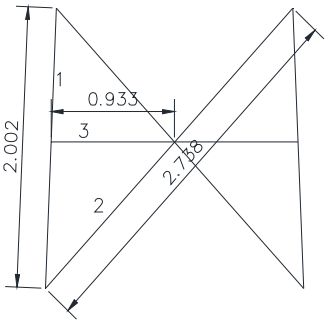
Height reduction factor $K_h = e^{\left(\frac{f\,z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\ K_z\ K_{zt}\ K_d\ I\ V^2$ (clause 2.6.9.6)

= 1259 N/m²

#	Component	Profile	Qty.	Length m	Width m	A_f m²	A_r m²
1	Leg	L80x8	2	2.002	0.08	0.3202816	
2	Diag	L60x4	2	2.738	0.06	0.3285363	
3	Sec-Horiz	L40x4	2	0.933	0.04	0.074635	
					Total	0.723	0.000



Centre of gravity offset for leg e_{Leg} = 0.023 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(1.954 + 2 * 0.023) + (1.786 + 2 * 0.023)] /2 * 2.00

3.83 m²

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.189 (clause 2.6.9.1.1)

C_f = 4ε^2 - 5.9ε + 4.0 = 3.03 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.14 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f\,[\,D_f\,\Sigma A_f + D_r\,\Sigma(A_r\,R_r)\,]$ (clause 2.6.9.1.1)

= 2.19 m² For normal wind

= 2.50 m² For 45° wind

Design wind force on the panel $F_{ST} = q_z\,G_h\,(EPA)_S$ (clause 2.6.9.1)

= 2344 N For normal wind

= 2676 N For 45° wind

Panel #10 Bottom level = 20.0 m Top level = 22.0 m

Bottom width = 2.12 m Top width = 1.95 m

Average height Z = 21.0 m

Velocity pressure coefficient $K_z = 2.01\left(\frac{z}{z}\right)^{2/\alpha}$ = 1.170 (clause 2.6.5.2)

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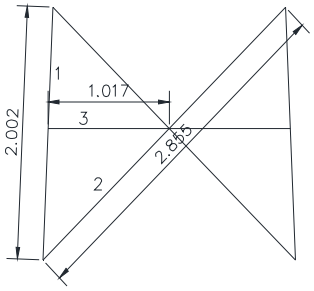
Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\, K_z\, K_{zt}\, K_d\, I\, V^2$ (clause 2.6.9.6)

$= 1235 \ N/m^2$

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L90x9	2	2.002	0.09	0.3603168	
2	Diag	L60x4	2	2.855	0.06	0.342608	
3	Sec-Horiz	L40x4	2	1.017	0.04	0.0813617	
					Total	0.784	0.000



Centre of gravity offset for leg e_{Leg} = 0.026 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.121 + 2 * 0.026) + (1.954 + 2 * 0.026)] /2 * 2.00

$= 4.18 \ m^2$

Solidity ratio $\varepsilon = (A_f + A_r) / A_g$ = 0.188 (clause 2.6.9.1.1)

$C_f = 4\varepsilon\text{^}2 - 5.9\varepsilon + 4.0$ = 3.03 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.14 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 2.38 \ m^2$ For normal wind

$= 2.71 \ m^2$ For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2497 N For normal wind

= 2849 N For 45° wind

Panel #11 Bottom level = 18.0 m Top level = 20.0 m

Bottom width = 2.29 m Top width = 2.12 m

Average height Z = 19.0 m

Velocity pressure coefficient $K_z = 2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$ = 1.146 (clause 2.6.5.2)

Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\, K_z\, K_{zt}\, K_d\, I\, V^2$ (clause 2.6.9.6)

$= 1209 \ N/m^2$

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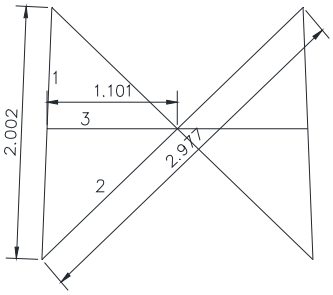
#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L90x9	2	2.002	0.09	0.3603168	
2	Diag	L60x4	2	2.977	0.06	0.3572616	
3	Sec-Horiz	L40x4	2	1.101	0.04	0.0880865	
					Total	0.806	0.000



Centre of gravity offset for leg e_{Leg} = 0.026 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.289 + 2 * 0.026) + (2.121 + 2 * 0.026)] /2 * 2.00

= 4.51 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.178 (clause 2.6.9.1.1)

C_f = $4\varepsilon^2 - 5.9\varepsilon + 4.0$ = 3.07 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.13 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 2.48 m^2 For normal wind

= 2.81 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2546 N For normal wind

= 2887 N For 45° wind

Panel #12 Bottom level = 16.0 m Top level = 18.0 m

Bottom width = 2.46 m Top width = 2.29 m

Average height Z = 17.0 m

Velocity pressure coefficient K_z = $2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$ = 1.120 (clause 2.6.5.2)

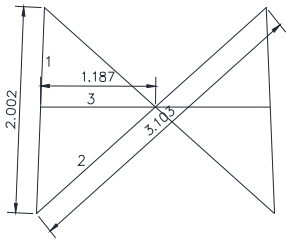
Height reduction factor K_h = $e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 1181 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L90x9	2	2.002	0.09	0.3603168	
2	Diag	L60x4	2	3.104	0.06	0.3724284	
3	Sec-Horiz	L40x4	2	1.185	0.04	0.0948098	
					Total	0.828	0.000



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Centre of gravity offset for leg e_{Leg} = 0.026 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.457 + 2 * 0.026) + (2.289 + 2 * 0.026)] /2 * 2.00

4.85 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.171 (clause 2.6.9.1.1)

C_f = $4\varepsilon^2 - 5.9\varepsilon + 4.0$ = 3.11 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.13 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 2.57 m^2 For normal wind

= 2.90 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2584 N For normal wind

= 2915 N For 45° wind

Panel #13 Bottom level = 14.0 m Top level = 16.0 m

Bottom width = 2.63 m Top width = 2.46 m

Average height Z = 15.0 m

Velocity pressure coefficient K_z = $2.01 \left(\frac{z}{z_g}\right)^{2/\alpha}$ = 1.090 (clause 2.6.5.2)

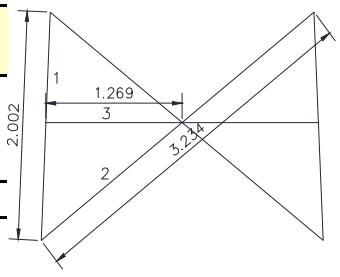
Height reduction factor K_h = $e^{\left(f\frac{z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 1151 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L100x10	2	2.002	0.1	0.400352	
2	Diag	L60x4	2	3.234	0.06	0.3880482	
3	Sec-Horiz	L40x4	2	1.269	0.04	0.101532	
					Total	0.890	0.000



Centre of gravity offset for leg e_{Leg} = 0.029 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.625 + 2 * 0.029) + (2.457 + 2 * 0.029)] /2 * 2.00

5.20 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.171 (clause 2.6.9.1.1)

C_f = $4\varepsilon^2 - 5.9\varepsilon + 4.0$ = 3.11 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.13 For 45° wind (Table 2-6)

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Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 2.76 \ m^2$ For normal wind

$= 3.12 \ m^2$ For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

$= 2704 \ N$ For normal wind

$= 3051 \ N$ For 45° wind

Panel #14 Bottom level = 12.0 m Top level = 14.0 m

Bottom width = 2.79 m Top width = 2.63 m

Average height $Z = 13.0$ m

Velocity pressure coefficient $K_z = 2.01 \left(\frac{z}{z_g}\right)^{2/\alpha} = 1.058$ (clause 2.6.5.2)

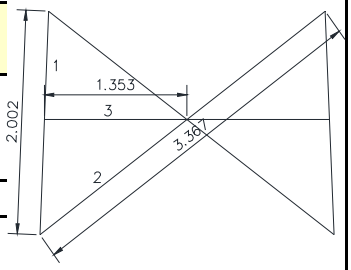
Height reduction factor $K_h = e^{\left(\frac{f z}{H}\right)} = N.A.$ (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613 K_z K_{zt} K_d I V^2$ (clause 2.6.9.6)

$= 1116 \ N/m^2$

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L100x10	2	2.002	0.1	0.400352	
2	Diag	L60x4	2	3.367	0.06	0.4040686	
3	Sec-Horiz	L40x4	2	1.353	0.04	0.1082531	
					Total	0.913	0.000



Centre of gravity offset for leg $e_{Leg} = 0.029$ m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.793 + 2 * 0.029) + (2.625 + 2 * 0.029)] /2 * 2.00

$5.53 \ m^2$

Solidity ratio $\varepsilon = (A_f + A_r) / A_g = 0.165$ (clause 2.6.9.1.1)

$C_f = 4\varepsilon^2 - 5.9\varepsilon + 4.0 = 3.14$ (clause 2.6.9.1.1)

Wind direction factor for flat $D_f = 1.00$ For normal wind (Table 2-6)

$= 1.12$ For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 2.86 \ m^2$ For normal wind

$= 3.22 \ m^2$ For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

$= 2716 \ N$ For normal wind

$= 3052 \ N$ For 45° wind

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Panel #15

Bottom level	=	10.0	m	Top level	=	12.0	m
Bottom width	=	2.96	m	Top width	=	2.79	m
Average height	Z	=	11.0	m			

Velocity pressure coefficient $K_z = 2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$ = 1.021 (clause 2.6.5.2)

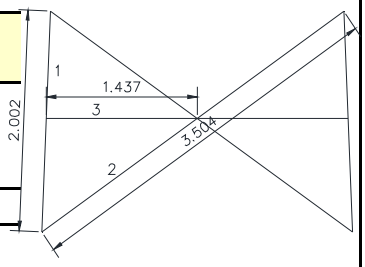
Height reduction factor $K_h = e^{\left(\frac{f\,z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\, K_z\, K_{zt}\, K_d\, I\, V^2$ (clause 2.6.9.6)

= 1078 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L100x10	2	2.002	0.1	0.400352	
2	Diag	L60x4	2	3.504	0.06	0.4204437	
3	Sec-Horiz	L40x4	2	1.437	0.04	0.1149735	
					Total	0.936	0.000



Centre of gravity offset for leg e_{Leg} = 0.029 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(2.961 + 2 * 0.029) + (2.793 + 2 * 0.029)] /2 * 2.00

5.87 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.159 (clause 2.6.9.1.1)

C_f = 4ε^2 - 5.9ε + 4.0 = 3.16 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.12 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 2.96 m^2 For normal wind

= 3.31 m^2 For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2710 N For normal wind

= 3034 N For 45° wind

Panel #16

Bottom level	=	8.0	m	Top level	=	10.0	m
Bottom width	=	3.13	m	Top width	=	2.96	m
Average height	Z	=	9.0	m			

Velocity pressure coefficient $K_z = 2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$ = 0.979 (clause 2.6.5.2)

Height reduction factor $K_h = e^{\left(\frac{f\,z}{H}\right)}$ = N.A. (clause 2.6.6.4)

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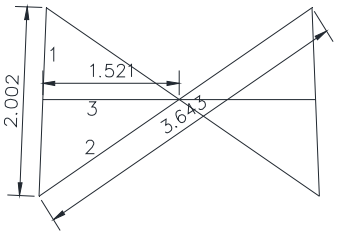
Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\ K_z\ K_{zt}\ K_d\ I\ V^2$ (clause 2.6.9.6)

$= 1033\ N/m^2$

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L120x10	2	2.002	0.12	0.4804225	
2	Diag	L60x4	2	3.643	0.06	0.4371337	
3	Sec-Horiz	L40x4	2	1.521	0.04	0.1216932	
					Total	1.039	0.000



Centre of gravity offset for leg $e_{Leg} = 0.034$ m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(3.129 + 2 * 0.034) + (2.961 + 2 * 0.034)] /2 * 2.00

$6.22\ m^2$

Solidity ratio $\varepsilon = (A_f + A_r) / A_g = 0.167$ (clause 2.6.9.1.1)

$C_f = 4\varepsilon\text{^}2 - 5.9\varepsilon + 4.0 = 3.13$ (clause 2.6.9.1.1)

Wind direction factor for flat $D_f = 1.00$ For normal wind (Table 2-6)

$= 1.13$ For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S = C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

$= 3.25\ m^2$ For normal wind

$= 3.66\ m^2$ For 45° wind

Design wind force on the panel $F_{ST} = q_z G_h (EPA)_S$ (clause 2.6.9.1)

$= 2853$ N For normal wind

$= 3211$ N For 45° wind

Panel #17

Bottom level	=	6.0	m	Top level	=	8.0	m
Bottom width	=	3.30	m	Top width	=	3.13	m
Average height	Z =	7.0	m				

Velocity pressure coefficient $K_z = 2.01 \left(\frac{z}{z_g}\right)^{2/\alpha} = 0.929$ (clause 2.6.5.2)

Height reduction factor $K_h = e^{\left(\frac{f\ z}{H}\right)} =$ N.A. (clause 2.6.6.4)

Topographic factor $K_{zt} = \left[1 + \frac{K_e K_t}{K_h}\right]^2 = 1.000$ (clause 2.6.6.4)

Velocity pressure $q_z = 0.613\ K_z\ K_{zt}\ K_d\ I\ V^2$ (clause 2.6.9.6)

$= 980\ N/m^2$

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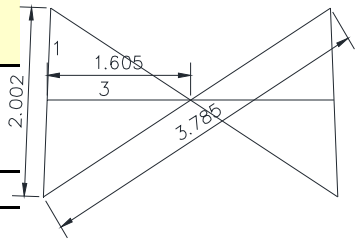
Subject:	Wind load calculation					Checked by:	a.shaban
						Approved by:	

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L120x10	2	2.002	0.12	0.4804225	
2	Diag	L60x4	2	3.784	0.06	0.4541038	
3	Sec-Horiz	L40x4	2	1.605	0.04	0.1284123	
					Total	1.063	0.000



Centre of gravity offset for leg e_{Leg} = 0.034 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(3.296 + 2 * 0.034) + (3.129 + 2 * 0.034)] /2 * 2.00

6.56 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.162 (clause 2.6.9.1.1)

C_f = $4\varepsilon^2 - 5.9\varepsilon + 4.0$ = 3.15 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.12 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 3.35 m^2 For normal wind

= 3.75 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2788 N For normal wind

= 3127 N For 45° wind

Panel #18 Bottom level = 4.0 m Top level = 6.0 m

Bottom width = 3.464 m Top width = 3.296 m

Average height Z = 5.0 m

Velocity pressure coefficient K_z = $2.01 \left(\frac{Z}{Z_g}\right)^{2/\alpha}$ = 0.865 (clause 2.6.5.2)

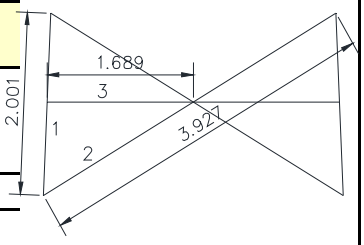
Height reduction factor K_h = $e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 913 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L120x10	2	2.002	0.12	0.4804225	
2	Diag	L60x4	2	3.928	0.06	0.4713238	
3	Sec-Horiz	L40x4	2	1.689	0.04	0.1351309	
					Total	1.087	0.000



ASMTower Result Verification

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Subject: Wind load calculation			Checked by: a.shaban
			Approved by:

Centre of gravity offset for leg e_{Leg} = 0.034 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(3.464 + 2 * 0.034) + (3.296 + 2 * 0.034)] /2 * 2.00

6.90 m^2

Solidity ratio ε = $(A_f + A_r) / A_g$ = 0.158 (clause 2.6.9.1.1)

C_f = 4ε^2 - 5.9ε + 4.0 = 3.17 (clause 2.6.9.1.1)

Wind direction factor for flat D_f = 1.00 For normal wind (Table 2-6)

= 1.12 For 45° wind (Table 2-6)

Effective Projected Area $(EPA)_S$ = $C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$ (clause 2.6.9.1.1)

= 3.44 m^2 For normal wind

= 3.85 m^2 For 45° wind

Design wind force on the panel F_{ST} = $q_z G_h (EPA)_S$ (clause 2.6.9.1)

= 2673 N For normal wind

= 2989 N For 45° wind

Panel #19 Bottom level = 0.0 m Top level = 4.0 m

Bottom width = 3.80 m Top width = 3.46 m

Average height Z = 2.0 m

Velocity pressure coefficient K_z = $2.01 \left(\frac{z}{z_g}\right)^{2/\alpha}$ = 0.850 (clause 2.6.5.2)

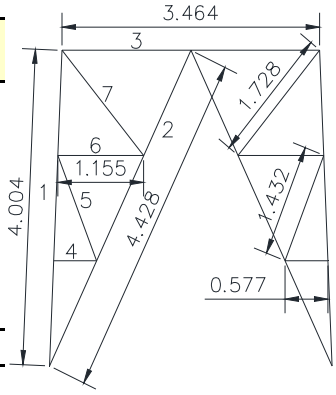
Height reduction factor K_h = $e^{\left(\frac{f z}{H}\right)}$ = N.A. (clause 2.6.6.4)

Topographic factor K_{zt} = $\left[1 + \frac{K_e K_t}{K_h}\right]^2$ = 1.000 (clause 2.6.6.4)

Velocity pressure q_z = 0.613 K_z K_{zt} K_d I V^2 (clause 2.6.9.6)

= 897 N/m^2

#	Component	Profile	Qty.	Length m	Width m	A_f m^2	A_r m^2
1	Leg	L120x10	2	4.004	0.12	0.9608449	
2	Diag	L80x6	2	4.428	0.08	0.7085309	
3	Horiz	L70x5	1	3.464	0.07	0.24248	
4	Sec-Horiz	L40x4	2	0.5773	0.04	0.046184	
5	Sec-Diag	L40x4	2	1.4316	0.04	0.114528	
6	Sec-Horiz	L40x4	2	1.1547	0.04	0.092376	
7	Sec-Diag	L40x4	2	1.7277	0.04	0.138216	
					Total	2.303	0.000



Centre of gravity offset for leg e_{Leg} = 0.034 m

Gross area of one face A_g = [(Top width + 2 e_{Leg}) + (Bottom width + 2 e_{Leg})] /2 * Panel Height

= [(3.800 + 2 * 0.034) + (3.464 + 2 * 0.034)] /2 * 4.00

14.80 m^2

ASMTower Result Verification

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Subject: Wind load calculation			Checked by: a.shaban
			Approved by:

Solidity ratio	ε	=	$(A_f + A_r) / A_g$ = 0.156		(clause 2.6.9.1.1)
	C_f	=	$4\varepsilon^2 - 5.9\varepsilon + 4.0$ = 3.18		(clause 2.6.9.1.1)
Wind direction factor for flat	D_f	=	1.00	For normal wind	(Table 2-6)
		=	1.12	For 45° wind	(Table 2-6)
Effective Projected Area	$(EPA)_S$	=	$C_f [D_f \Sigma A_f + D_r \Sigma(A_r R_r)]$		(clause 2.6.9.1.1)
		=	7.32 m^2	For normal wind	
		=	8.18 m^2	For 45° wind	
Design wind force on the panel	F_{ST}	=	$q_z G_h (EPA)_S$		(clause 2.6.9.1)
		=	5581 N	For normal wind	
		=	6232 N	For 45° wind	

#	Z	A_f m^2	A_r m^2	A_g m^2	ε	c_f	q_z N/m^2	0° Wind				45° Wind			
								D_f	Epa m^2	F_{ST} N	OTM KN.m	D_f	Epa m^2	F_{ST} N	OTM KN.m
1	39.0	0.65	0.00	2.98	0.218	2.90	1407	1.00	1.88	2254	87.9	1.16	2.19	2622	102.3
2	37.0	0.65	0.00	2.98	0.218	2.90	1391	1.00	1.88	2229	82.5	1.16	2.19	2593	95.9
3	35.0	0.63	0.00	2.98	0.213	2.92	1375	1.00	1.86	2169	75.9	1.16	2.15	2515	88.0
4	33.0	0.63	0.00	2.98	0.213	2.92	1358	1.00	1.86	2142	70.7	1.16	2.15	2484	82.0
5	31.0	0.63	0.00	2.98	0.213	2.93	1340	1.00	1.86	2115	65.6	1.16	2.15	2452	76.0
6	29.0	0.63	0.00	2.98	0.213	2.93	1322	1.00	1.86	2085	60.5	1.16	2.15	2418	70.1
7	27.0	0.76	0.00	3.16	0.239	2.82	1302	1.00	2.13	2358	63.7	1.18	2.51	2782	75.1
8	25.0	0.70	0.00	3.50	0.201	2.97	1281	1.00	2.09	2278	57.0	1.15	2.41	2622	65.6
9	23.0	0.72	0.00	3.83	0.189	3.03	1259	1.00	2.19	2344	53.9	1.14	2.50	2676	61.6
10	21.0	0.78	0.00	4.18	0.188	3.03	1235	1.00	2.38	2497	52.4	1.14	2.71	2849	59.8
11	19.0	0.81	0.00	4.51	0.178	3.07	1209	1.00	2.48	2546	48.4	1.13	2.81	2887	54.8
12	17.0	0.83	0.00	4.85	0.171	3.11	1181	1.00	2.57	2584	43.9	1.13	2.90	2915	49.5
13	15.0	0.89	0.00	5.20	0.171	3.11	1151	1.00	2.76	2704	40.6	1.13	3.12	3051	45.8
14	13.0	0.91	0.00	5.53	0.165	3.14	1116	1.00	2.86	2716	35.3	1.12	3.22	3052	39.7
15	11.0	0.94	0.00	5.87	0.159	3.16	1078	1.00	2.96	2710	29.8	1.12	3.31	3034	33.4
16	9.0	1.04	0.00	6.22	0.167	3.13	1033	1.00	3.25	2853	25.7	1.13	3.66	3211	28.9
17	7.0	1.06	0.00	6.56	0.162	3.15	980	1.00	3.35	2788	19.5	1.12	3.75	3127	21.9
18	5.0	1.09	0.00	6.90	0.158	3.17	913	1.00	3.44	2673	13.4	1.12	3.85	2989	14.9
19	2.0	2.30	0.00	14.80	0.156	3.18	897	1.00	7.32	5581	11.2	1.12	8.18	6232	12.5
								Total	51	49626	937.7	Total	58	56511	1077.8

ASMTower Result Verification

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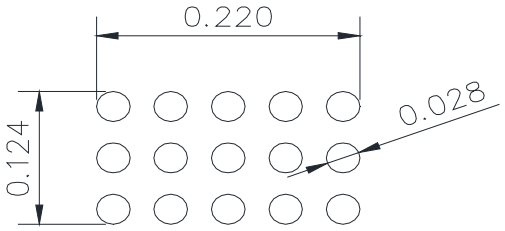
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

WIND LOAD of feeder clusters According to ANSI/TIA-222-G

Feeder diameter	=	28.000	mm
No. of rows	=	3	
No. of columns	=	5	
Row spacing (C. to C.)	=	48.000	mm
Column spacing (C. to C.)	=	48.000	mm
Cluster width	=	220	mm
Cluster thickness	=	124	mm
C_f^{indivd}	=	1.20	
C_f^{front}	=	1.50	
$C_f^{tangent}$	=	1.50	



Front effective projected area $(EPA)_n = C_f^{front}$ x Cluster width x Length

Side effective projected area $(EPA)_t = C_f^{tangent}$ x Cluster thickness x Length

Effective projected area $(EPA)_a = K_a [(EPA)_N \cos^2(\theta) + (EPA)_T \sin^2(\theta)]$

Wind load on feeder cluster at wind direction 0 °

#	Bot. Level m	Top. Level m	Z m	K_z	K_{zt}	q_z N/m²	ε	K_a	EPA_n m²	EPA_t m²	θ Deg.	EPA_a m²	F_a N	OTM KN.m
1	38.0	40.0	39.0	1.33	1.00	1406.9	0.218	0.60	0.66	0.372	45	0.3096	370	14.4
2	36.0	38.0	37.0	1.32	1.00	1391.4	0.218	0.60	0.66	0.372	45	0.3096	366	13.5
3	34.0	36.0	35.0	1.30	1.00	1375.2	0.213	0.60	0.66	0.372	45	0.3096	362	12.7
4	32.0	34.0	33.0	1.29	1.00	1358.2	0.213	0.60	0.66	0.372	45	0.3096	357	11.8
5	30.0	32.0	31.0	1.27	1.00	1340.5	0.213	0.60	0.66	0.372	45	0.3096	353	10.9
6	28.0	30.0	29.0	1.25	1.00	1321.8	0.213	0.60	0.66	0.372	45	0.3096	348	10.1
7	26.0	28.0	27.0	1.23	1.00	1302.1	0.239	0.60	0.66	0.372	45	0.3096	343	9.3
8	24.0	26.0	25.0	1.21	1.00	1281.1	0.201	0.60	0.66	0.372	45	0.3096	337	8.4
9	22.0	24.0	23.0	1.19	1.00	1258.8	0.189	0.60	0.66	0.372	45	0.3096	331	7.6
10	20.0	22.0	21.0	1.17	1.00	1235	0.188	0.60	0.66	0.372	45	0.3096	325	6.8
11	18.0	20.0	19.0	1.15	1.00	1209.2	0.178	0.60	0.66	0.372	45	0.3096	318	6.0
12	16.0	18.0	17.0	1.12	1.00	1181.2	0.171	0.60	0.66	0.372	45	0.3096	311	5.3
13	14.0	16.0	15.0	1.09	1.00	1150.5	0.171	0.60	0.66	0.372	45	0.3096	303	4.5
14	12.0	14.0	13.0	1.06	1.00	1116.4	0.165	0.60	0.66	0.372	45	0.3096	294	3.8
15	10.0	12.0	11.0	1.02	1.00	1077.8	0.159	0.60	0.66	0.372	45	0.3096	284	3.1
16	8.0	10.0	9.0	0.98	1.00	1033.2	0.167	0.60	0.66	0.372	45	0.3096	272	2.4
17	6.0	8.0	7.0	0.93	1.00	979.95	0.162	0.60	0.66	0.372	45	0.3096	258	1.8
18	4.0	6.0	5.0	0.87	1.00	912.94	0.158	0.60	0.66	0.372	45	0.3096	240	1.2
19	2.0	4.0	3.0	0.85	1.00	896.86	0.156	0.60	0.66	0.372	45	0.3096	236	0.7
											Total	5.88	6008	134.6

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Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

Wind load on feeder cluster at wind direction 45 °

#	Bot. Level	Top. Level	Z m	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	38.0	40.0	39.0	0	0.396	474	18.5
2	36.0	38.0	37.0	0	0.396	468	17.3
3	34.0	36.0	35.0	0	0.396	463	16.2
4	32.0	34.0	33.0	0	0.396	457	15.1
5	30.0	32.0	31.0	0	0.396	451	14.0
6	28.0	30.0	29.0	0	0.396	445	12.9
7	26.0	28.0	27.0	0	0.396	438	11.8
8	24.0	26.0	25.0	0	0.396	431	10.8
9	22.0	24.0	23.0	0	0.396	424	9.7
10	20.0	22.0	21.0	0	0.396	416	8.7
11	18.0	20.0	19.0	0	0.396	407	7.7
12	16.0	18.0	17.0	0	0.396	398	6.8
13	14.0	16.0	15.0	0	0.396	387	5.8
14	12.0	14.0	13.0	0	0.396	376	4.9
15	10.0	12.0	11.0	0	0.396	363	4.0
16	8.0	10.0	9.0	0	0.396	348	3.1
17	6.0	8.0	7.0	0	0.396	330	2.3
18	4.0	6.0	5.0	0	0.396	307	1.5
19	2.0	4.0	3.0	0	0.396	302	0.9
				Total	7.52	7684	172.1

ASMTower Result Verification

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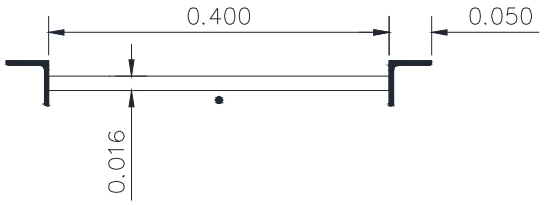
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

WIND LOAD of ladder According to ANSI/TIA-222-G

Ladder clear width		=	400	mm
Rung spacing		=	300	mm
Main rail width (L50x5)		=	50	mm
Rung width (SR 16)		=	16	mm
Saftey wire width (SR 8)		=	8	mm
Rung aspect ratio		=	25	
Rail coefficient	C_f^{Rail}	=	2.00	Flat appurtenances
Rung coefficient	C_f^{Rung}	=	1.20	Round appurtenances
Saftey wire coefficient	$C_f^{Saftey\ wire}$	=	1.20	Round appurtenances
Front effective projected area	$(EPA)_n$	=	C_f^{front} x Cluster width x Length	
Side effective projected area	$(EPA)_t$	=	$C_f^{tangent}$ x Cluster thickness x Length	
Effective projected area	$(EPA)_a$	=	$K_a [(EPA)_N \cos^2(\theta) + (EPA)_T \sin^2(\theta)]$	



Wind load on ladder at wind direction 0°

#	Bot. Level	Top. Level	Z m	K_z	K_{zt}	q_z N/m²	ε	K_a	EPA_n m²	EPA_t m²	θ Deg.	EPA_a m²	F_a N	OTM KN.m
1	38.0	40.0	39.0	1.33	1.00	1406.9	0.218	0.60	0.47	0.4192	45	0.2669	319	12.4
2	36.0	38.0	37.0	1.32	1.00	1391.4	0.218	0.60	0.47	0.4192	45	0.2669	316	11.7
3	34.0	36.0	35.0	1.30	1.00	1375.2	0.213	0.60	0.47	0.4192	45	0.2669	312	10.9
4	32.0	34.0	33.0	1.29	1.00	1358.2	0.213	0.60	0.47	0.4192	45	0.2669	308	10.2
5	30.0	32.0	31.0	1.27	1.00	1340.5	0.213	0.60	0.47	0.4192	45	0.2669	304	9.4
6	28.0	30.0	29.0	1.25	1.00	1321.8	0.213	0.60	0.47	0.4192	45	0.2669	300	8.7
7	26.0	28.0	27.0	1.23	1.00	1302.1	0.239	0.60	0.47	0.4192	45	0.2669	295	8.0
8	24.0	26.0	25.0	1.21	1.00	1281.1	0.201	0.60	0.47	0.4192	45	0.2669	291	7.3
9	22.0	24.0	23.0	1.19	1.00	1258.8	0.189	0.60	0.47	0.4192	45	0.2669	286	6.6
10	20.0	22.0	21.0	1.17	1.00	1235	0.188	0.60	0.47	0.4192	45	0.2669	280	5.9
11	18.0	20.0	19.0	1.15	1.00	1209.2	0.178	0.60	0.47	0.4192	45	0.2669	274	5.2
12	16.0	18.0	17.0	1.12	1.00	1181.2	0.171	0.60	0.47	0.4192	45	0.2669	268	4.6
13	14.0	16.0	15.0	1.09	1.00	1150.5	0.171	0.60	0.47	0.4192	45	0.2669	261	3.9
14	12.0	14.0	13.0	1.06	1.00	1116.4	0.165	0.60	0.47	0.4192	45	0.2669	253	3.3
15	10.0	12.0	11.0	1.02	1.00	1077.8	0.159	0.60	0.47	0.4192	45	0.2669	244	2.7
16	8.0	10.0	9.0	0.98	1.00	1033.2	0.167	0.60	0.47	0.4192	45	0.2669	234	2.1
17	6.0	8.0	7.0	0.93	1.00	979.95	0.162	0.60	0.47	0.4192	45	0.2669	222	1.6
18	4.0	6.0	5.0	0.87	1.00	912.94	0.158	0.60	0.47	0.4192	45	0.2669	207	1.0
19	0.0	4.0	2.0	0.85	1.00	896.86	0.156	0.60	0.94	0.8384	45	0.5338	407	0.8
											Total	5.34	5382	116.2

ASMTower Result Verification

Project no.:	40m square tower	Date: 12/21/2017	Sheet no.: of	Computed by:	M.Joe
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

Wind load on ladder at wind direction 45 °

#	Bot. Level	Top. Level	Z m	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	38.0	40.0	39.0	0	0.2822	338	13.2
2	36.0	38.0	37.0	0	0.2822	334	12.4
3	34.0	36.0	35.0	0	0.2822	330	11.5
4	32.0	34.0	33.0	0	0.2822	326	10.8
5	30.0	32.0	31.0	0	0.2822	322	10.0
6	28.0	30.0	29.0	0	0.2822	317	9.2
7	26.0	28.0	27.0	0	0.2822	312	8.4
8	24.0	26.0	25.0	0	0.2822	307	7.7
9	22.0	24.0	23.0	0	0.2822	302	6.9
10	20.0	22.0	21.0	0	0.2822	296	6.2
11	18.0	20.0	19.0	0	0.2822	290	5.5
12	16.0	18.0	17.0	0	0.2822	283	4.8
13	14.0	16.0	15.0	0	0.2822	276	4.1
14	12.0	14.0	13.0	0	0.2822	268	3.5
15	10.0	12.0	11.0	0	0.2822	259	2.8
16	8.0	10.0	9.0	0	0.2822	248	2.2
17	6.0	8.0	7.0	0	0.2822	235	1.6
18	4.0	6.0	5.0	0	0.2822	219	1.1
19	0.0	4.0	2.0	0	0.5645	430	0.9
				Total	5.64	5692	122.9

ASMTower Result Verification

Project no.:	40m square tower	Date: 12/21/2017	Sheet no.: of	Computed by:	M.Joe
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

WIND LOAD of panel antenna According to ANSI/TIA-222-G

Front coefficient	C_a^{Front} =	Force coefficiet based on front aspect ratio	(table 2-8)
Side coefficient	C_a^{Side} =	Force coefficiet based on side aspect ratio	(table 2-8)
Front effective projected area	$(EPA)_n$ =	$\Sigma (C_a A_a)_n$	(clause 2.6.9.2)
Side effective projected area	$(EPA)_t$ =	$\Sigma (C_a A_a)_t$	(clause 2.6.9.2)
Effective projected area	$(EPA)_a$ =	$K_a [(EPA)_N \cos^2(\theta) + (EPA)_T \sin^2(\theta)]$	(clause 2.6.9.2)

Wind load on panel antenna with mounts at wind direction 0 °

#	Z m	Width mm	Thick mm	Height mm	Pipe Dia. mm	Pipe Length mm	K_z	K_{zt}	q_z N/m^2	K_a	EPA_n m^2	EPA_t m^2	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	45	0.9469	1132	44.2
2	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	45	0.9469	1132	44.2
3	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	135	0.9469	1132	44.2
4	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	135	0.9469	1132	44.2
5	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	45	0.9469	1132	44.2
6	39	250	135	2560	76	3000	1.33	1.00	1406.9	1.00	1.00	0.90	45	0.9469	1132	44.2
7	37	430	120	560	76	1500	1.32	1.00	1391.4	1.00	0.36	0.21	45	0.2855	338	12.5
8	37	430	120	560	76	1500	1.32	1.00	1391.4	1.00	0.36	0.21	45	0.2855	338	12.5
													Total	6.25	7469	290

Wind load on panel antenna with mounts at wind direction 45 °

#	Z m	K_a	EPA_n m^2	EPA_t m^2	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	39	1.00	1.00	0.90	90	0.8953	1071	41.8
2	39	1.00	1.00	0.90	90	0.8953	1071	41.8
3	39	1.00	1.00	0.90	0	0.9986	1194	46.6
4	39	1.00	1.00	0.90	0	0.9986	1194	46.6
5	39	1.00	1.00	0.90	90	0.8953	1071	41.8
6	39	1.00	1.00	0.90	180	0.9986	1194	46.6
7	37	1.00	0.36	0.21	90	0.2106	249	9.2
8	37	1.00	0.36	0.21	0	0.3604	426	15.8
					Total	6.25	7469	290

ASMTower Result Verification

Project no.:	40m square tower	Date: 12/21/2017	Sheet no.: of	Computed by:	M.Joe
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

WIND LOAD of microwave dish According to ANSI/TIA-222-G

Wind load on MW dish at wind direction 0 °

#	Z m	Diam. m	K_z	K_{zt}	q_z N/m^2	Area m^2	θ Deg.	C_a	C_s	F_a N	F_s N	F_w N	OTM KN.m
1	35	1.20	1.30	1.00	1375.2	1.13	45	1.1211	0.293	1482.1	387	1322	46.3
2	35	1.20	1.30	1.00	1375.2	1.13	315	1.1211	-0.293	1482.1	-387	1322	46.3
3	37	1.20	1.32	1.00	1391.4	1.13	225	-0.897	-0.272	-1199	-363	1105	40.9
4	37	1.20	1.32	1.00	1391.4	1.13	135	-0.897	0.2715	-1199	363	1105	40.9
											Total	4853	174.3

Wind load on MW dish at wind direction 45 °

#	Z m	Diam. m	K_z	K_{zt}	q_z N/m^2	Area m^2	θ Deg.	C_a	C_s	F_a N	F_s N	F_w N	OTM KN.m
1	35	1.20	1.30	1.00	1375.2	1.13	90	-0.109	0.625	-144.6	826	826	28.9
2	35	1.20	1.30	1.00	1375.2	1.13	0	1.2617	0	1668	0	1668	58.4
3	37	1.20	1.32	1.00	1391.4	1.13	270	-0.109	-0.625	-146.3	-836	836	30.9
4	37	1.20	1.32	1.00	1391.4	1.13	180	-1.016	0	-1358	0	1358	50.3
											Total	4689	168.5

Wind load on panel antenna with mounts at wind direction 0 °

#	Z m	Pipe Dia. m	Pipe Length m	MW Diam. m	K_z	K_{zt}	q_z N/m^2	K_a	EPA_n m^2	EPA_t m^2	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	45	0.0731	87.5	3.4
2	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	315	0.0731	87.5	3.4
3	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	225	0.0731	87.5	3.4
4	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	135	0.0731	87.5	3.4
											Total	0.293	350	13.6

Wind load on panel antenna with mounts at wind direction 45 °

#	Z m	Pipe Dia. m	Pipe Length m	MW Diam. m	K_z	K_{zt}	q_z N/m^2	K_a	EPA_n m^2	EPA_t m^2	θ Deg.	EPA_a m^2	F_a N	OTM KN.m
1	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	90	0.1235	148	5.8
2	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	0	0.0228	27.3	1.1
3	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	270	0.1235	148	5.8
4	39	0.076	1.50	1.20	1.33	1.00	1406.9	1.00	0.02	0.12	180	0.0228	27.3	1.1
											Total	0.293	350	13.6

ASMTower Result Verification

Project no.:	40m square tower	Date: 12/21/2017	Sheet no.: of	Computed by:	M.Joe
Subject:	Wind load calculation			Checked by:	a.shaban
				Approved by:	

Comparsion between manual calculation and ASMTower results

Summary of manual wind load calculation

Component	Base Shear N		Base Moment KN.m	
	Wind 0 Deg.	Wind 45 Deg.	Wind 0 Deg.	Wind 45 Deg.
Latticed Panels	49625.6	56511.0	937.7	1077.8
Feeder Clusters	6007.7	7684.2	134.6	172.1
Ladder	5382.1	5691.9	116.2	122.9
Panel Antenna with mount	7469.3	7469.3	290.0	290.0
MW Dish	4853.1	4688.6	174.3	168.5
Mounts of MW Dish	349.8	349.8	13.6	13.6
Total	73687.7	82394.9	1666.3	1844.9
Total x load factor 1.6	117900.3	131831.8	2666.1	2951.8

Summary of manual wind load calculation

Component	Manual Calculation	ASMTower Results		Manual Vs. applied	Manual Vs. reaction	Applied Vs. reaction
		Applied	Reaction			
Base Shear Wind Dir. 0 Deg. (N)	117900.3	117923.1	117923.1	0.0%	0.0%	0.0%
Base Shear Wind Dir. 45 Deg. (N)	131831.8	131861.1	131861.1	0.0%	0.0%	0.0%
Base Moment Wind Dir. 0 Deg. (KN.m)	2666.1	2663.0	2663.0	0.1%	0.1%	0.0%
Base Moment Wind Dir. 45 Deg. (KN.m)	2951.8	2949.1	2949.1	0.1%	0.1%	0.0%

Note : In manual calculation the base moment due to weight of panel antenna and MW dishes was not consided in the manual calculation however ASMTower considerd. This is which cause slight difference between base moment

Conclusion :

From above caculations, it can be conclude that load calculation generated by ASMTower is matched with the manual calculation for the 40m tower and the overall reaction of the tower resulted from ASMTowe satisfy the equilbrium with applied loads