Our Ref. No. CC 13 /C500/012 Date: Jan 30,2015

TO WHOMSOEVER IT MAY CONCERN

This is to certify that at the request of M/s Ramkrishna Iron Works Private Limited, their Design of 80 M Tall Lattice Wind Mast having below mentioned specifications was evaluated and verified by us for Structural Stability:

1. 80m Tall Slender Lattice Structure Supported by Inclined Pre-Tensioned Cables
2. Design Wind Velocity : 55 mps at 10M above Ground Level
3. Wind Loading in conformity to IS : 875 - 1987: Code of Practice for Design Loads, Part 3 – Wind Loads
4. Lattice Structure is 250mm x 250mm, formed using Four Corner Legs of ISA 40 x 40 x 6 Lacing & Bracing Members of 10mm round Bars and Section Flange Members of ISA 50 x50x6 , all Grade 250MPa (RKIWPL Drg No. BY - 1 - 3011, Rev. R0 dtd 30.01.2015 : Assembly and Details of 80m Lattice Wind Mast)
5. Cables adopted are 8mm dia Galvanized Wire-ropes in 6 x 19 (12 / 6/ 1) Construction in Conformity to IS:2266 : Steel Wire Ropes for General Engineering Purpose - Specification, of Grade 1570MPa (Steel Core) with Minimum Breaking Force of 36 kN
6. Pre-Tensioning of Cable : 5 kN
7. Cable Anchoring Blocks are 2500mm Long x 1250mm Wide x 5000mm Deep Concrete Blocks placed at 16m,32m from Mast Centre on Four Orthogonal Directions (RKIWPL Drg No. BY - 4 – 3012, Rev. R0 dtd 30.01.2015 : Foundation Drawing for 80m Lattice Wind Mast)
8. On Each of Four Orthogonal Directions, One Set of Cables is Anchored 16m from Mast Centre and tied with Lattice Structure at 10m,20m,30m and 40m Level
9. On Each of Four Orthogonal Directions, One Set of Cables is Anchored 32m from Mast Centre and tied with Lattice Structure at 50m,60m,70m and 78m Level
10. Forces in all Lattice and Cable Elements are found within Permissible Limits
11. Cable Anchor Blocks are found safe against Uplift, Sliding and Overturning
12. Stability of foundation is verified for water table well below the founding level.
13. Boom Arm made of 25.4 Outer Dia 2 thk MS Pipe (RKIWPL Drg No. BY - 4 – 3013 Rev. R0 dtd 30.01.2015) is certified Structurally Adequate.

After due verification including Non-linear Analysis, it is certified that the design as submitted by M/s Ramkrishna Iron Works Private Limited is structurally sound and stable in conformity to IS 800 and IS 875 up to 55 mps wind velocity

For **Clique Consultants Private Limited**,

A D Paranjape, Director
MIE (India) Regn No. **M 041815**

Encl: 1. RKIWPL Drg No. BY - 1– 3011, Rev. R0 dtd 30.01.2015: Assembly and Details of 120m Lattice Wind Mast)

2. RKIWPL Drg No. BY - 4 – 3012, Rev. R0 dtd 30.01.2015: Foundation Drawing for 120m Lattice Wind Mast)

3. RKIWPL Drg No. BY - 4 – 3013 Rev. R0 dtd 30.01.2015: Boom Arm

CLIQUE CONSULTANTS PRIVATE LIMITED

Doc No. : C500 / CI / DS / A4 / 801

Analysis and Design Review

for

80 m Tall Latticed Wind Mast

for

Ramkrishna Iron Works Private Limited
26 Gobind Mahal
Marine Drive
Mumbai - 400 001

By

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R0	30-1-2015	ISSUED FOR RECORDS	CBD	NPV	ADP
Rev.	**Date**	**Description**	**By**	**Chkd.**	**Appv.**

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DESIGN VERIFICATION BASIS FOR 80M TALL WIND MAST

1 Introduction :-

This document validates the Structural Adequacies of all Elements of 80 m Tall Latticed Wind Mast. The Mast is formed by Four Legs which are Laced and Guyed in Four Orthogonal Directions at Multiple Levels

2 References :-

a. IS: 875-1987 : Code of Practice for Design Loads (other than earth-quake) for Buildings & Structures- Part-3 -Wind Loads.

b. IS: 1835-1976 : Specificationz for round steel wire for ropes.

c. IS: 2266-1989 : Steel wire ropes for general engineering purposes-specification.

d. IS: 2363-1981 : Glossary of terms relating to wire ropes.

e. IS: 3459-1977 : Specification for small wire ropes.

f. IS: 6594-2001 : Technical supply conditions for steel wire ropes & strands.

g IS: 800- 1984 : Code of Practice for General Construction in Steel

3 Materials Of Construction :-

a. Angles: 50x50x8, 40x40x6 - Grade - 250 Mpa.

b. Steel Plates & 10 Dia /SQ Round Bar - Grade - 250 Mpa.

c. Steel wire ropes - Grade 1570 Mpa, 8mm diameter.

4 Specification For Steel Wire Ropes :-

a. The wires shall conform to IS : 6594-2001 " Technical supply conditions for wire ropes & Strands (Second Revision)" & IS:2266-1989 "Steel Wire Ropes For General Engineering Purposes-Specifications(Third Revision)"

b. The wires shall be of 6 x 19 (12 / 6 / 1) construction which implies that the wire c/s consists of Total 6 Nos. Strands with 19 Nos. Small Wires Arranged in the Form (12 / 6 / 1) i.e. 12 Wires in the Outer Layer, 6 in the Middle Layer & 1 Wire in the Inner-most Layer. (Refer IS : 2266:1989 Steel Wire Ropes For General Engineering Purposes-Specifications.)

5 Software used :-

Staad-Pro V8i for Structural Analysis.

MS Excel for Design Verification Calculations.

6 Design Loads :-

The following are the loads acting on the structure :

a. Self-weight of the structure :-

1) Self weight of the mast and cables is generated through selfweight command in *Staad-Pro V8i*

b. Pre-Tensioning of Guy-Ropes :-

5.0 kN Pre-Tension in all Guy-Ropes

c. Wind-Loading :-

Wind loads are Estimated in Conformity to IS : 875 - 1987 - Part 3 - Wind Loads.

(Basic wind speed considerd for the design is 55 m/s.)

7 Sub Structure Design Parameters :-

a. The Unit Weight of Concrete		=	25	kN/m^3
b. Net Safe Bearing Capacity of Soil		=	100	kN/m^2
c. Co-efficient of Friction Against Sliding		=	0.5	
d. Grade Of Concrete	fck	=	20	N/mm^2
e. Grade Of Steel	fy	=	415	N/mm^2
f. The Unit Weight of Soil		=	18	kN/m^3
g. Clear Cover At Bottom (Footing)		=	75	mm
h. Clear Cover At Sides & Top (Footing)		=	50	mm
i. Factor Of Safey Against Slinding		=	1.4	
j. Factor Of Safey Against Overturning		=	1.4	

8 Structural Analysis & Design Review Approach for 120M Tall Lattice Wind Mast :-

1 Structural Analysis and Design Review of 120M Tall Lattice Wind Mast is performed using *Staad-Pro V8i* with steps as under :

1.1 Create a Model which numerically defines the Geometry, Properties, Loading and Analysis Parameters for the Structure.

1.2 Perform an Analysis of the Model.

1.3 Review the Results of the Analysis.

1.4 Check and Optimize The Design of the Strcuture.

2 The Latticed Wind Mast Structure is Modeled using:

2.1 The Beam Element for Three Dimensional Latticed (Truss) Mast Structure.

The Beam Element activates three translational Degrees of Freedom at each end.

2.2 The Cable Element for Guywires predominantly carrying Axial Tension.

Guy Wires are very slender and significant support movement is expected during the duty conditions and hence the Catenary Cable Element is the Best Choice to model guy wires.

The Cable Element activates the three translational degrees of freedom at each end of its connected joints. Rotational degrees of freedom are not activated. The Cable Element contributes stiffness to all these translational degrees of freedom

Guy wires are subjected to self weight and transverse wind load. Adequate Pre-Tension is applied to ensure that Cable Element always remain under Axial Tension for all possible duty conditions/ deformations.

Since the guy wires are not subjected to any intermediate masses/ concentrated loads, Single Segment suffices as the Best choice to define these Catenary Elements.

The Cable Element uses as elastic catenary formulation to represent the behaviour of the slender cable under its own self weight and transverse wind load. This behaviour is highly non-linear and inherently includes tension-stiffening (P-delta) and large deflection effects. Slack and Taut behaviour is automatically considered.

Convergence in Element Formation is attained by adequate iterations under actual load combination. The specified combination of applied loads is applied incrementally, using as many steps as necessary to satisfy equilibrium.

The Non-linear equations are solved iteratively in each load step. This did require re-forming and re-solving the stiffness matrix. The iterations were carried out until solution converged.

3 Maximum Horizontal Deflection observed at the tip of the mast in normal condition is 260.324 mm. This magnitude of deflection will not have adverse effect on the performance of Wind Velocity Measuring Devices to be mounted there on.

Estimation of Levelwise Wind Pressure Values

Wind loading is calculated in accordance with IS: 875 - Part 3(1987)

Basic Wind Speed(Vb) = 55 m/s

K_1 (Risk Factor.) = 0.67

Considered as Temperory Structure for life span of 5 years

K_3 (Topography factor) = 1

Category of Structure = 1

Class of Structure = C

K_2(Terrain,Height and Structure Size Factor) as per Table2 Clause 5.3.2.2 ,IS 875 Part III

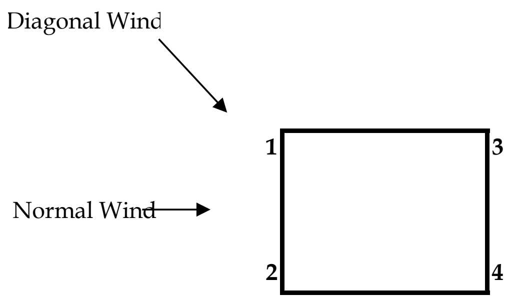
Design wind speed (Vb) = K1 X K2 X K3 X Vb

Design wind press. (Pz) = 0.6 X Vb2

Levels (m)	Height (m)	K2	Vz m/s	Pz kN/m2
0 to 10	10	0.99	36.48	0.799
10 to 15	5	1.03	37.96	0.864
15 to 20	5	1.06	39.06	0.915
20 to 25	5	1.075	39.61	0.942
25 to 30	5	1.09	40.17	0.968
30 to 35	5	1.1025	40.63	0.990
35 to 40	5	1.115	41.09	1.013
40 to 45	5	1.1275	41.55	1.036
45 to 50	5	1.14	42.01	1.059
50 to 55	5	1.146	42.23	1.070
55 to 60	5	1.152	42.45	1.081
60 to 65	5	1.158	42.67	1.093
65 to 70	5	1.164	42.89	1.104
70 to 75	5	1.17	43.11	1.115
75 to 80	5	1.176	43.34	1.127

Estimation of (Wind Load) Force Co-efficients

Wind Mast is Analysed for Normal and Diagonal Wind Load Cases
These two directions are depicted herebelow:



Sample calculation for first 5m height of the Lattice Structure:

Projected area :
For aproximate analysis of the structure, to calculate the Fondation forces, let us consider that all columns are of ISA 50 x 50 x 6
and all bracings are of 10 mm Dia Bar
Based upon these sections the projected area of all individual members of a frame normal to wind in X-Direction is given by,

Projected Area =

= (5000*40*2)	….	Vertical members of column, ISA 40*40*6
= (250-40*2)*40*2	….	Top an bottom member, ISA 40*40*6
= (650*16*1)	….	Bottom base plate, 16mm thick
= (520*6*1)	….	Top base plate, 6mm thick
= (250-40*2)*10*20	….	horizontal round bars, 10mm
= (294*10*20)	….	Diagonal round bars, 10mm
= 350*290*1	….	Logger shelter, 350 mm*290 mm

Total projected area = 621420 mm^2
0.62 m^2

Gross Area = 5000 x 250
= 1.250 X 10^6 mm2
= 1.250 m2

SolidityRatio (F) = $\frac{\text{Projected Area}}{\text{Gross Area}}$
= 0.50

Force Coeff (Fc) = 2.10 **(Refer Table 30 of IS :875 Part 3 - 1987 , Pg 47)**

Summary Of Wind Shears as per IS 875 (Part3)-1987						
Sections	**Levels (metres)**	**Projected Area for Normal Wind (m^2)**	**Force Coefficient (Cf)**	**Pressure (KN/m^2)**	**Forces on Each Node due to wind Normal to the Mast (kN)**	**Forces on Each Node due to Diagonal Wind = 1.2 x Normal Wind(kN)**
S1/ 5m	0	0.0130	2.100	0.799	0.022	0.026
	0.25	0.0130	2.100	0.799	0.022	0.026
	0.5	0.0130	2.100	0.799	0.022	0.026
	0.75	0.0130	2.100	0.799	0.022	0.026
	1	0.0130	2.100	0.799	0.022	0.026
	1.25	0.0130	2.100	0.799	0.022	0.026
	1.5	0.0130	2.100	0.799	0.022	0.026
	1.75	0.0130	2.100	0.799	0.022	0.026
	2	0.0130	2.100	0.799	0.022	0.026
	2.25	0.0130	2.100	0.799	0.022	0.026
	2.5	0.0130	2.100	0.799	0.022	0.026
	2.75	0.0130	2.100	0.799	0.022	0.026
	3	0.0130	2.100	0.799	0.022	0.026
	3.25	0.0130	2.100	0.799	0.022	0.026
	3.5	0.0130	2.100	0.799	0.022	0.026
	3.75	0.0130	2.100	0.799	0.022	0.026
	4	0.0130	2.100	0.799	0.022	0.026
	4.25	0.0130	2.100	0.799	0.022	0.026
	4.5	0.0130	2.100	0.799	0.022	0.026
	4.75	0.0130	2.100	0.799	0.022	0.026
	5	0.0130	2.100	0.799	0.022	0.026
S2/ 10m	5.25	0.0130	2.100	0.799	0.022	0.026
	5.5	0.0130	2.100	0.799	0.022	0.026
	5.75	0.0130	2.100	0.799	0.022	0.026
	6	0.0130	2.100	0.799	0.022	0.026
	6.25	0.0130	2.100	0.799	0.022	0.026
	6.5	0.0130	2.100	0.799	0.022	0.026
	6.75	0.0130	2.100	0.799	0.022	0.026
	7	0.0130	2.100	0.799	0.022	0.026
	7.25	0.0130	2.100	0.799	0.022	0.026
	7.5	0.0130	2.100	0.799	0.022	0.026
	7.75	0.0130	2.100	0.799	0.022	0.026
	8	0.0130	2.100	0.799	0.022	0.026
	8.25	0.0130	2.100	0.799	0.022	0.026
	8.5	0.0130	2.100	0.799	0.022	0.026
	8.75	0.0130	2.100	0.799	0.022	0.026
	9	0.0130	2.100	0.799	0.022	0.026
	9.25	0.0130	2.100	0.799	0.022	0.026
	9.5	0.0130	2.100	0.799	0.022	0.026
	9.75	0.0130	2.100	0.799	0.022	0.026
	10	0.0130	2.100	0.799	0.022	0.026
S3/ 15m	10.25	0.0130	2.100	0.864	0.024	0.028
	10.5	0.0130	2.100	0.864	0.024	0.028
	10.75	0.0130	2.100	0.864	0.024	0.028
	11	0.0130	2.100	0.864	0.024	0.028
	11.25	0.0130	2.100	0.864	0.024	0.028
	11.5	0.0130	2.100	0.864	0.024	0.028

	11.75	0.0130	2.100	0.864	0.024	0.028
	12	0.0130	2.100	0.864	0.024	0.028
	12.25	0.0130	2.100	0.864	0.024	0.028
	12.5	0.0130	2.100	0.864	0.024	0.028
	12.75	0.0130	2.100	0.864	0.024	0.028
	13	0.0130	2.100	0.864	0.024	0.028
	13.25	0.0130	2.100	0.864	0.024	0.028
	13.5	0.0130	2.100	0.864	0.024	0.028
	13.75	0.0130	2.100	0.864	0.024	0.028
	14	0.0130	2.100	0.864	0.024	0.028
	14.25	0.0130	2.100	0.864	0.024	0.028
	14.5	0.0130	2.100	0.864	0.024	0.028
	14.75	0.0130	2.100	0.864	0.024	0.028
	15	0.0130	2.100	0.864	0.024	0.028
S2/ 20m	15.25	0.0130	2.100	0.915	0.025	0.030
	15.5	0.0130	2.100	0.915	0.025	0.030
	15.75	0.0130	2.100	0.915	0.025	0.030
	16	0.0130	2.100	0.915	0.025	0.030
	16.25	0.0130	2.100	0.915	0.025	0.030
	16.5	0.0130	2.100	0.915	0.025	0.030
	16.75	0.0130	2.100	0.915	0.025	0.030
	17	0.0130	2.100	0.915	0.025	0.030
	17.25	0.0130	2.100	0.915	0.025	0.030
	17.5	0.0130	2.100	0.915	0.025	0.030
	17.75	0.0130	2.100	0.915	0.025	0.030
	18	0.0130	2.100	0.915	0.025	0.030
	18.25	0.0130	2.100	0.915	0.025	0.030
	18.5	0.0130	2.100	0.915	0.025	0.030
	18.75	0.0130	2.100	0.915	0.025	0.030
	19	0.0130	2.100	0.915	0.025	0.030
	19.25	0.0130	2.100	0.915	0.025	0.030
	19.5	0.0130	2.100	0.915	0.025	0.030
	19.75	0.0130	2.100	0.915	0.025	0.030
	20	0.0130	2.100	0.915	0.025	0.030
S3/ 25m	20.25	0.0130	2.100	0.942	0.026	0.031
	20.5	0.0130	2.100	0.942	0.026	0.031
	20.75	0.0130	2.100	0.942	0.026	0.031
	21	0.0130	2.100	0.942	0.026	0.031
	21.25	0.0130	2.100	0.942	0.026	0.031
	21.5	0.0130	2.100	0.942	0.026	0.031
	21.75	0.0130	2.100	0.942	0.026	0.031
	22	0.0130	2.100	0.942	0.026	0.031
	22.25	0.0130	2.100	0.942	0.026	0.031
	22.5	0.0130	2.100	0.942	0.026	0.031
	22.75	0.0130	2.100	0.942	0.026	0.031
	23	0.0130	2.100	0.942	0.026	0.031
	23.25	0.0130	2.100	0.942	0.026	0.031
	23.5	0.0130	2.100	0.942	0.026	0.031
	23.75	0.0130	2.100	0.942	0.026	0.031
	24	0.0130	2.100	0.942	0.026	0.031
	24.25	0.0130	2.100	0.942	0.026	0.031
	24.5	0.0130	2.100	0.942	0.026	0.031
	24.75	0.0130	2.100	0.942	0.026	0.031
	25	0.0130	2.100	0.942	0.026	0.031
S2/ 30m	25.25	0.0130	2.100	0.968	0.026	0.032

	25.5	0.0130	2.100	0.968	0.026	0.032
	25.75	0.0130	2.100	0.968	0.026	0.032
	26	0.0130	2.100	0.968	0.026	0.032
	26.25	0.0130	2.100	0.968	0.026	0.032
	26.5	0.0130	2.100	0.968	0.026	0.032
	26.75	0.0130	2.100	0.968	0.026	0.032
	27	0.0130	2.100	0.968	0.026	0.032
	27.25	0.0130	2.100	0.968	0.026	0.032
	27.5	0.0130	2.100	0.968	0.026	0.032
	27.75	0.0130	2.100	0.968	0.026	0.032
	28	0.0130	2.100	0.968	0.026	0.032
	28.25	0.0130	2.100	0.968	0.026	0.032
	28.5	0.0130	2.100	0.968	0.026	0.032
	28.75	0.0130	2.100	0.968	0.026	0.032
	29	0.0130	2.100	0.968	0.026	0.032
	29.25	0.0130	2.100	0.968	0.026	0.032
	29.5	0.0130	2.100	0.968	0.026	0.032
	29.75	0.0130	2.100	0.968	0.026	0.032
	30	0.0130	2.100	0.968	0.026	0.032
S3/ 35m	30.25	0.0130	2.100	0.990	0.027	0.032
	30.5	0.0130	2.100	0.990	0.027	0.032
	30.75	0.0130	2.100	0.990	0.027	0.032
	31	0.0130	2.100	0.990	0.027	0.032
	31.25	0.0130	2.100	0.990	0.027	0.032
	31.5	0.0130	2.100	0.990	0.027	0.032
	31.75	0.0130	2.100	0.990	0.027	0.032
	32	0.0130	2.100	0.990	0.027	0.032
	32.25	0.0130	2.100	0.990	0.027	0.032
	32.5	0.0130	2.100	0.990	0.027	0.032
	32.75	0.0130	2.100	0.990	0.027	0.032
	33	0.0130	2.100	0.990	0.027	0.032
	33.25	0.0130	2.100	0.990	0.027	0.032
	33.5	0.0130	2.100	0.990	0.027	0.032
	33.75	0.0130	2.100	0.990	0.027	0.032
	34	0.0130	2.100	0.990	0.027	0.032
	34.25	0.0130	2.100	0.990	0.027	0.032
	34.5	0.0130	2.100	0.990	0.027	0.032
	34.75	0.0130	2.100	0.990	0.027	0.032
	35	0.0130	2.100	0.990	0.027	0.032
S2/ 40m	35.25	0.0130	2.100	1.013	0.028	0.033
	35.5	0.0130	2.100	1.013	0.028	0.033
	35.75	0.0130	2.100	1.013	0.028	0.033
	36	0.0130	2.100	1.013	0.028	0.033
	36.25	0.0130	2.100	1.013	0.028	0.033
	36.5	0.0130	2.100	1.013	0.028	0.033
	36.75	0.0130	2.100	1.013	0.028	0.033
	37	0.0130	2.100	1.013	0.028	0.033
	37.25	0.0130	2.100	1.013	0.028	0.033
	37.5	0.0130	2.100	1.013	0.028	0.033
	37.75	0.0130	2.100	1.013	0.028	0.033
	38	0.0130	2.100	1.013	0.028	0.033
	38.25	0.0130	2.100	1.013	0.028	0.033
	38.5	0.0130	2.100	1.013	0.028	0.033
	38.75	0.0130	2.100	1.013	0.028	0.033
	39	0.0130	2.100	1.013	0.028	0.033

	39.25	0.0130	2.100	1.013	0.028	0.033
	39.5	0.0130	2.100	1.013	0.028	0.033
	39.75	0.0130	2.100	1.013	0.028	0.033
	40	0.0130	2.100	1.013	0.028	0.033
S3/ 45m	40.25	0.0130	2.100	1.036	0.028	0.034
	40.5	0.0130	2.100	1.036	0.028	0.034
	40.75	0.0130	2.100	1.036	0.028	0.034
	41	0.0130	2.100	1.036	0.028	0.034
	41.25	0.0130	2.100	1.036	0.028	0.034
	41.5	0.0130	2.100	1.036	0.028	0.034
	41.75	0.0130	2.100	1.036	0.028	0.034
	42	0.0130	2.100	1.036	0.028	0.034
	42.25	0.0130	2.100	1.036	0.028	0.034
	42.5	0.0130	2.100	1.036	0.028	0.034
	42.75	0.0130	2.100	1.036	0.028	0.034
	43	0.0130	2.100	1.036	0.028	0.034
	43.25	0.0130	2.100	1.036	0.028	0.034
	43.5	0.0130	2.100	1.036	0.028	0.034
	43.75	0.0130	2.100	1.036	0.028	0.034
	44	0.0130	2.100	1.036	0.028	0.034
	44.25	0.0130	2.100	1.036	0.028	0.034
	44.5	0.0130	2.100	1.036	0.028	0.034
	44.75	0.0130	2.100	1.036	0.028	0.034
	45	0.0130	2.100	1.036	0.028	0.034
S2/ 50m	45.25	0.0130	2.100	1.059	0.029	0.035
	45.5	0.0130	2.100	1.059	0.029	0.035
	45.75	0.0130	2.100	1.059	0.029	0.035
	46	0.0130	2.100	1.059	0.029	0.035
	46.25	0.0130	2.100	1.059	0.029	0.035
	46.5	0.0130	2.100	1.059	0.029	0.035
	46.75	0.0130	2.100	1.059	0.029	0.035
	47	0.0130	2.100	1.059	0.029	0.035
	47.25	0.0130	2.100	1.059	0.029	0.035
	47.5	0.0130	2.100	1.059	0.029	0.035
	47.75	0.0130	2.100	1.059	0.029	0.035
	48	0.0130	2.100	1.059	0.029	0.035
	48.25	0.0130	2.100	1.059	0.029	0.035
	48.5	0.0130	2.100	1.059	0.029	0.035
	48.75	0.0130	2.100	1.059	0.029	0.035
	49	0.0130	2.100	1.059	0.029	0.035
	49.25	0.0130	2.100	1.059	0.029	0.035
	49.5	0.0130	2.100	1.059	0.029	0.035
	49.75	0.0130	2.100	1.059	0.029	0.035
	50	0.0130	2.100	1.059	0.029	0.035
S3/ 55m	50.25	0.0130	2.100	1.070	0.029	0.035
	50.5	0.0130	2.100	1.070	0.029	0.035
	50.75	0.0130	2.100	1.070	0.029	0.035
	51	0.0130	2.100	1.070	0.029	0.035
	51.25	0.0130	2.100	1.070	0.029	0.035
	51.5	0.0130	2.100	1.070	0.029	0.035
	51.75	0.0130	2.100	1.070	0.029	0.035
	52	0.0130	2.100	1.070	0.029	0.035
	52.25	0.0130	2.100	1.070	0.029	0.035
	52.5	0.0130	2.100	1.070	0.029	0.035
	52.75	0.0130	2.100	1.070	0.029	0.035

	53	0.0130	2.100	1.070	0.029	0.035
	53.25	0.0130	2.100	1.070	0.029	0.035
	53.5	0.0130	2.100	1.070	0.029	0.035
	53.75	0.0130	2.100	1.070	0.029	0.035
	54	0.0130	2.100	1.070	0.029	0.035
	54.25	0.0130	2.100	1.070	0.029	0.035
	54.5	0.0130	2.100	1.070	0.029	0.035
	54.75	0.0130	2.100	1.070	0.029	0.035
	55	0.0130	2.100	1.070	0.029	0.035
S2/ 60m	55.25	0.0130	2.100	1.081	0.030	0.035
	55.5	0.0130	2.100	1.081	0.030	0.035
	55.75	0.0130	2.100	1.081	0.030	0.035
	56	0.0130	2.100	1.081	0.030	0.035
	56.25	0.0130	2.100	1.081	0.030	0.035
	56.5	0.0130	2.100	1.081	0.030	0.035
	56.75	0.0130	2.100	1.081	0.030	0.035
	57	0.0130	2.100	1.081	0.030	0.035
	57.25	0.0130	2.100	1.081	0.030	0.035
	57.5	0.0130	2.100	1.081	0.030	0.035
	57.75	0.0130	2.100	1.081	0.030	0.035
	58	0.0130	2.100	1.081	0.030	0.035
	58.25	0.0130	2.100	1.081	0.030	0.035
	58.5	0.0130	2.100	1.081	0.030	0.035
	58.75	0.0130	2.100	1.081	0.030	0.035
	59	0.0130	2.100	1.081	0.030	0.035
	59.25	0.0130	2.100	1.081	0.030	0.035
	59.5	0.0130	2.100	1.081	0.030	0.035
	59.75	0.0130	2.100	1.081	0.030	0.035
	60	0.0130	2.100	1.081	0.030	0.035
S3/ 65m	60.25	0.0130	2.100	1.093	0.030	0.036
	60.5	0.0130	2.100	1.093	0.030	0.036
	60.75	0.0130	2.100	1.093	0.030	0.036
	61	0.0130	2.100	1.093	0.030	0.036
	61.25	0.0130	2.100	1.093	0.030	0.036
	61.5	0.0130	2.100	1.093	0.030	0.036
	61.75	0.0130	2.100	1.093	0.030	0.036
	62	0.0130	2.100	1.093	0.030	0.036
	62.25	0.0130	2.100	1.093	0.030	0.036
	62.5	0.0130	2.100	1.093	0.030	0.036
	62.75	0.0130	2.100	1.093	0.030	0.036
	63	0.0130	2.100	1.093	0.030	0.036
	63.25	0.0130	2.100	1.093	0.030	0.036
	63.5	0.0130	2.100	1.093	0.030	0.036
	63.75	0.0130	2.100	1.093	0.030	0.036
	64	0.0130	2.100	1.093	0.030	0.036
	64.25	0.0130	2.100	1.093	0.030	0.036
	64.5	0.0130	2.100	1.093	0.030	0.036
	64.75	0.0130	2.100	1.093	0.030	0.036
	65	0.0130	2.100	1.093	0.030	0.036
S2/ 70m	65.25	0.0130	2.100	1.104	0.030	0.036
	65.5	0.0130	2.100	1.104	0.030	0.036
	65.75	0.0130	2.100	1.104	0.030	0.036
	66	0.0130	2.100	1.104	0.030	0.036
	66.25	0.0130	2.100	1.104	0.030	0.036
	66.5	0.0130	2.100	1.104	0.030	0.036

	66.75	0.0130	2.100	1.104	0.030	0.036
	67	0.0130	2.100	1.104	0.030	0.036
	67.25	0.0130	2.100	1.104	0.030	0.036
	67.5	0.0130	2.100	1.104	0.030	0.036
	67.75	0.0130	2.100	1.104	0.030	0.036
	68	0.0130	2.100	1.104	0.030	0.036
	68.25	0.0130	2.100	1.104	0.030	0.036
	68.5	0.0130	2.100	1.104	0.030	0.036
	68.75	0.0130	2.100	1.104	0.030	0.036
	69	0.0130	2.100	1.104	0.030	0.036
	69.25	0.0130	2.100	1.104	0.030	0.036
	69.5	0.0130	2.100	1.104	0.030	0.036
	69.75	0.0130	2.100	1.104	0.030	0.036
	70	0.0130	2.100	1.104	0.030	0.036
S3/ 75m	70.25	0.0130	2.100	1.115	0.030	0.037
	70.5	0.0130	2.100	1.115	0.030	0.037
	70.75	0.0130	2.100	1.115	0.030	0.037
	71	0.0130	2.100	1.115	0.030	0.037
	71.25	0.0130	2.100	1.115	0.030	0.037
	71.5	0.0130	2.100	1.115	0.030	0.037
	71.75	0.0130	2.100	1.115	0.030	0.037
	72	0.0130	2.100	1.115	0.030	0.037
	72.25	0.0130	2.100	1.115	0.030	0.037
	72.5	0.0130	2.100	1.115	0.030	0.037
	72.75	0.0130	2.100	1.115	0.030	0.037
	73	0.0130	2.100	1.115	0.030	0.037
	73.25	0.0130	2.100	1.115	0.030	0.037
	73.5	0.0130	2.100	1.115	0.030	0.037
	73.75	0.0130	2.100	1.115	0.030	0.037
	74	0.0130	2.100	1.115	0.030	0.037
	74.25	0.0130	2.100	1.115	0.030	0.037
	74.5	0.0130	2.100	1.115	0.030	0.037
	74.75	0.0130	2.100	1.115	0.030	0.037
	75	0.0130	2.100	1.115	0.030	0.037
S2/ 80m	75.25	0.0130	2.100	1.127	0.031	0.037
	75.5	0.0130	2.100	1.127	0.031	0.037
	75.75	0.0130	2.100	1.127	0.031	0.037
	76	0.0130	2.100	1.127	0.031	0.037
	76.25	0.0130	2.100	1.127	0.031	0.037
	76.5	0.0130	2.100	1.127	0.031	0.037
	76.75	0.0130	2.100	1.127	0.031	0.037
	77	0.0130	2.100	1.127	0.031	0.037
	77.25	0.0130	2.100	1.127	0.031	0.037
	77.5	0.0130	2.100	1.127	0.031	0.037
	77.75	0.0130	2.100	1.127	0.031	0.037
	78	0.0130	2.100	1.127	0.031	0.037
	78.25	0.0130	2.100	1.127	0.031	0.037
	78.5	0.0130	2.100	1.127	0.031	0.037
	78.75	0.0130	2.100	1.127	0.031	0.037
	79	0.0130	2.100	1.127	0.031	0.037
	79.25	0.0130	2.100	1.127	0.031	0.037
	79.5	0.0130	2.100	1.127	0.031	0.037
	79.75	0.0130	2.100	1.127	0.031	0.037
	80	0.0130	2.100	1.127	0.031	0.037
				Total =	**35.031**	**42.037**

Estimation of Levelwise Wind Pressure Values on Cables

Wind loading is calculated in accordance with IS: 875 - Part 3(1987)

Basic Wind Speed(Vb)	=	55	m/s
K_1 (Risk Factor.)	=	0.67	Considered as Temperory Structure for life span of 5 years
K_3 (Topography factor)	=	1	
Category of Structure	=	1	
Class of Structure	=	C	

K_2(Terrain,Height and Structure Size Factor) as per Table2 Clause 5.3.2.2 ,IS 875 Part III

Design wind speed (Vb) = K1 X K2 X K3 X Vb

Design wind press. (Pz) = 0.6 X Vb2

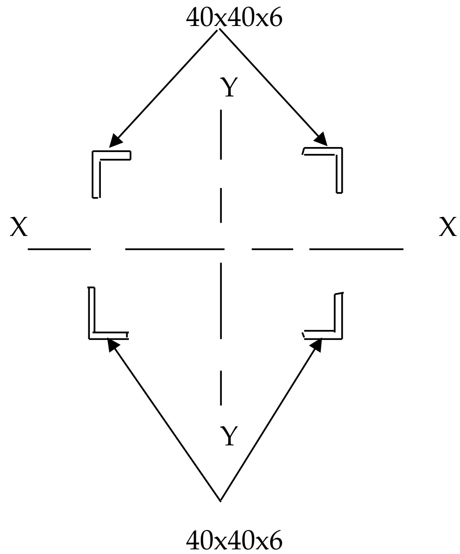
Force (kN/m) = Cf x Pz x d

where Cf is the Force coefficient, taken from Table 27, Pg no. 46 of IS 875

d is the diameter of the cable = 0.008 m

Levels	Height	K2	Vz	Pz	Cf	Force	Average value
(m)	(m)		m/s	kN/m2		(kN/m)	taken for analysis
0 to 10	10	0.99	36.48	0.799	1.20	0.008	0.008
10 to 15	5	1.03	37.96	0.864	1.20	0.008	0.008
15 to 20	5	1.06	39.06	0.915	1.20	0.009	0.008
20 to 25	5	1.075	39.61	0.942	1.20	0.009	0.009
25 to 30	5	1.09	40.17	0.968	1.20	0.009	0.009
30 to 35	5	1.1025	40.63	0.990	1.20	0.010	0.009
35 to 40	5	1.115	41.09	1.013	1.20	0.010	0.009
40 to 45	5	1.1275	41.55	1.036	1.20	0.010	0.009
45 to 50	5	1.14	42.01	1.059	1.20	0.010	0.009
50 to 55	5	1.146	42.23	1.070	1.20	0.010	0.009
55 to 60	5	1.152	42.45	1.081	1.20	0.010	0.009
60 to 65	5	1.158	42.67	1.093	1.20	0.010	0.009
65 to 70	5	1.164	42.89	1.104	1.20	0.011	0.010
70 to 75	5	1.17	43.11	1.115	1.20	0.011	0.010
75 to 80	5	1.176	43.34	1.127	1.20	0.011	0.010

CHECKING THE SLENDERNESS OF WIND MAST



1).	Length	=	250	mm
2).	Breadth	=	250	mm
3).	Angle Used	=	40x40x6	
4).	No. of Angles	=	4	nos.
5).	Area of 40 x 40 x 6	=	447	mm^2
6).	Cxx = Cyy	=	12	mm
7).	Ixx = Iyy	=	63000	mm^4

$I_{yy(\text{whole section})}$ = 4 x 63000 + 4 x 447 x ((250/2)-12)^2 mm^4

$I_{yy\ (\text{whole section})}$ = 23082972 mm^4

& Radius of gyration, $R_{yy} = \sqrt{\dfrac{23082972}{4 \times 447}}$ = 113.62 mm

8) Unsupported length of the mast, L = 10.0 m

Shaft is effectively held in position at both ends, but not restrained against rotation.

Recommended value of effective length,

$$L_{eff} = 1 \times L$$

∴ Effective length, L_{eff} = 10000 mm

∴ Slenderness ratio,

$$l = \frac{L_{eff}}{Ry} = 88.01119 < 180$$

Hence OK

Here, it is observed that 250 mm x 250 mm Mast Dimension is adequate to meet the Slenderness Criteria when guyed every 10meters.

Design of Tower Leg upto 80 m :

					L/C	Member no
1)	Max. compressive force (P) in the column =		37.97	KN	3	640
	Factored load =		56.955	KN		
2)	Max Tensile force in the column	=	37.6	KN	-	-
	Factored load =		56.4	KN		
3)	Max shear on each Leg	=	0.1	KN	3	648
	Factored load =		0.15	KN		
4)	Angle used	=	40X40X6	section		
5)	Length	=	250	mm		
6)	Area	=	447	mm2		
7)	Max Compressive force in lacing bar	=	1.297	KN	3	3532
	Factored load =		1.9455	KN		
8)	Max Tensile force in lacing bar	=	1.298	KN	3	3532
	Factored load =		1.947	KN		
9)	Yield Stress of Steel Section (fy)	=	250	N/mm2		
10)	Partial Safety factor (ɣmo)	=	1.1			

i) ***Checking the permissible compressive capacity of the column :***

a) $L_{effective}$ = 1 x L = 162.5 mm

b) Rvv = 7.7 mm

c) Slenderness Ratio = $\frac{L_{effective}}{Rvv}$ = 21.10

By interpolation,

fcd = 222.14 N/mm2 **... from Table 9(c) of IS 800- 2007**

Hence Permissible Axial Load in the column = 99.30 KN

Since 99.30 > 56.955

Hence OK

ii) ***Checking the permissible tensile capacity of the column :***

a) Tensile Force = 56.4 KN

b) Area of Section = 447 mm2

Therefore,

Tensile Stress = $\frac{56.4x1000}{447}$

Tensile Stress = 126.17 N/mm2 < **fy/ɣmo** **... from 6.2 pg 32**

< **227.25** N/mm2

where, 227.5 N/mm^2 is the permissible tensile stress of the section

Hence OK

iii) ***Checking the permissible shear capacity of the column :***

a) Shear Area = 40 x 6 mm2

= 240 mm2

b) Shear Stress (ζ) = $\frac{0.15x1000}{240}$

Therefore,

Shear Stress (ζ) = 0.63 N/mm2 **<** $\frac{fy}{\sqrt{3 \times ɣmo}}$ **...from 8.4 pg 59**

< **131** N/mm2

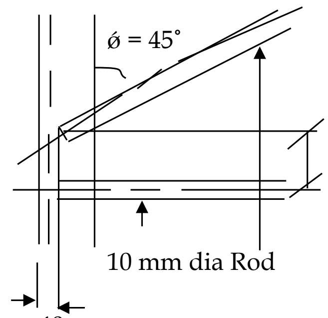
where,131 N/mm^2 is the avg permissible shear stress of the section

Hence OK

iv) ***Design of 10 mm dia Round Bar :***

For 250 x 250 mm2 section , Round Bar is inclined at ø with the axis of the column

where ø tan-1(250/250)
= 45



Bar is inclined at 45˚ with the axis of the column

Hzl Span of the bar	=	250 - 2 x 40	mm
	=	170	mm
Ver Span of the bar	=	250 -2 x 0 mm	
		210	mm
Length of the bar	=	$\sqrt{170^2 + 210^2}$	
	=	270.19	mm
Le of the bar	=	0.7 x 270.19	mm
where Le = Effective Length			
	=	189.133	mm

Now, for 10 mm Dia rod

Area = $\frac{PI() \times 10 \times 10}{4}$

= 78.54 mm2

Ixx = Iyy $\frac{PI() \times 10^4}{64}$

= 490.87 mm4

r_{yy} = $\sqrt{\frac{490.87}{78.54}}$

= 2.5 mm

Therefore, Le/r_{yy} = $\frac{189.133}{2.5}$

= 75.65 < 180

Hence OK

Checking the permissible compressive capacity of the section,

Therefore, fcd = 142.25 N/mm2 **… from Table 9(c) of IS 800- 2007**

Hence Permissible Axial Load in the column = 11.17 KN

Since 11.17 > 1.9455

Hence OK

Checking the permissible tensile capacity of the section,

Tensile Force in the lacing = 1.298 KN

Area of bar = 78.54 mm2

Tensile Stress = 16.53 **<** **fy/ɣmo** **… from 6.2 pg 32**

< **227.25** N/mm2

Hence OK

CONNECTIONS:

a). At the Ring Angles :

			load case	member no
Maximum Axial force in the ring angle =	3	kN	3	1601
Factored load =	4.5	KN		

This Axial force will be transferred as a Shear force to the Bolts

No. of Bolts provided = 12 of 12mm Dia

Shear Area of Each Bolt = $\frac{pi() \times 12^2}{4}$

Shear Area = 113.10 mm2

Shear force in Each Bolt = 113.1 x100

where, 100 N/mm2 is the permissible shear & Axial Tension stress for shop driven power rivets

= 113.1 kN

Shear Force of 6 Bolts = 678.6 kN > 4.5 kN

Hence OK

Maximum Tension in the column = 56.4 kN

No. of bolts provided to resist tension 12

Tensile Area = = 113.10 mm2

Tensile capacity of Each Bolt = 113.1 kN

Tensile Force of 12 Bolts = 1357.2 > 56.4 kN

Hence OK

b). For 10 mm Dia Rod :

Maximum Axial force in the ring/brace 10 mm dia bar = 1.5 kN

This Axial force will be transferred as a Shear force to the Weld

Effective Length of the Weld = 20 mm ….. Assumed

Thickness of the Throat = 0.7 x s

where, s is the size of weld

Assuming 6 mm Weld Size

Therefore, Throat thickness = 4.2 mm

Safe Load P = 108 x 20 x 4.2 kN
where 108 kN/mm^2 is the permissible stress in the fillet wel as per IS 816- 1969

Safe Load P = 9.072 kN > 1.5

Hence OK

Gusset Connection Between cable and plate:

			L/C	Member no
Maximum Tension in the cable =	15.203	kN	3	3871
Factored load =	22.8045	KN		

Assuming 23.616 kN Tension will be present in the gusset plate

The plate may fail at the connection by tearing between rivet holes

Checking of tearing of plate between rivet holes

Area resisting the tension = (70-22) x 10
= 480 mm2

Tensile Stress = $\frac{15203}{480}$ = **31.67** < **fy/γmo … from 6.2 pg 32**
< **227.25** N/mm2

DESIGN OF CABLE ELEMENT

Wirerope Properties for proposed 80 M Latticed Wind Mast as under :

Diameter of wire rope	=	8	mm
Construction	=	6 x 19 (12 / 6 / 1)	
Main Core	=	steel	
Lay	=	Right Hand Ordinary	
Finish	=	Galvanised	
Tensile Designation	=	1570	
Governing Specification	=	IS 3459 / 1977	

Minimum Breaking Load (Fo) = 36 KN **....IS 2266 : 2002**

Permissible tension (cable) = **0.909 x 36**
= **32.724** KN

Member no

Actual. Axial Tnsn In the Cable = **15.203** KN 3871

Since 32.724 > 15.203

Hence OK

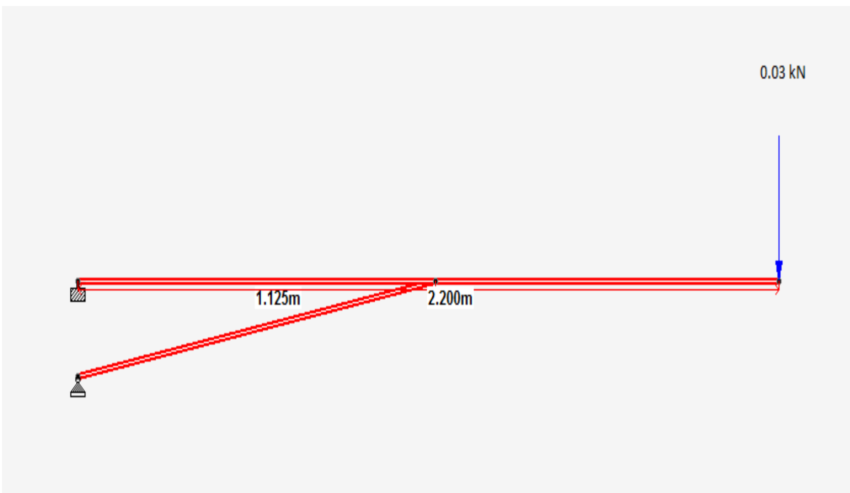
Design of bracket for side mounted wind sensor

Design data

Weight of wind sensor = 3 Kg

Using pipe having properties

OD	=	25.4	mm
Thickness	=	2	mm
C/S Area (A)	=	147.03	mm^2
Ze	=	798.17	mm^3
Zp	=	1,097.79	mm^3
r_{min}	=	8.30	mm
Self-weight	=	1.15	Kg/m
Length	=	2,200	mm



Design

Bending capacity of pipe

$$= \frac{ßb \times Zp \times fy}{\gamma mo}$$

$$= \frac{1 \times 1097.79 \times 250}{1.1}$$

= 249497.7273 N.mm

Tension capacity of pipe

$$= \frac{Ag \times fy}{\gamma mo}$$

$$= \frac{147.03 \times 250}{1.1}$$

= 33415.90909 N

Compression capacity of pipe

= Ae x fcd

l/r = 2200/8.3

= 265.06

Buckling class b

fcd = 43.619 N/mm^2 …..from table 9(b) pg 41 of IS 800 : 2007

C **=** 147.03 x 43.619

= 6413.30157 N

Shear capacity of pipe

$$= \frac{Av \text{ X } fyw}{\sqrt{3} \times \gamma mo}$$

$$Av = \frac{2 \times A}{\pi}$$

= 93.7 mm^2

$$S = \frac{93.7 \times 250}{1.73 \times 1.1}$$

= 12294.94215 N

Check for combined stresses

* Axial compression

$$\frac{615}{5768.87} = 0.11$$

* Axial Tension + Bending

$$\frac{615}{33415.9} + \frac{24000}{249498} = 0.11$$

FOUNDATION DESIGN

Data :-

1) The unit weight of concrete used = 25 kN / m^3

2) Net Safe Bearing Capacity of Soil = 100 kN/m^2

2) Coefficient of friction μ, = 0.5

3) Plan dimensions of the foundation block = 1.8 x 1.5 m
L x W

4) Depth of the foundation block = 5.0 m

5) Depth of foundation = 0.8 m

Design :-

Bouyant force = 0*1.8*1.5*10

= 0 KN Considering dry soil

The support node numbered 4 in the STAAD geometry becomes critical w.r.t uplift

& shear when the wind flows in the X-direction.

Refering to analysis result (support reactions),

Forces in X-direction,

F_x = 28.753 KN

= Total shear (F_h)

Forces in Y-direction,

F_y = 49.338 KN

= Total uplift (P_u)

Dead weight of the foundation block, = 337.5 KN

effective downward weight (W) = 337.5 - 0

337.5 KN

Check for stability against uplift :-

Minimum factor of safety against uplift = 1.5

∴ Actual factor of safety = $\frac{0.9 \times W}{P_u}$

= 6.16

Hence **SAFE**

Check for stability against sliding :-

Minimum factor of safety against sliding = 1.4

.'. Actual factor of safety = $\frac{\mu\ (0.9 \times W - P_u)}{F_h}$

= 4.42

Hence **SAFE**

Check for stability against overturning :-

Minimum factor of safety against overturning 1.4

Stabilizing downward force (P_s) = $0.9 \times W - P_u$

= 254.412 KN

Lever arm for restoring moment due tc weight only = 0.9 m

Lever arm for overturning moment = 5.0 m

Restoring moment due to dead weight = 254.412 x 0.9

M_{RD} = 228.9708 KN-m

Overturning moment, M_O = 28.753 x 5

= 143.765 KN-m

.'. Actual factor of safety against overturning = $\frac{\text{Restoring moment}}{\text{Overturning moment}}$

= 1.593

Hence **SAFE**

Design Calculation for blocks where cables are anchored:

Maximum Tension At the support = 74.007 kN

Taking the moment from the centre of the block

Moment @ centre = 74.007 x 0.9

= 66.7 kN-m

$$Ast,reqd. = \frac{0.5 \times 20}{415} \left\{ 1 - \sqrt{1 - \frac{4.6 \times 1.5 \times 66.7 \times 10^6}{20 \times 1500 \times 4917^2}} \right\} 1500 \times 4917$$

= 163 mm2

Ast,min. = 0.06% x 1500 x 5000

= 4500 mm^2

Top & Bottom Reinforcement :

Provide 12 Dia bars Area of one Bar = 113.15 mm^2

$$\text{Spacing Reqd.} = \frac{1500 \times 113.15}{4500}$$

= 37.72

Provide 12 Dia. Bars @ 90 mm c/c Both ways

Side Face Reinforcement :

Provide 12 Dia bars Area of one Bar = 113.15 mm^2

$$\text{Area Required @ each face} = \frac{0.1 \times 1500 \times 5000}{2 \times 100}$$

= 3750 mm2

$$\text{Spacing Reqd.} = \frac{113.15 \times 5000}{3750}$$

= 150.87

Provide 12 Dia. Bars @ 100 mm c/c Both ways

Check for Development Length :

$$Ldt = \frac{\text{Diameter of bar x Stress in the bar considered at deisgn load}}{\text{4 x Design Bond Stress}}$$

where, Diameter of bar = 12 mm
Stress in the bar = 361.05 N/mm2
Design Bond Stress= 1.2 **… for M20, IS 456:2000, Pg no. 43)**

$$= \frac{16 \times 0.87 \times 415}{4 \times 1.2}$$

= 902.625 < 2 x 760 mm … (Provided)
1520 mm

Hence Safe in Development Length

<u>Design Calculation of block below mast:</u>

Maximum Compression = 38.249 kN load case 3 & Node no 4

Area Assumed = 1.2 x 1.2 m^2

Depth = 0.5 m

Self Weight of footing = 1.2 x 1.2 x 0.5 x 25
= 18 kN

Pressure Check:

Total Vertical Load = 38.249 + 18
= 56.249 kN

$$\text{Gross Safe Bearing Capacity Of Soil} = \frac{56.249}{1.2 \times 1.2}$$

= 39.0618 kN/m^2 < 100 kN/m2

Hence ok

Provide 12 Dia bars Area of one Bar = 113.15 mm^2

Ast,min. = 0.06% x 1200 x 500
= 360 mm^2

Spacing Reqd. $= \frac{1200 \times 113.15}{360}$

$= 377.17$

Provide 12 Dia. Bars @ 300 mm c/c Both ways

Side Face Reinforcement :

Provide 12 Dia bars Area of one Bar = 113.15 mm^2

Area Required @ each face $= \frac{0.1 \times 1200 \times 500}{2 \times 100}$

$= 300$ mm2

Spacing Reqd. $= \frac{113.15 \times 500}{300}$

$= 188.58$

Provide 2 bars of 12 Dia (Both ways)

Check for two way shear:

Maximum Compression = 57.3735 kN load case 3 & Node no 4

Force to be resisted by $= (0.25 + 2 \times 0.25) \times 4 \times 0.5$

$= 1.5$ m^2

$= 1500000$ mm^2

$\tau_v = \frac{P}{A}$

$= \frac{57.3735 \times 1000}{1500000}$

$= 0.03825$

$\tau_c = 0.25 \sqrt{f_{ck}}$

$= 1.11803$ $N/mm^2 > 0.038249$ N/mm^2

Hence OK

Base Plate Design :

Area Assumed = 0.45 x 0.45 m^2

Bearing Pressure $= \frac{57.3735}{0.45 \times 0.45}$

$= 283.33$ $kN/m^2 < \sigma_{cc}$

where, σ_{cc} = Permissible stress in Concrete due to direct compression

$= (0.67 \times f_{ck}) / \gamma_m$

$= 8933.33$ kN/m2

Hence safe

Thk. Reqd. = $\sqrt{\dfrac{2.5 \times w \quad (a^2 \; - 0.3\, b^2) \times \gamma_{mo}}{f_y}}$

w	=	283.33	kN/m²	=	0.28333	N/mm²
a = b	=	$\dfrac{450 - 250}{2}$		=	100	mm
γ_{mo}	=	1.1				
f_y	=	250	N/mm²			

Thk. Reqd. = 4.67077

Thk. provided = 16 mm

Hence Safe

SUPPORT REACTIONS							
Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
1	1 DEAD LOAD	0.02	24.746	0.014	0	0	0
	2 WIND N	-0.298	22.134	-0.29	0	0	0
	3 WIND D	-0.192	25.446	-0.209	0	0	0
2	1 DEAD LOAD	0.014	24.746	-0.02	0	0	0
	2 WIND N	0.061	29.791	-0.043	0	0	0
	3 WIND D	-0.182	31.641	0.205	0	0	0
3	1 DEAD LOAD	-0.014	24.746	0.02	0	0	0
	2 WIND N	-0.026	22.36	0.058	0	0	0
	3 WIND D	-0.348	32.054	0.39	0	0	0
4	1 DEAD LOAD	-0.02	24.746	-0.014	0	0	0
	2 WIND N	-0.399	30.018	-0.377	0	0	0
	3 WIND D	-0.377	38.249	-0.376	0	0	0
1285	1 DEAD LOAD	7.757	-9.411	0.003	0	0	0
	2 WIND N	3.067	-2.668	-0.524	0	0	0
	3 WIND D	0.42	-0.886	0	0	0	0
1287	1 DEAD LOAD	-7.757	-9.411	-0.003	0	0	0
	2 WIND N	-11.779	-15.107	-0.536	0	0	0
	3 WIND D	-17.974	-24.987	-0.01	0	0	0
1289	1 DEAD LOAD	-0.003	-9.411	7.757	0	0	0
	2 WIND N	-0.526	-2.672	3.065	0	0	0
	3 WIND D	-1.385	-7.447	6.554	0	0	0
1291	1 DEAD LOAD	0.003	-9.411	-7.757	0	0	0
	2 WIND N	-0.527	-15.101	-11.779	0	0	0
	3 WIND D	-1.379	-7.43	-6.553	0	0	0
1293	1 DEAD LOAD	4.97	-9.272	0.002	0	0	0
	2 WIND N	-1.405	0.545	-1.414	0	0	0
	3 WIND D	-3.652	0.557	0	0	0	0
1294	1 DEAD LOAD	-0.002	-9.271	4.97	0	0	0
	2 WIND N	-1.414	0.545	-1.406	0	0	0
	3 WIND D	-3.674	-6.795	3.709	0	0	0
1295	1 DEAD LOAD	-4.97	-9.271	-0.002	0	0	0
	2 WIND N	-13.17	-22.822	-1.439	0	0	0
	3 WIND D	-28.753	-49.388	-0.015	0	0	0
1296	1 DEAD LOAD	0.002	-9.271	-4.97	0	0	0
	2 WIND N	-1.428	-22.802	-13.159	0	0	0
	3 WIND D	-3.67	-6.77	-3.697	0	0	0

CABLE FORCES									
Beam	L/C	Node	Axial Force kN	Shear-Y kN	Shear-Z kN	Torsion kNm	Moment-Y kNm	Moment-Z kNm
3871	3	1295	15.203	0	0	0	0	0
3887	3	1295	15.095	0	0	0	0	0
3867	3	1295	13.592	0	0	0	0	0
3883	3	1295	12.129	0	0	0	0	0
3861	3	641	9.969	0	0	0	0	0
3856	3	1287	9.339	0	0	0	0	0
3871	2	1295	7.101	0	0	0	0	0
3873	2	1296	7.091	0	0	0	0	0
3889	2	1251	6.739	0	0	0	0	0
3887	2	1295	6.728	0	0	0	0	0
3867	2	1295	6.579	0	0	0	0	0
3869	2	1296	6.549	0	0	0	0	0
3851	3	321	6.267	0	0	0	0	0
3884	2	1296	5.826	0	0	0	0	0
3883	2	1295	5.819	0	0	0	0	0
3848	3	1287	5.372	0	0	0	0	0
3860	2	1291	5.175	0	0	0	0	0
3861	2	641	5.167	0	0	0	0	0
3856	2	1287	5.026	0	0	0	0	0
3855	2	1291	5.006	0	0	0	0	0
3846	2	1291	4.896	0	0	0	0	0
3848	2	1287	4.890	0	0	0	0	0
3852	2	1291	4.511	0	0	0	0	0
3851	2	321	4.510	0	0	0	0	0
3845	1	1285	4.054	0	0	0	0	0
3847	1	1289	4.054	0	0	0	0	0
3846	1	1291	4.054	0	0	0	0	0
3848	1	1287	4.053	0	0	0	0	0
3846	3	1291	3.822	0	0	0	0	0
3847	3	1289	3.806	0	0	0	0	0
3849	1	1285	3.165	0	0	0	0	0
3852	1	1291	3.165	0	0	0	0	0
3850	1	1289	3.165	0	0	0	0	0
3851	1	321	3.165	0	0	0	0	0
3845	2	1285	3.093	0	0	0	0	0
3847	2	1289	3.087	0	0	0	0	0
3886	1	1293	2.859	0	0	0	0	0
3888	1	1294	2.859	0	0	0	0	0
3889	1	1251	2.859	0	0	0	0	0
3887	1	1295	2.859	0	0	0	0	0
3853	1	1285	2.808	0	0	0	0	0
3855	1	1291	2.808	0	0	0	0	0
3854	1	1289	2.808	0	0	0	0	0
3856	1	1287	2.808	0	0	0	0	0
3870	1	1293	2.764	0	0	0	0	0

3872	1	1294	2.764	0	0	0	0	0
3873	1	1296	2.764	0	0	0	0	0
3871	1	1295	2.764	0	0	0	0	0
3857	1	1285	2.746	0	0	0	0	0
3858	1	1289	2.746	0	0	0	0	0
3860	1	1291	2.746	0	0	0	0	0
3861	1	641	2.746	0	0	0	0	0
3882	1	1293	2.717	0	0	0	0	0
3884	1	1296	2.717	0	0	0	0	0
3885	1	1294	2.717	0	0	0	0	0
3883	1	1295	2.717	0	0	0	0	0
3866	1	1293	2.699	0	0	0	0	0
3868	1	1294	2.699	0	0	0	0	0
3869	1	1296	2.699	0	0	0	0	0
3867	1	1295	2.699	0	0	0	0	0
3852	3	1291	2.608	0	0	0	0	0
3850	3	1289	2.604	0	0	0	0	0
3889	3	1251	2.207	0	0	0	0	0
3888	3	1294	2.190	0	0	0	0	0
3845	3	1285	2.115	0	0	0	0	0
3854	3	1289	2.090	0	0	0	0	0
3872	3	1294	2.071	0	0	0	0	0
3873	3	1296	2.051	0	0	0	0	0
3855	3	1291	2.043	0	0	0	0	0
3884	3	1296	2.022	0	0	0	0	0
3885	3	1294	2.002	0	0	0	0	0
3868	3	1294	1.992	0	0	0	0	0
3869	3	1296	1.947	0	0	0	0	0
3860	3	1291	1.940	0	0	0	0	0
3858	3	1289	1.926	0	0	0	0	0
3849	2	1285	1.434	0	0	0	0	0
3850	2	1289	1.433	0	0	0	0	0
3854	2	1289	0.142	0	0	0	0	0
3853	2	1285	0.131	0	0	0	0	0
3857	2	1285	0.029	0	0	0	0	0
3858	2	1289	0.028	0	0	0	0	0
3882	2	1293	0.015	0	0	0	0	0
3885	2	1294	0.015	0	0	0	0	0
3886	2	1293	0.000	0	0	0	0	0
3888	2	1294	0.000	0	0	0	0	0
3886	3	1252	0.000	0	0	0	0	0
3853	3	484	0.000	0	0	0	0	0
3886	3	1293	0.000	0	0	0	0	0
3868	2	1294	0.000	0	0	0	0	0
3870	3	1293	0.000	0	0	0	0	0
3882	3	1293	0.000	0	0	0	0	0
3849	3	1285	0.000	0	0	0	0	0
3882	3	804	0.000	0	0	0	0	0
3849	3	324	0.000	0	0	0	0	0
3870	3	1124	0.000	0	0	0	0	0
3857	3	1285	0.000	0	0	0	0	0
3868	2	962	0.000	0	0	0	0	0

3872	2	1294	0.000	0	0	0	0	0
3866	2	964	0.000	0	0	0	0	0
3866	2	1293	0.000	0	0	0	0	0
3866	3	964	0.000	0	0	0	0	0
3866	3	1293	0.000	0	0	0	0	0
3870	2	1124	0.000	0	0	0	0	0
3857	3	644	0.000	0	0	0	0	0
3870	2	1293	0.000	0	0	0	0	0
3872	2	1122	0.000	0	0	0	0	0
3853	3	1285	0.000	0	0	0	0	0
3888	2	1250	0.000	0	0	0	0	0
3886	2	1252	0.000	0	0	0	0	0
3885	2	802	-0.015	0	0	0	0	0
3882	2	804	-0.015	0	0	0	0	0
3858	2	642	-0.028	0	0	0	0	0
3857	2	644	-0.029	0	0	0	0	0
3853	2	484	-0.131	0	0	0	0	0
3854	2	482	-0.142	0	0	0	0	0
3850	2	322	-1.433	0	0	0	0	0
3849	2	324	-1.434	0	0	0	0	0
3858	3	642	-1.926	0	0	0	0	0
3860	3	643	-1.940	0	0	0	0	0
3869	3	963	-1.947	0	0	0	0	0
3868	3	962	-1.992	0	0	0	0	0
3885	3	802	-2.002	0	0	0	0	0
3884	3	803	-2.022	0	0	0	0	0
3855	3	483	-2.043	0	0	0	0	0
3873	3	1123	-2.051	0	0	0	0	0
3872	3	1122	-2.071	0	0	0	0	0
3854	3	482	-2.090	0	0	0	0	0
3845	3	164	-2.115	0	0	0	0	0
3888	3	1250	-2.190	0	0	0	0	0
3889	3	1296	-2.207	0	0	0	0	0
3850	3	322	-2.604	0	0	0	0	0
3852	3	323	-2.608	0	0	0	0	0
3867	1	961	-2.699	0	0	0	0	0
3869	1	963	-2.699	0	0	0	0	0
3868	1	962	-2.699	0	0	0	0	0
3866	1	964	-2.699	0	0	0	0	0
3883	1	801	-2.717	0	0	0	0	0
3884	1	803	-2.717	0	0	0	0	0
3885	1	802	-2.717	0	0	0	0	0
3882	1	804	-2.717	0	0	0	0	0
3861	1	1287	-2.746	0	0	0	0	0
3858	1	642	-2.746	0	0	0	0	0
3860	1	643	-2.746	0	0	0	0	0
3857	1	644	-2.746	0	0	0	0	0
3871	1	1121	-2.764	0	0	0	0	0
3872	1	1122	-2.764	0	0	0	0	0
3873	1	1123	-2.764	0	0	0	0	0
3870	1	1124	-2.764	0	0	0	0	0
3856	1	481	-2.808	0	0	0	0	0

3854	1	482	-2.808	0	0	0	0	0
3855	1	483	-2.808	0	0	0	0	0
3853	1	484	-2.808	0	0	0	0	0
3887	1	1249	-2.859	0	0	0	0	0
3889	1	1296	-2.859	0	0	0	0	0
3888	1	1250	-2.859	0	0	0	0	0
3886	1	1252	-2.859	0	0	0	0	0
3847	2	162	-3.087	0	0	0	0	0
3845	2	164	-3.093	0	0	0	0	0
3851	1	1287	-3.165	0	0	0	0	0
3850	1	322	-3.165	0	0	0	0	0
3852	1	323	-3.165	0	0	0	0	0
3849	1	324	-3.165	0	0	0	0	0
3847	3	162	-3.806	0	0	0	0	0
3846	3	163	-3.822	0	0	0	0	0
3848	1	161	-4.053	0	0	0	0	0
3847	1	162	-4.054	0	0	0	0	0
3846	1	163	-4.054	0	0	0	0	0
3845	1	164	-4.054	0	0	0	0	0
3851	2	1287	-4.510	0	0	0	0	0
3852	2	323	-4.511	0	0	0	0	0
3848	2	161	-4.890	0	0	0	0	0
3846	2	163	-4.896	0	0	0	0	0
3855	2	483	-5.006	0	0	0	0	0
3856	2	481	-5.026	0	0	0	0	0
3861	2	1287	-5.167	0	0	0	0	0
3860	2	643	-5.175	0	0	0	0	0
3848	3	161	-5.372	0	0	0	0	0
3883	2	801	-5.819	0	0	0	0	0
3884	2	803	-5.826	0	0	0	0	0
3851	3	1287	-6.267	0	0	0	0	0
3869	2	963	-6.549	0	0	0	0	0
3867	2	961	-6.579	0	0	0	0	0
3887	2	1249	-6.728	0	0	0	0	0
3889	2	1296	-6.739	0	0	0	0	0
3873	2	1123	-7.091	0	0	0	0	0
3871	2	1121	-7.101	0	0	0	0	0
3856	3	481	-9.339	0	0	0	0	0
3861	3	1287	-9.969	0	0	0	0	0
3883	3	801	-12.129	0	0	0	0	0
3867	3	961	-13.592	0	0	0	0	0
3887	3	1249	-15.095	0	0	0	0	0
3871	3	1121	-15.203	0	0	0	0	0
3871	3 WIND D		15.203	MAX				

STAAD SPACE C500-80M TOWER NONLINER CABLE ANALYSIS WITH 5KN TENSION

START JOB INFORMATION

ENGINEER DATE 30 JAN 2015

JOB NAME Analysis & Design review for 80m Tall Latticed Wind Mast

JOB CLIENT Ramkrishna Iron work Pvt. Ltd.

JOB NO C500

ENGINEER NAME CBD

CHECKER NAME NPV

APPROVED NAME NPV

CHECKER DATE 30 JAN 2015

APPROVED DATE 30 JAN 2015

END JOB INFORMATION

INPUT WIDTH 79

UNIT METER KN

JOINT COORDINATES

1 0 0 0; 2 0.177 0 0.177; 3 0.177 0 -0.177; 4 0.354 0 0; 5 0 0.25 0;

6 0.177 0.25 0.177; 7 0.177 0.25 -0.177; 8 0.354 0.25 0; 9 0 0.5 0;

10 0.177 0.5 0.177; 11 0.177 0.5 -0.177; 12 0.354 0.5 0; 13 0 0.75 0;

14 0.177 0.75 0.177; 15 0.177 0.75 -0.177; 16 0.354 0.75 0; 17 0 1 0;

18 0.177 1 0.177; 19 0.177 1 -0.177; 20 0.354 1 0; 21 0 1.25 0;

22 0.177 1.25 0.177; 23 0.177 1.25 -0.177; 24 0.354 1.25 0; 25 0 1.5 0;

26 0.177 1.5 0.177; 27 0.177 1.5 -0.177; 28 0.354 1.5 0; 29 0 1.75 0;

30 0.177 1.75 0.177; 31 0.177 1.75 -0.177; 32 0.354 1.75 0; 33 0 2 0;

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POISSON 0.3
DENSITY 78.5
ALPHA 1.2e-005
DAMP 0.03
TYPE STEEL
STRENGTH FY 250000 FU 407800 RY 1.5 RT 1.2
END DEFINE MATERIAL
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3845 TO 3858 3860 3861 3866 TO 3873 3882 TO 3889 PRIS YD 0.008
MEMBER PROPERTY INDIAN
9 TO 12 17 TO 20 25 TO 28 41 TO 44 49 TO 52 57 TO 60 73 TO 76 81 TO 84 89 -
90 TO 92 105 TO 108 113 TO 116 121 TO 124 137 TO 140 145 TO 148 153 TO 156 -
169 TO 172 177 TO 180 185 TO 188 201 TO 204 209 TO 212 217 TO 220 -
233 TO 236 241 TO 244 249 TO 252 265 TO 268 273 TO 276 281 TO 284 -
297 TO 300 305 TO 308 313 TO 316 329 TO 332 337 TO 340 345 TO 348 -
361 TO 364 369 TO 372 377 TO 380 393 TO 396 401 TO 404 409 TO 412 -
425 TO 428 433 TO 436 441 TO 444 457 TO 460 465 TO 468 473 TO 476 -
489 TO 492 497 TO 500 505 TO 508 521 TO 524 529 TO 532 537 TO 540 -
553 TO 556 561 TO 564 569 TO 572 585 TO 588 593 TO 596 601 TO 604 -
617 TO 620 625 TO 628 633 TO 636 649 TO 652 657 TO 660 665 TO 668 -
681 TO 684 689 TO 692 697 TO 700 713 TO 716 721 TO 724 729 TO 732 -
745 TO 748 753 TO 756 761 TO 764 777 TO 780 785 TO 788 793 TO 796 -
809 TO 812 817 TO 820 825 TO 828 841 TO 844 849 TO 852 857 TO 860 -
873 TO 876 881 TO 884 889 TO 892 905 TO 908 913 TO 916 921 TO 924 -
937 TO 940 945 TO 948 953 TO 956 969 TO 972 977 TO 980 985 TO 988 -
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1002 TO 1004 1009 TO 1012 1017 TO 1020 1033 TO 1036 1041 TO 1044 1049 TO 1052 -
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1865 TO 1868 1873 TO 1876 1881 TO 1884 1897 TO 1900 1905 TO 1908 -

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157 TO 168 173 TO 176 181 TO 184 189 TO 200 205 TO 208 213 TO 216 -

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CONSTANTS

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2350 2358 2366 2374 2382 2390 2398 2406 2414 2422 2430 2438 2446 2454 2462 -

2470 2478 2486 2494 2502 2510 2518 2526 2534 2542 2550 2558

BETA 270 MEMB 7 15 23 31 39 47 55 63 71 79 87 95 103 111 119 127 135 143 151 -

159 167 175 183 191 199 207 215 223 231 239 247 255 263 271 279 287 295 303 -

311 319 327 335 343 351 359 367 375 383 391 399 407 415 423 431 439 447 455 -

463 471 479 487 495 503 511 519 527 535 543 551 559 567 575 583 591 599 607 -

615 623 631 639 647 655 663 671 679 687 695 703 711 719 727 735 743 751 759 -

767 775 783 791 799 807 815 823 831 839 847 855 863 871 879 887 895 903 911 -

919 927 935 943 951 959 967 975 983 991 999 1007 1015 1023 1031 1039 1047 -

1055 1063 1071 1079 1087 1095 1103 1111 1119 1127 1135 1143 1151 1159 1167 -

1175 1183 1191 1199 1207 1215 1223 1231 1239 1247 1255 1263 1271 1279 1287 -

1295 1303 1311 1319 1327 1335 1343 1351 1359 1367 1375 1383 1391 1399 1407 -

1415 1423 1431 1439 1447 1455 1463 1471 1479 1487 1495 1503 1511 1519 1527 -

1535 1543 1551 1559 1567 1575 1583 1591 1599 1607 1615 1623 1631 1639 1647 -

1655 1663 1671 1679 1687 1695 1703 1711 1719 1727 1735 1743 1751 1759 1767 -

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1775 1783 1791 1799 1807 1815 1823 1831 1839 1847 1855 1863 1871 1879 1887 -
1895 1903 1911 1919 1927 1935 1943 1951 1959 1967 1975 1983 1991 1999 2007 -
2015 2023 2031 2039 2047 2055 2063 2071 2079 2087 2095 2103 2111 2119 2127 -
2135 2143 2151 2159 2167 2175 2183 2191 2199 2207 2215 2223 2231 2239
BETA 270 MEMB 2247 2255 2263 2271 2279 2287 2295 2303 2311 2319 2327 2335 -
2343 2351 2359 2367 2375 2383 2391 2399 2407 2415 2423 2431 2439 2447 2455 -
2463 2471 2479 2487 2495 2503 2511 2519 2527 2535 2543 2551 2559
**********************************************************************************************
MATERIAL STEEL ALL
SUPPORTS
1 TO 4 PINNED
1285 1287 1289 1291 1293 TO 1296 FIXED
**********************************************************************************************
MEMBER CABLE
3845 TO 3858 3860 3861 3866 TO 3873 3882 TO 3889 TENSION 5
**********************************************************************************************
LOAD 1 LOADTYPE Dead  TITLE DEAD LOAD
SELFWEIGHT Y -1
PERFORM CABLE ANALYSIS
*STEPS 20 EQITERATIONS 100
CHANGE
***********************************************************************************************
**************************************************************************************************
LOAD 2 LOADTYPE Wind  TITLE WIND N
SELFWEIGHT Y -1
MEMBER LOAD
**ON MAST IN X DIRECTION**
5 TO 8 13 TO 16 21 TO 24 29 TO 32 37 TO 40 45 TO 48 53 TO 56 61 TO 64 -
69 TO 72 77 TO 80 85 TO 88 93 TO 96 101 TO 104 109 TO 112 117 TO 120 125 -
126 TO 128 133 TO 136 141 TO 144 149 TO 152 157 TO 160 165 TO 168 173 TO 176 -
181 TO 184 189 TO 192 197 TO 200 205 TO 208 213 TO 216 221 TO 224 -
229 TO 232 237 TO 240 245 TO 248 253 TO 256 261 TO 264 269 TO 272 -
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277 TO 280 285 TO 288 293 TO 296 301 TO 304 309 TO 312 317 TO 319 -

320 UNI GX 0.031

325 TO 328 333 TO 336 341 TO 344 349 TO 352 357 TO 360 365 TO 368 373 TO 376 -

381 TO 384 389 TO 392 397 TO 400 405 TO 408 413 TO 416 421 TO 424 -

429 TO 432 437 TO 440 445 TO 448 453 TO 456 461 TO 464 469 TO 472 -

477 TO 480 UNI GX 0.0334

485 TO 488 493 TO 496 501 TO 504 509 TO 512 517 TO 520 525 TO 528 533 TO 536 -

541 TO 544 549 TO 552 557 TO 560 565 TO 568 573 TO 576 581 TO 584 -

589 TO 592 597 TO 600 605 TO 608 613 TO 616 621 TO 624 629 TO 632 -

637 TO 640 UNI GX 0.0354

645 TO 648 653 TO 656 661 TO 664 669 TO 672 677 TO 680 685 TO 688 693 TO 696 -

701 TO 704 709 TO 712 717 TO 720 725 TO 728 733 TO 736 741 TO 744 -

749 TO 752 757 TO 760 765 TO 768 773 TO 776 781 TO 784 789 TO 792 -

797 TO 800 UNI GX 0.0364

805 TO 808 813 TO 816 821 TO 824 829 TO 832 837 TO 840 845 TO 848 853 TO 856 -

861 TO 864 869 TO 872 877 TO 880 885 TO 888 893 TO 896 901 TO 904 -

909 TO 912 917 TO 920 925 TO 928 933 TO 936 941 TO 944 949 TO 952 -

957 TO 960 UNI GX 0.0374

965 TO 968 973 TO 976 981 TO 984 989 TO 992 997 TO 1000 1005 TO 1008 1013 -

1014 TO 1016 1021 TO 1024 1029 TO 1032 1037 TO 1040 1045 TO 1048 1053 TO 1056 -

1061 TO 1064 1069 TO 1072 1077 TO 1080 1085 TO 1088 1093 TO 1096 -

1101 TO 1104 1109 TO 1112 1117 TO 1120 UNI GX 0.0383

1125 TO 1128 1133 TO 1136 1141 TO 1144 1149 TO 1152 1157 TO 1160 1165 TO 1168 -

1173 TO 1176 1181 TO 1184 1189 TO 1192 1197 TO 1200 1205 TO 1208 -

1213 TO 1216 1221 TO 1224 1229 TO 1232 1237 TO 1240 1245 TO 1248 -

1253 TO 1256 1261 TO 1264 1269 TO 1272 1277 TO 1280 UNI GX 0.0392

1285 TO 1288 1293 TO 1296 1301 TO 1304 1309 TO 1312 1317 TO 1320 1325 TO 1328 -

1333 TO 1336 1341 TO 1344 1349 TO 1352 1357 TO 1360 1365 TO 1368 -

1373 TO 1376 1381 TO 1384 1389 TO 1392 1397 TO 1400 1405 TO 1408 -

1413 TO 1416 1421 TO 1424 1429 TO 1432 1437 TO 1440 UNI GX 0.0401

1445 TO 1448 1453 TO 1456 1461 TO 1464 1469 TO 1472 1477 TO 1480 1485 TO 1488 -

1493 TO 1496 1501 TO 1504 1509 TO 1512 1517 TO 1520 1525 TO 1528 -

1533 TO 1536 1541 TO 1544 1549 TO 1552 1557 TO 1560 1565 TO 1568 -

1573 TO 1576 1581 TO 1584 1589 TO 1592 1597 TO 1600 UNI GX 0.0409

1605 TO 1608 1613 TO 1616 1621 TO 1624 1629 TO 1632 1637 TO 1640 1645 TO 1648 -

1653 TO 1656 1661 TO 1664 1669 TO 1672 1677 TO 1680 1685 TO 1688 -

1693 TO 1696 1701 TO 1704 1709 TO 1712 1717 TO 1720 1725 TO 1728 -

1733 TO 1736 1741 TO 1744 1749 TO 1752 1757 TO 1760 UNI GX 0.0414

1765 TO 1768 1773 TO 1776 1781 TO 1784 1789 TO 1792 1797 TO 1800 1805 TO 1808 -

1813 TO 1816 1821 TO 1824 1829 TO 1832 1837 TO 1840 1845 TO 1848 -

1853 TO 1856 1861 TO 1864 1869 TO 1872 1877 TO 1880 1885 TO 1888 -

1893 TO 1896 1901 TO 1904 1909 TO 1912 1917 TO 1920 UNI GX 0.0418

1925 TO 1928 1933 TO 1936 1941 TO 1944 1949 TO 1952 1957 TO 1960 1965 TO 1968 -

1973 TO 1976 1981 TO 1984 1989 TO 1992 1997 TO 2000 2005 TO 2008 -

2013 TO 2016 2021 TO 2024 2029 TO 2032 2037 TO 2040 2045 TO 2048 -

2053 TO 2056 2061 TO 2064 2069 TO 2072 2077 TO 2080 UNI GX 0.0422

2085 TO 2088 2093 TO 2096 2101 TO 2104 2109 TO 2112 2117 TO 2120 2125 TO 2128 -

2133 TO 2136 2141 TO 2144 2149 TO 2152 2157 TO 2160 2165 TO 2168 -

2173 TO 2176 2181 TO 2184 2189 TO 2192 2197 TO 2200 2205 TO 2208 -

2213 TO 2216 2221 TO 2224 2229 TO 2232 2237 TO 2240 UNI GX 0.0427

2245 TO 2248 2253 TO 2256 2261 TO 2264 2269 TO 2272 2277 TO 2280 2285 TO 2288 -

2293 TO 2296 2301 TO 2304 2309 TO 2312 2317 TO 2320 2325 TO 2328 -

2333 TO 2336 2341 TO 2344 2349 TO 2352 2357 TO 2360 2365 TO 2368 -

2373 TO 2376 2381 TO 2384 2389 TO 2392 2397 TO 2400 UNI GX 0.0431

2405 TO 2408 2413 TO 2416 2421 TO 2424 2429 TO 2432 2437 TO 2440 2445 TO 2448 -

2453 TO 2456 2461 TO 2464 2469 TO 2472 2477 TO 2480 2485 TO 2488 -

2493 TO 2496 2501 TO 2504 2509 TO 2512 2517 TO 2520 2525 TO 2528 -

2533 TO 2536 2541 TO 2544 2549 TO 2552 2557 TO 2560 UNI GX 0.0436

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MEMBER LOAD

ON MAST IN Z DIRECTION

5 TO 8 13 TO 16 21 TO 24 29 TO 32 37 TO 40 45 TO 48 53 TO 56 61 TO 64 -

69 TO 72 77 TO 80 85 TO 88 93 TO 96 101 TO 104 109 TO 112 117 TO 120 125 -

126 TO 128 133 TO 136 141 TO 144 149 TO 152 157 TO 160 165 TO 168 173 TO 176 -

181 TO 184 189 TO 192 197 TO 200 205 TO 208 213 TO 216 221 TO 224 -

229 TO 232 237 TO 240 245 TO 248 253 TO 256 261 TO 264 269 TO 272 -

277 TO 280 285 TO 288 293 TO 296 301 TO 304 309 TO 312 317 TO 319 -

320 UNI GZ 0.031

325 TO 328 333 TO 336 341 TO 344 349 TO 352 357 TO 360 365 TO 368 373 TO 376 -

381 TO 384 389 TO 392 397 TO 400 405 TO 408 413 TO 416 421 TO 424 -

429 TO 432 437 TO 440 445 TO 448 453 TO 456 461 TO 464 469 TO 472 -

477 TO 480 UNI GZ 0.0334

485 TO 488 493 TO 496 501 TO 504 509 TO 512 517 TO 520 525 TO 528 533 TO 536 -

541 TO 544 549 TO 552 557 TO 560 565 TO 568 573 TO 576 581 TO 584 -

589 TO 592 597 TO 600 605 TO 608 613 TO 616 621 TO 624 629 TO 632 -

637 TO 640 UNI GZ 0.0354

645 TO 648 653 TO 656 661 TO 664 669 TO 672 677 TO 680 685 TO 688 693 TO 696 -

701 TO 704 709 TO 712 717 TO 720 725 TO 728 733 TO 736 741 TO 744 -

749 TO 752 757 TO 760 765 TO 768 773 TO 776 781 TO 784 789 TO 792 -

797 TO 800 UNI GZ 0.0364

805 TO 808 813 TO 816 821 TO 824 829 TO 832 837 TO 840 845 TO 848 853 TO 856 -

861 TO 864 869 TO 872 877 TO 880 885 TO 888 893 TO 896 901 TO 904 -

909 TO 912 917 TO 920 925 TO 928 933 TO 936 941 TO 944 949 TO 952 -

957 TO 960 UNI GZ 0.0374

965 TO 968 973 TO 976 981 TO 984 989 TO 992 997 TO 1000 1005 TO 1008 1013 -

1014 TO 1016 1021 TO 1024 1029 TO 1032 1037 TO 1040 1045 TO 1048 1053 TO 1056 -

1061 TO 1064 1069 TO 1072 1077 TO 1080 1085 TO 1088 1093 TO 1096 -

1101 TO 1104 1109 TO 1112 1117 TO 1120 UNI GZ 0.0383

1125 TO 1128 1133 TO 1136 1141 TO 1144 1149 TO 1152 1157 TO 1160 1165 TO 1168 -

1173 TO 1176 1181 TO 1184 1189 TO 1192 1197 TO 1200 1205 TO 1208 -

1213 TO 1216 1221 TO 1224 1229 TO 1232 1237 TO 1240 1245 TO 1248 -

1253 TO 1256 1261 TO 1264 1269 TO 1272 1277 TO 1280 UNI GZ 0.0392

1285 TO 1288 1293 TO 1296 1301 TO 1304 1309 TO 1312 1317 TO 1320 1325 TO 1328 -

1333 TO 1336 1341 TO 1344 1349 TO 1352 1357 TO 1360 1365 TO 1368 -

1373 TO 1376 1381 TO 1384 1389 TO 1392 1397 TO 1400 1405 TO 1408 -

1413 TO 1416 1421 TO 1424 1429 TO 1432 1437 TO 1440 UNI GZ 0.0401

1445 TO 1448 1453 TO 1456 1461 TO 1464 1469 TO 1472 1477 TO 1480 1485 TO 1488 -

1493 TO 1496 1501 TO 1504 1509 TO 1512 1517 TO 1520 1525 TO 1528 -

1533 TO 1536 1541 TO 1544 1549 TO 1552 1557 TO 1560 1565 TO 1568 -

1573 TO 1576 1581 TO 1584 1589 TO 1592 1597 TO 1600 UNI GZ 0.0409

1605 TO 1608 1613 TO 1616 1621 TO 1624 1629 TO 1632 1637 TO 1640 1645 TO 1648 -

1653 TO 1656 1661 TO 1664 1669 TO 1672 1677 TO 1680 1685 TO 1688 -

1693 TO 1696 1701 TO 1704 1709 TO 1712 1717 TO 1720 1725 TO 1728 -

1733 TO 1736 1741 TO 1744 1749 TO 1752 1757 TO 1760 UNI GZ 0.0414

1765 TO 1768 1773 TO 1776 1781 TO 1784 1789 TO 1792 1797 TO 1800 1805 TO 1808 -

1813 TO 1816 1821 TO 1824 1829 TO 1832 1837 TO 1840 1845 TO 1848 -

1853 TO 1856 1861 TO 1864 1869 TO 1872 1877 TO 1880 1885 TO 1888 -

1893 TO 1896 1901 TO 1904 1909 TO 1912 1917 TO 1920 UNI GZ 0.0418

1925 TO 1928 1933 TO 1936 1941 TO 1944 1949 TO 1952 1957 TO 1960 1965 TO 1968 -

1973 TO 1976 1981 TO 1984 1989 TO 1992 1997 TO 2000 2005 TO 2008 -

2013 TO 2016 2021 TO 2024 2029 TO 2032 2037 TO 2040 2045 TO 2048 -

2053 TO 2056 2061 TO 2064 2069 TO 2072 2077 TO 2080 UNI GZ 0.0422

2085 TO 2088 2093 TO 2096 2101 TO 2104 2109 TO 2112 2117 TO 2120 2125 TO 2128 -

2133 TO 2136 2141 TO 2144 2149 TO 2152 2157 TO 2160 2165 TO 2168 -

2173 TO 2176 2181 TO 2184 2189 TO 2192 2197 TO 2200 2205 TO 2208 -

2213 TO 2216 2221 TO 2224 2229 TO 2232 2237 TO 2240 UNI GZ 0.0427

2245 TO 2248 2253 TO 2256 2261 TO 2264 2269 TO 2272 2277 TO 2280 2285 TO 2288 -

2293 TO 2296 2301 TO 2304 2309 TO 2312 2317 TO 2320 2325 TO 2328 -

2333 TO 2336 2341 TO 2344 2349 TO 2352 2357 TO 2360 2365 TO 2368 -

2373 TO 2376 2381 TO 2384 2389 TO 2392 2397 TO 2400 UNI GZ 0.0431

2405 TO 2408 2413 TO 2416 2421 TO 2424 2429 TO 2432 2437 TO 2440 2445 TO 2448 -

2453 TO 2456 2461 TO 2464 2469 TO 2472 2477 TO 2480 2485 TO 2488 -

2493 TO 2496 2501 TO 2504 2509 TO 2512 2517 TO 2520 2525 TO 2528 -

2533 TO 2536 2541 TO 2544 2549 TO 2552 2557 TO 2560 UNI GZ 0.0436

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** LOAD ON CABLE IN X DIRECTION**

3845 TO 3848 UNI GX 0.008

3849 TO 3852 UNI GX 0.008

3853 TO 3856 UNI GX 0.009

3857 3858 3860 3861 3882 TO 3885 UNI GX 0.009

3866 TO 3873 UNI GX 0.01

3886 TO 3889 UNI GX 0.01

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LOAD ON CABLE IN Z DIRECTION

3845 TO 3848 UNI GZ 0.008

3849 TO 3852 UNI GZ 0.008

3853 TO 3856 UNI GZ 0.009

3857 3858 3860 3861 3882 TO 3885 UNI GZ 0.009

3866 TO 3873 UNI GZ 0.01

3886 TO 3889 UNI GZ 0.01

****

PERFORM CABLE ANALYSIS

*STEPS 20 EQITERATIONS 100

CHANGE

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LOAD 3 LOADTYPE Wind TITLE WIND D

SELFWEIGHT Y -1

MEMBER LOAD

ON MAST IN X DIRECTION

5 TO 8 13 TO 16 21 TO 24 29 TO 32 37 TO 40 45 TO 48 53 TO 56 61 TO 64 -

69 TO 72 77 TO 80 85 TO 88 93 TO 96 101 TO 104 109 TO 112 117 TO 120 125 -

126 TO 128 133 TO 136 141 TO 144 149 TO 152 157 TO 160 165 TO 168 173 TO 176 -

181 TO 184 189 TO 192 197 TO 200 205 TO 208 213 TO 216 221 TO 224 -

229 TO 232 237 TO 240 245 TO 248 253 TO 256 261 TO 264 269 TO 272 -

277 TO 280 285 TO 288 293 TO 296 301 TO 304 309 TO 312 317 TO 319 -

320 UNI GX 0.0524

325 TO 328 333 TO 336 341 TO 344 349 TO 352 357 TO 360 365 TO 368 373 TO 376 -

381 TO 384 389 TO 392 397 TO 400 405 TO 408 413 TO 416 421 TO 424 -

429 TO 432 437 TO 440 445 TO 448 453 TO 456 461 TO 464 469 TO 472 -

477 TO 480 UNI GX 0.0567

485 TO 488 493 TO 496 501 TO 504 509 TO 512 517 TO 520 525 TO 528 533 TO 536 -

541 TO 544 549 TO 552 557 TO 560 565 TO 568 573 TO 576 581 TO 584 -

589 TO 592 597 TO 600 605 TO 608 613 TO 616 621 TO 624 629 TO 632 -

637 TO 640 UNI GX 0.0601

645 TO 648 653 TO 656 661 TO 664 669 TO 672 677 TO 680 685 TO 688 693 TO 696 -

701 TO 704 709 TO 712 717 TO 720 725 TO 728 733 TO 736 741 TO 744 -

749 TO 752 757 TO 760 765 TO 768 773 TO 776 781 TO 784 789 TO 792 -

797 TO 800 UNI GX 0.0618

805 TO 808 813 TO 816 821 TO 824 829 TO 832 837 TO 840 845 TO 848 853 TO 856 -

861 TO 864 869 TO 872 877 TO 880 885 TO 888 893 TO 896 901 TO 904 -

909 TO 912 917 TO 920 925 TO 928 933 TO 936 941 TO 944 949 TO 952 -

957 TO 960 UNI GX 0.0635

965 TO 968 973 TO 976 981 TO 984 989 TO 992 997 TO 1000 1005 TO 1008 1013 -

1014 TO 1016 1021 TO 1024 1029 TO 1032 1037 TO 1040 1045 TO 1048 1053 TO 1056 -

1061 TO 1064 1069 TO 1072 1077 TO 1080 1085 TO 1088 1093 TO 1096 -

1101 TO 1104 1109 TO 1112 1117 TO 1120 UNI GX 0.065

1125 TO 1128 1133 TO 1136 1141 TO 1144 1149 TO 1152 1157 TO 1160 1165 TO 1168 -

1173 TO 1176 1181 TO 1184 1189 TO 1192 1197 TO 1200 1205 TO 1208 -

1213 TO 1216 1221 TO 1224 1229 TO 1232 1237 TO 1240 1245 TO 1248 -

1253 TO 1256 1261 TO 1264 1269 TO 1272 1277 TO 1280 UNI GX 0.0665

1285 TO 1288 1293 TO 1296 1301 TO 1304 1309 TO 1312 1317 TO 1320 1325 TO 1328 -

1333 TO 1336 1341 TO 1344 1349 TO 1352 1357 TO 1360 1365 TO 1368 -

1373 TO 1376 1381 TO 1384 1389 TO 1392 1397 TO 1400 1405 TO 1408 -

1413 TO 1416 1421 TO 1424 1429 TO 1432 1437 TO 1440 UNI GX 0.068

1445 TO 1448 1453 TO 1456 1461 TO 1464 1469 TO 1472 1477 TO 1480 1485 TO 1488 -

1493 TO 1496 1501 TO 1504 1509 TO 1512 1517 TO 1520 1525 TO 1528 -

1533 TO 1536 1541 TO 1544 1549 TO 1552 1557 TO 1560 1565 TO 1568 -

1573 TO 1576 1581 TO 1584 1589 TO 1592 1597 TO 1600 UNI GX 0.0695

1605 TO 1608 1613 TO 1616 1621 TO 1624 1629 TO 1632 1637 TO 1640 1645 TO 1648 -

1653 TO 1656 1661 TO 1664 1669 TO 1672 1677 TO 1680 1685 TO 1688 -

1693 TO 1696 1701 TO 1704 1709 TO 1712 1717 TO 1720 1725 TO 1728 -

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1733 TO 1736 1741 TO 1744 1749 TO 1752 1757 TO 1760 UNI GX 0.0702
1765 TO 1768 1773 TO 1776 1781 TO 1784 1789 TO 1792 1797 TO 1800 1805 TO 1808 -
1813 TO 1816 1821 TO 1824 1829 TO 1832 1837 TO 1840 1845 TO 1848 -
1853 TO 1856 1861 TO 1864 1869 TO 1872 1877 TO 1880 1885 TO 1888 -
1893 TO 1896 1901 TO 1904 1909 TO 1912 1917 TO 1920 UNI GX 0.071
1925 TO 1928 1933 TO 1936 1941 TO 1944 1949 TO 1952 1957 TO 1960 1965 TO 1968 -
1973 TO 1976 1981 TO 1984 1989 TO 1992 1997 TO 2000 2005 TO 2008 -
2013 TO 2016 2021 TO 2024 2029 TO 2032 2037 TO 2040 2045 TO 2048 -
2053 TO 2056 2061 TO 2064 2069 TO 2072 2077 TO 2080 UNI GX 0.0717
2085 TO 2088 2093 TO 2096 2101 TO 2104 2109 TO 2112 2117 TO 2120 2125 TO 2128 -
2133 TO 2136 2141 TO 2144 2149 TO 2152 2157 TO 2160 2165 TO 2168 -
2173 TO 2176 2181 TO 2184 2189 TO 2192 2197 TO 2200 2205 TO 2208 -
2213 TO 2216 2221 TO 2224 2229 TO 2232 2237 TO 2240 UNI GX 0.0724
2245 TO 2248 2253 TO 2256 2261 TO 2264 2269 TO 2272 2277 TO 2280 2285 TO 2288 -
2293 TO 2296 2301 TO 2304 2309 TO 2312 2317 TO 2320 2325 TO 2328 -
2333 TO 2336 2341 TO 2344 2349 TO 2352 2357 TO 2360 2365 TO 2368 -
2373 TO 2376 2381 TO 2384 2389 TO 2392 2397 TO 2400 UNI GX 0.0732
2405 TO 2408 2413 TO 2416 2421 TO 2424 2429 TO 2432 2437 TO 2440 2445 TO 2448 -
2453 TO 2456 2461 TO 2464 2469 TO 2472 2477 TO 2480 2485 TO 2488 -
2493 TO 2496 2501 TO 2504 2509 TO 2512 2517 TO 2520 2525 TO 2528 -
2533 TO 2536 2541 TO 2544 2549 TO 2552 2557 TO 2560 UNI GX 0.0739
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** LOAD ON CABLE IN X DIRECTION**
3845 TO 3848 UNI GX 0.0204
3849 TO 3852 UNI GX 0.0216
3853 TO 3856 UNI GX 0.0228
3857 3858 3860 3861 3882 TO 3885 UNI GX 0.024
3866 TO 3873 UNI GX 0.0252
3886 TO 3889 UNI GX 0.0264
PERFORM CABLE ANALYSIS
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FINISH
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